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CLIMATE CHANGE AND ENVIRONMENTAL HEALTH

O-29A1-1

Heat-related Mortality and Heat Watch-warning Systems in the United States: Recent Developments

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Background/Aims: Heat watch-warning systems have increased in coverage, and in some US locales, have now been operational for over 15 years. Heat-related mortality has decreased over the last few decades, partially as a result of increased awareness, but it is still statistically significant in many locations. We present recent research results on several projects that assess these changes as well as projected future changes, and the spatiotemporal variability in heat-related mortality across the United States.

Methods: Trends are assessed using both the synoptic climatological methodology, utilized in the authors' heat watch-warning systems, and the Heat Stress Index, a numerical quantifier of the severity of heat relative to location. Estimates of heat-related mortality are developed for 40 large US cities, using climate models for 3 decades over the next hundred years and various emissions scenarios.

Results: Over the past 30 years, the heat-mortality relationship has tended to converge across the United States, with areas in the warmer climates experiencing generally slight increases in mortality response, and areas in colder locations, which were historically more sensitive, experiencing more significant decreases. On a seasonal level, there is an asymmetry in heat-related mortality, with most cities exhibiting the largest increases before the summer solstice; in some cases in the southern United States, the hottest days in late summer exhibit a mortality decrease. Heat-mortality relationships are much more consistent across larger cities than smaller cities.

Conclusion: The impacts of an anticipated climate change will vary among urban areas. The results show an increase in excessive heat event days and increased heat-attributable mortality across the cities with the most pronounced increase in the Southeast and Northeast. An evaluation to determine how various intervention activities would ameliorate this rise shows that public health responses and a nationalization of heat warning systems can dramatically lessen the increase posed by a climate change.

O-29A1-2

Mortality Related to Temperature and Persistent Extreme Temperatures—A Study of Cause-Specific and Age Stratified Mortality

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Background/Aims: High and low ambient temperatures cause large numbers of deaths annually. Many studies show higher mortality rates during heat waves, with mortality increasing with heat wave duration. However, such effects have not been explicitly incorporated in models of temperature and mortality; while from a physiological basis, dehydration followed by cardiovascular stress is more likely to occur in such conditions.

Methods: We established time-series Poisson regression models based on cause-specific mortality and age stratified mortality in Stockholm County, 1990–2002, adjusting for time trends and potential confounders. We studied the effects estimates as functions of time within summers and winters.

Results: Warmer temperatures increase all natural causes of death, while decreasing colder temperatures increases the risk of cardiovascular deaths. Moreover, persistent extreme heat exposure is associated substantially with additional deaths, and the risk of death increase significantly with longer heat exposure. Extreme exposure to heat is associated with higher death rates in people with lower age, compared to a rise in temperature. Furthermore, the impact of warm and cold temperatures decreases within the season, while the impact of persistent extreme heat exposure remains similar throughout the summer.

Conclusion: This study is the first to show that additional impacts of persistence of extreme heat exposure are important to account for in models of mortality related to ambient temperatures to avoid negatively biased estimates of the associated effects. Moreover, it appears that the impacts of temperature depend on the size of the pool of fragile individuals, while persistent extreme heat exposure increases the influx of new individuals to the pool and, thus, remain large throughout the season.

O-29A1-3

Diurnal Temperature Range and Cause-specific Cardiovascular Hospital Admission in Seoul, Korea—Time-series Analysis and Temperature-Matched Case-crossover Design

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Background/Aims: Rapid temperature change within a day may increase blood pressure, clot, or cardiovascular work load. Hence, diurnal temperature range (DTR) may cause higher risk of cardiovascular disease (CVD) for population vulnerable to thermal stress. In this study, we hypothesized an increase of DTR which was associated with cardiovascular-related hospital admission in Seoul, South Korea.

Methods: Data of daily hospital admission counts of 6 cause-specific CVD diseases in Seoul were collected from Korea National Health Insurance Corporation during 2003–2006. CVD diseases were arrhythmia, cardiac disease, cardiac failure, ischemic heart disease, myocardial infarction, and stroke. Results of time-series analysis and temperature-matched case-crossover design were compared. Associations in time-series analysis were evaluated using generalized linear model (glm) adjusted for confounding factors. In temperature-matched case-crossover design,

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control days were selected with temperature within ±1°C. Models included the first day of the month, day of the week, mean pressure, PM_{10}, influenza, and relative humidity. Cause-specific effect of DTR was presented in percent change of risk.

Results: Case-crossover design showed similar or greater effect than time-series analysis did. For time-series analysis, hospital admission risk was increased by 0.4%, 0.5%, 0.7%, and 1.4% for cardiac disease, stroke, myocardial infarction, and cardiac failure, respectively, with an increase of 1°C DTR. Significant risk of CVD-related hospital admission occurred after 5–8 days of higher DTR, depending on the symptoms.

Conclusion: Case-crossover design and time-series analysis showed that DTR was a risk factor for cause-specific CVD hospital admission in Seoul.

O-29A1-4

Choice of Temperature Thresholds for the French Heat Warning System

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Background/Aims: Heat-related deaths are largely preventable through appropriate measures. In 2004, a national heat prevention plan was developed by the French Ministry of Health. Heat alerts are activated when minimum and maximum temperatures averaged over 3 days reach city-specific thresholds.

Triggering of the warning system is crucial to ensure appropriate responses. It faces 2 issues: the choice of the temperature thresholds, and the forecasting uncertainties.

Methods: We compared 2 methods for defining the temperature thresholds in 6 French cities. The first relies on a descriptive analysis of the impact of past heat waves and expert judgment. The second uses generalized additive Poisson regression models, controlling for long-term trend, seasonality, and day of the week to determine the daily excess mortality related to temperature and the excess mortality associated to different percentiles of the distribution of the minimum and maximum temperatures averaged over 3 days. A protocol was defined with the national Weather Services to use probabilities of exceeding the temperature thresholds rather than predicted values of temperature, in order to reduce forecasting uncertainties.

Results: In all cities but Paris, there is a good agreement between the thresholds obtained by the 2 methods, with less than 1°C differences. In Paris, the 99th percentile corresponds to thresholds of 21°C and 34°C for minimum and maximum temperature, associated to an excess mortality of 47%. The descriptive study identified thresholds of 21°C and 31°C, associated to an excess mortality of 29%. Percentiles were used to define temperature thresholds for 90 additional cities. Using the probability of exceeding the temperature thresholds rather than the temperature helps reducing the number of false warnings (eg, from 52 to 10 during summer 2009 for 96 cities).

Conclusion: We concluded that a simple method is sufficient to define protective temperature thresholds and that forecasting uncertainties should be taken into account.

O-29A1-5

The Unfolding Story of Heatwaves in Adelaide: Severity, Duration, and Useful Triggers for Community Intervention

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Background/Aims: Two extreme heatwaves occurred in South Australia in 2008 and 2009. It is of interest how these 2 unprecedented heatwaves compare to averaged heatwave risks preceding these events. Dose-response effects of duration (increasing number of days within a heatwave) and intensity (by increments of 1°C above 35°C) of heatwaves (1993–2008) were also examined. Weather-based heatwave triggers were explored to inform relevance of current intervention measures.

Methods: Using case-series analysis, daily morbidity and mortality rates during heatwaves were compared with rates during non-heatwave periods within the respective years and restricted to the warm season (October–March). Health outcomes examined were total, age group and disease-specific hospital admissions, emergency presentations, ambulance call-outs, and mortality. Heatwave definition was maximum temperature ≥35°C for 3 or more days.

Results: Ambulance call-outs during the 2 extreme heat events significantly exceeded call-outs from averaged preceding heatwaves affecting mainly cardiac and neurologically related call-outs. Only small increases in total hospital and emergency visits were observed. Renal admissions were increased substantially in both clinical settings, particularly in the older age groups. Direct heat-related admissions increased 14-fold for hospital admissions and 12-fold for emergency presentations in 2009 compared to 3-fold during averaged heatwaves. Increases in total mortality were restricted to the 2009 heatwave (10%; 95% CI: 0.99–1.22; $P = 0.09$). The major impact occurred in the 15–64 yrs age group, where mortality increased by 37% (95% CI: 1.09–1.71; $P = 0.01$). Older age groups were not affected. Significant dose-response relationships were observed for duration (ambulance, hospital and emergency setting) and for intensity (ambulance and mortality). Mortality started to increase at average temperature 31°C (average of daily maximum and minimum; 3 or more days).

Conclusion: These findings indicate a higher level of health risk during the recent severe heatwaves in Adelaide than in previous heatwaves. Evaluation of health outcomes in relation to relevant thresholds will guide future community interventions.

O-29A1-6

The Effect of Heatwaves on Ambulance Callouts in Adelaide, South Australia

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Background/Aims: Although many studies have noted the association between high ambient temperatures and increases in hospital admissions and mortalities, relatively few have investigated the effect on ambulance services, a useful supplement to other morbidity data. The aim of this study was to investigate the effect of heatwaves on ambulance callouts and to identify heat-susceptible areas of the city of Adelaide, South Australia.

Methods: Ambulance service data and meteorological data relevant to the metropolitan area were obtained for the period between 1 July 1993 and 30 June 2005. Heatwaves in the warm season (October to March) were defined as being 3 or more consecutive days when daily maximum temperatures reached or exceeded 35°C. Statistical analysis of callouts was undertaken by comparing heatwave to non-heatwave periods using negative binomial regression accounting for overdispersion and long-term trends. Using destination postcodes of callouts, spatial epidemiological techniques investigated place-based risk. Exposure analysis was undertaken by determining threshold temperatures using non-linear least squares estimation.

Results: Ambulance callouts increased by 3.6% during heatwaves compared to non-heatwave periods in the warm season, with an increase of 2.6 callouts per 1 degree C increase in daily maximum temperature above a threshold of 34.6°C. Industrial suburbs and those with a high proportion of low income families were identified as heat-sensitive regions of the metropolitan area. Cause-specific attendances varied between

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suburbs with some recording an increase of more than three-fold in work-related callouts during heatwaves.

Conclusion: In the absence of population adaptation to warmer summers, ambulance and other emergency services may be in greater demand should heatwaves become more frequent and intense with a changing climate. Strategies required to mitigate the negative health effects of extreme heat may need to be targeted towards susceptible sub populations, communities art risk, and industrial workplaces.

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O-30A3-1

Projecting Temperature-related Mortality Impacts in New York City Under a Changing Climate

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Background/Aims: Climate change has lead to increasing temperatures in urban areas in recent decades, and these changes are likely to accelerate in the coming century. These changes may result in more heat-related mortality and less cold-related mortality, and the net impact remains uncertain. Our objective was to project future temperature-related mortality impacts over the full year in New York County across a range of climate change models and scenarios.

Methods: Temperature projections for the 2020s, 2050s, and 2080s over New York County were obtained from 5 different models that were run with the IPCC A2 and B1 greenhouse gas emissions scenarios. Downscaling to New York County was achieved. The association between maximum temperature and daily mortality in 1982–1999 was modeled using log-liner regression analysis. Percentage change in mortality in both winter and summer was calculated relative to the minimum mortality temperature. The heat- and cold-related deaths in the 1970s, 2020s, 2050s, and 2080s were estimated by integrating the results from the climate models and the empirical exposure-response relationship.

Results: In the A2 scenario, the mean annual temperature-related additional deaths were 686 in 2020s, 782 in 2050s, and 920 in 2080s. The mean increase in temperature, heat- and cold-related annual additional deaths in 2080s will be 52.3%, 56.0% and −66.7%, respectively, compared with 1970s. In B1 scenario, the mean annual temperature-related additional deaths were 681 in 2020s, 741 in 2050s, and 779 in 2080s. The mean increase in temperature, heat- and cold-related annual additional deaths in 2080s were 29.0%, 31.2%, and −44.4% compared with 1970s.

Conclusion: These new results suggest that, over a range of models and scenarios of future greenhouse gas emissions, increases in heat-related mortality will outweigh reductions in cold-related mortality; while the 2 emissions scenarios produce similar mortality estimates through mid-century, the lower-emission B1 scenario results in substantially smaller annual mortality impacts by the 2080s.

O-30A3-2

Influence of Heatwave Intensity, Duration, and Timing in Season on Heatwave Mortality Effects in the United States

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Background/Aims: Devastating health effects from recent heatwaves, and projected increase in frequency, duration, and severity of heatwaves from climate change, highlight the importance of understanding health consequences of heatwaves. We analyzed how mortality risk for heatwaves in 43 US cities (1987–2005) relate to heatwaves.

Methods: Heatwaves were defined as >2 days with temperature >95th percentile for the community for 1 May–30 September. Heatwaves were characterized by their intensity, duration, and timing in summer. Within each community, we estimated mortality risk during each heatwave compared to non-heatwave days, controlling for potential confounders. We estimated how heatwave mortality effects were modified by heatwave characteristics (intensity, duration, timing in summer).

Results: Nationally, on average, heatwave mortality risk increased 2.49% for every 1°F (0.56°C) increase in heatwave intensity and 0.38% for every 1-day increase in heatwave duration. Heatwaves were associated with a 5.04% (95% confidence interval: 3.06%–7.06%) increase in mortality risk compared to non-heatwave days for the first heatwave of the summer versus 2.65% (95% confidence interval: 1.14%–4.18%) for later heatwaves. Heatwave mortality impacts and effect modification by heatwave characteristics were more pronounced in the Northeast and Midwest compared to the South.

Conclusion: We found higher mortality risk from more intense, longer, or earlier heatwaves. Findings have implications for decision-makers and researchers estimating health effects from climate change.

O-30A3-3

Heat Index Estimated by Weather Parameters Is Associated With Mortality in Taiwan

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Background/Aims: The increased mortality linked to events of extreme high temperatures is recognized as one critical challenge to the public health sector. An ecological study was conducted to assess whether a significant association remains using heat index as the independent predictor.

Methods: Sample population was from 6 major cities in Taiwan. Daily mortality data from 1994 through 2008 were retrieved from the Taiwan Death Registry, Department of Health, Taiwan. Meteorological data, including daily ambient temperature and relative humidity, were requested from the Central Weather Bureau. The generalized additive models and Poisson regression analyses were applied to estimate temperature-mortality relationship using heat index metric.

Results: The increasing percentiles of heat index appeared to be associated with mortality risk compared with 0-4th and presented a rising trend. Risk ratios of daily mortality for heat index above 95th percentile, more vulnerable to heat stress, were significantly elevated in City of Taipei, Taichung, Chiayi, Tainan, and Kaohsiung, except for Keelung. These risks seemed to increase to a greater scale among the elderly, a phenomenon seen in all cities. Short-term effects were suggested by lag models (0–2 days).

Conclusion: In Taiwan, the city-specific magnitude of increase indicated heat index may provide a realistic prediction for mortality risk, especially for the elderly. Regional differences of vulnerability should be further examined.

O-30A3-4

Associations of Cardiovascular and Respiratory Mortality With Air Temperature in the Urban Area of Beijing, China

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Background/Aims: Associations between air temperature and mortality have been consistently observed in studies conducted in Europe and the United States; however, there is still a lack of studies for Asian countries. Our study aimed at investigating the association between daily air temperature and daily cardiovascular as well as respiratory mortality in the urban area of Beijing, China.

Methods: Daily death counts for cardiovascular and respiratory diseases for adult residents (≥15 years) and meteorological parameters were obtained from local authorities from January 2003 to August 2005. Confounder-adjusted semiparametric Poisson regression models were used to estimate the effects of 2-day and 15-day temperature averages. Time trend and relative humidity were forced in every model. Exposure-response curves for temperature were estimated using penalized regression splines. Moreover, we analyzed the associations between temperature and mortality for the potentially more susceptible subgroup of elderly people (≥65 years). Effects are presented as relative risk (RR) for mortality per 5°C change in the whole temperature range if the shape of the exposure-response curve was linear, or, if non-linear, for the slopes above a temperature threshold.

Results: We observed J-shaped exposure-response relationships between 2-day average temperature and cardiovascular mortality with a temperature threshold of 23°C. For respiratory mortality, the relationships were considered linear. Overall, a 5°C increase of the 2-day average temperature was associated with a RR of 1.017 (95% confidence-interval [CI]: 1.008–1.027) and 1.143 (95% CI: 1.089–1.199) for cardiovascular and respiratory mortality, respectively. For elderly people, the associations were weaker for respiratory mortality, but stronger for cardiovascular mortality.

Regarding cold effects, a 5°C decrease of the 15-day average temperature was associated with a RR of 1.036 (95% CI: 1.001–1.071) for cardiovascular mortality. Elderly people showed again a similar effect.

Conclusion: Heat as well as cold effects were found for the association of air temperature with cardiovascular and respiratory mortality. Thereby, heat effects were immediate, while with longer time lags cold effects became predominant.

O-30A3-5

Deaths in Australia Attributable to Climate Change, Now and to 2100

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Background/Aims: Deaths from heat extremes are already important in Australia, and will increase under global warming. A total of 1500 people die from heat extremes in Australian cities and this could treble by mid-century (Research Australia 2007).

Many researchers have estimated response functions relating mortality to temperature extremes, including in Australia. For example, Vaneckova et al (2008) estimated that in Sydney the increase in mortality is between 4.5% and 12.1% for a 10°C increase in maximum daily temperature. Estimates for each city and state in Australia are reported elsewhere in this conference work (Dear, ISEE 2010).

Methods: Age-specific response functions estimated were derived for each state and each capital city in Australia from 16 years of historical mortality data in relation to weather records. The frequency distributions of daily temperatures in 1980–1995 were shifted according to each IPCC climate change scenario, downscaled, to give local mortality estimates from the present to 2100 as the population profile changes. Deaths attributable to climate change were calculated by subtracting mortality estimates under a hypothetical scenario in which the 1990 climate applies through this century.

Results: The greatest negative impacts of temperature-related death will be in the hotter northern cities of Australia. In colder cities to the south, reduction in cold-related deaths will dominate in the first half of the century, but will be outweighed by increases in heat-related deaths by the end of the century.

Conclusion: Assessing the impact of climate change on mortality demands attention both to local variation in anticipated climate change, and to the differing susceptibility of local populations.

O-30A3-6

Short-term Effect of High Temperatures on Mortality in Mediterranean Cities: Results From the Circe Project

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Background/Aims: Climate change predictions estimate an increase in temperatures and extreme events especially in the Mediterranean area. The impact of high temperatures on mortality in European cities are well known, while the effect in urban areas of North Africa and the Middle East are to date limited. This study, carried out within the CIRCE EU Project, aims to assess the impact of extreme temperatures on mortality in 10 Mediterranean cities (Athens, Bari, Barcelona, Istanbul, Lisbon, Palermo, Rome, Telaviv, Tunis, and Valencia). The analysis allows the comparison of the effect among the more temperate European and drier North African and Middle Eastern areas of the Mediterranean.

Methods: Maximum apparent temperature (Tappmax) was chosen as exposure variable to estimate the impact on total mortality (by age groups) during summer. The segmented regression approach was used to identify city-specific threshold values of Tappmax, corresponding to the minimum mortality rate. A time-series approach was used to estimate the percent increase in mortality for 1°C increase in Tappmax above the city-specific threshold.

Results: Great heterogeneity among cities was observed in the exposure and in the threshold values, ranging from 25°C in Lisbon to 36°C in Tunis. The Tappmax-mortality relationship showed a J-shaped curve in most cities, with a significant impact of high temperatures on mortality above the threshold, but in the hottest cities as Telaviv, Tunis and Valencia the relationship was weaker. In most cities, the greatest impact of high temperatures on mortality was found in the 65+ age group, ranging from +1.71% in Telaviv to +6.15% in Rome; while in the 0–64 age group the impact was higher in Lisbon (+9.21%) and Telaviv (+3.60%).

Conclusion: The impact of high temperatures on mortality was heterogeneous among the Mediterranean cities, although the greatest impact on mortality wasn't in the hottest cities, suggesting local population adaptation to heat.

O-31B1-1

Climate Change and Health Mongolia

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Background/Aims: The climate change studies conducted in Mongolia concluded (P. Batima, 2005) that global warming would have a significant impact on natural zones, water resources, snow cover, and permafrost. It is important to make a distinction between the processes of climate change and the impacts on water suppliers resulting from these changes. Although global warming is fairly straightforward, the impacts on water

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suppliers may involve many additional cause and effect relationships. There have been certain changes in Mongolia's hydrological regime. Increased winter air temperature and more intense rainfall in summer have affected not only the timing of stream flows but also seasonal runoff, i.e., there is a longer dry period with lower flows in the low flow seasons and a shorter period with higher flows in the peak flow periods.

Methods: Water quality testing is carried out by authorized laboratories of state and local water utility organizations, State and local specialized inspections agencies, Public Health Institute, and other organizations.

Results: According to bacteriological contamination of drinking water, when the highest contamination of drinking water falls to Gobi region (348.75 ± 61.0), then the lowest contamination was observed in eastern region (41.6 ± 7.4) and UB (12.0 ± 6.0). In order to see the impact of climate change on water quality, we analyzed statistically air temperature and precipitation in comparison with water bacteriological and chemical parameters. By correlation analysis, air temperature has weak correlation with mineralization, sulfate, ammonia, nitrate, and total coliform, out of all water parameters. With the increase in air temperature, slight tendency in increase of these water parameters was observed. However, there was no observed relationship between air temperature and other water parameters. In order to determine how incidences of waterborne diseases are affected by water quality and climate parameters, in the first model, total bacteria count, coliform count, NH_4, NO_2, and NO_3, and in the second, model air temperature and precipitation, and in the third model, all above water quality and climate parameter parameters were selected as independent variables, respectively. Statistically, it was proved that air temperature and precipitation have an impact on salmonellosis, dysentery, and hepatitis A, out of all studied waterborne diseases except typhoid. Air temperature and precipitation do influence the incidence of salmonellosis by 3.5%, dysentery by 4.5%, and hepatitis A by 10.2%. In order to see threshold effect of precipitation on salmonellosis incidence, we compared disease incidence in different ranges of precipitation. Incidence of salmonellosis is gradually increased with an increase of precipitation and the highest incidences observed during the period with higher precipitation.

Conclusion: Water resources and its regime are under treat of climate change. Mongolia already experiences considerable water stress as a result of insufficient and unreliable rainfall, changing rainfall patterns, or flooding. The impacts of climate change—including predicted increases in extremes—are likely to add to this stress, leading to additional pressure on water availability, accessibility, supply, and demand. A general increasing tendency of mineralization and content of chloride and sulfate ions in drinking water was observed year after year in Mongolia, which could be caused by an impact of climate change on quality of surface and ground water. Some waterborne diseases are correlated with climate parameters (air temperature and precipitation) for a particular extent.

O-31B1-2

The Impact of the 2008 Cold Spell on Mortality in Shanghai, China

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Background/Aims: Global climate change may cause more occurrence of extreme weather conditions, including both heat wave and cold spell. Although several studies in China have reported the health impact of heat wave, no study has been carried out to examine the relationship between cold spell and adverse health outcomes.

Methods: Cold spell was defined as a period of at least 9 consecutive days with daily temperature below the 3 percentile during the study period, of which at least 6 days have daily average temperatures below the 1 percentile. Between January 2001 and December 2009, Shanghai recorded a cold spell between 27 January and 16 February 2008. We investigated the impact of cold spell on mortality of the residents living in 9 urban Districts of Shanghai. We calculated rate ratios (RRs) during the cold spell compared to a reference period (6–16 January 2008, and 28 February–8 March 2008). Both total and cardiopulmonary mortality were assessed. For total mortality, we stratified the analysis by gender and age.

Results: During the cold spells, the RR of total mortality was 1.16 (95% confidence interval [CI]: 1.11–1.22). The impact was statistically significant for cardiovascular mortality (RR = 1.24, 95% CI: 1.16–1.33), but not for respiratory mortality (RR = 1.10, 95% CI: 0.96–1.25). For total mortality, gender did not make statistically significant difference for the cold spell impact. Cold spell had significant impact of mortality in both middle-aged people (45–64 years) (RR = 1.16, 95% CI: 1.02–1.31) and elderly people (over 65 years) (RR = 1.16, 95% CI: 1.11–1.23).

Conclusion: Our analysis showed that the 2008 cold spell had a substantial effect on mortality in Shanghai. Public health programs should be tailored to prevent cold spell-related health problems in the city.

O-31B1-3

Health Impact of Climate Change on Occupational Health and Productivity in Thailand

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Background/Aims: Rise in global temperature is well documented. Thailand is experiencing similar trend with an increase of about 1°C over a 20-year period. Changes in temperature lead to increases in heat exposure which has ranges of health effects, from mild heat rashes to deadly heat stroke. Heat exposure can also aggravate several chronic diseases, including cardiovascular and respiratory disease. This study examined the relationship between climate condition and health status and productivity in 2 main categories of occupational setting where 1 setting involves heat generated from the industry and the other with heat in a natural setting.

Methods: This cross-sectional study included 4 industrial sites (pottery industry, power plant, knife industry, and construction site) and 1 agricultural site in Pathum Thani and Ayutthaya provinces. Exposure data comprised of meteorological data, heat exposure measured by Wet-Bulb Globe Temperature, and relative humidity. Heat index was calculated to measure the effects of heat exposure on the study population which consisted of 21 workers at 5 worksites; questionnaire was also used to collect data on workers.

Results: Among the 5 workplaces, outdoor wet-bulb globe temperature is found to be highest at 34.58°C during 12.00–1.00 PM at agricultural site. It was found that 4 out of 5 study sites, had heat indices in the "extreme caution" where heat cramp and exhaustion may be possible and 1 site showed a value of 41°C which fall into the category of "danger," where sunstroke and heat exhaustion are likely and prolong exposure may lead to heatstroke. Productivity as perceived by the workers revealed that only the construction and pottery industry workers assessed a loss of productivity as high as 60% reduction.

Conclusion: In conclusion, climate conditions in Thailand potentially affect both the health and productivity in occupational setting.

O-31B1-4

Strong Biological Response for the Upper Level of Weather Index to Korean

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Background/Aims: To quantify the association between health indices; systolic blood pressure (SBP, mm Hg), diastolic blood pressure (DBP, mm Hg), brachial artery diameter (cm), internal carotid artery diameter (cm) and weather variables; discomfort index (DI), apparent temperature (AT), heat index (HI), and ultra violet index (UVI) with categorization using different cutoff point for the short term exposure.

Methods: A total of 103 participants were involved in this panel study and the biological variables were collected once every month with meteorological information such as DI, AT, HI, and UVI. Mixed effects model analysis was used to quantify the associations between health outcomes and the meteorological variables after adjusting for school, sex, current smoking status, and body mass index (BMI).

Results: The biological outcomes of the panel showed significant changes by both DI and AT while less changes by HI and UVI. Through current DI and AT categorization set by Korea Meteorology Administration, SBP declined by 2.65 (95% CI: −3.72, −1.58) and 1.4 (95% CI: −2.41, −0.434) and DBP declined by 1.66 (95% CI: −2.51, −0.805) and 0.903 (95% CI: −1.69, −0.121), respectively. On the other hand, when the newly categorized cutoff point out of mixed effect model is applied to DI and AT, SBP declined by 5.23 (95% CI: −7.06, −3.40) and 2.86 (95% CI: −3.96, −1.75), and DBP by 4.18 (95% CI: −5.57, −2.79) and 1.33 (95% CI: −2.21, −0.448). Declines of SBP and DBP can explain increase of brachial artery diameter and internal carotid artery diameter.

Conclusion: We found that change of weather affects human health outcomes including blood pressure and the effect size is bigger when the higher level of cutoff point is applied than the current standard. This suggests the possibility of recategorizing current cutoff values upward to the higher level to reflect Koreans' biological response.

O-31B1-5

Weather and Airway Inflammation

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Background/Aims: Adverse human health effects associate with weather conditions in the outdoor environment. However, there is little information about the influence of meteorological parameters on airway inflammation in everyday life. In this study, we evaluated acute effects of temperature, relative humidity, dew point, wind speed, and ambient barometric pressure on the fraction of exhaled nitric oxide (FENO), a noninvasive measure of airway inflammation.

Methods: FENO was measured in 939 subjects between December 2003 and January 2004 in a community based in Gwangyang, Korea. Meteorological factors were measured concurrently at a central monitoring station.

Results: An interquartile range (IQR) increase in the 21-hour moving average (MA) temperature of 5.1°C was associated with an decrease in FENO of 24.9% (95% confidence interval [CI]: 16.8–32.2); an IQR increase in the 57 hour MA relative humidity of 19.0% was associated with an decrease in FENO of 25.7% (95% CI: 13.3–36.2); an IQR increase in the 72 hour MA dew point of 5.7°C was associated with an decrease in FENO of 23.0% (95% CI: 14.2–30.9); an IQR increase in the 6 hour lag ambient barometric pressure of 3.6 mm Hg was associated with an increase in FENO of 15.9% (95% CI: 10.4–21.8), adjusting for age and gender in models.

Conclusion: Short-term variations in weather conditions may lead to airway inflammation as measured by FENO. This study suggests that cold temperature, low humidity, low dew point, or high atmospheric pressure may contribute to adverse effects on cardiorespiratory health in dry and cold winter.

O-31B1-6

Short-term Effects of Weather on Hand, Foot, and Mouth Disease

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Background/Aims: Since late 1990s, there have been increasing hand, foot, and mouth disease (HFMD) outbreaks with complications leading to death, especially in Asia. The outbreaks of HFMD peak in the warmer season of the year, but the underlying factors for this upsurging trend have not yet been established. This study analyzes how weather variables influence the risk of HFMD incidence in Singapore.

Methods: The relative risks between weekly HFMD and weekly temperature and rainfall were estimated for the period 2001–2008 using time series Poisson regression models. Smoothing was used to allow non-linear relationship between weather and weekly counts of HFMD. Models were adjusted for seasonality, long-term time trends, autocorrelation, and allowed for delays between exposures and the resulting effects.

Results: Short-term changes in weekly temperature and rainfall influence HFMD incidence at time lag of 1–2 weeks. Inverse relationship is established between HFMD incidence and minimum temperature. Nevertheless, every 1° increase in maximum temperature above 32°C and temperature difference greater than 7°C elevates relative risk of HFMD incidence by 45% and 48%, respectively. Simultaneously, weekly cumulative rainfall ranging from 0 to 75 mm poses relative risk of HFMD.

Conclusion: Weather parameters could possibly be used as risk indicators to alert local authority and community for potential HFMD outbreaks; thus, allows early response to strengthen infection control measures and promotes community preparedness to disrupt chain of disease transmission. Similar studies considering spatiotemporal risk heterogeneity are encouraged to further understand the effects of weather or climate variability on HFMD transmission patterns.

O-31B1-7

Perception and Response to Heatwaves in Adelaide: A Qualitative Interview About the Elderly and Stakeholders

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Background/Aims: To understand the perception of heatwaves and its impact on the health among the elderly and relevant response mechanism to heatwaves, specially targeting on the elderly from different government, nongovernment organizations and industries; and to provide policy implications to decision-makers and guidance to health practitioners.

Methods: An argumentative policy analysis has been set up to identify the perception, arguments, and knowledge of target population and policy makers about specific actions that have to be taken before, during, and after heatwaves periods. Data were collected by anonymous semistructured interviews with relevant stakeholders and the elderly. The interviews were used to reconstruct participants' perspectives.

Results: Stakeholders have different views about the problem definition but did agree that an education campaign is necessary to inform the elderly about heat waves. Older people agreed about the definition of a heatwaves and they all gained this information through the media. The elderly cannot list direct heat effects but they do change daily activities.

Conclusion: An education campaign needs to be established and performed through the media to educate the elderly about health risks of heat waves and how to prevent themselves and others.

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PP-30-072

Assessing the Cumulative Climate-related Health Risks in the Eastern United States

Yang Liu,[1] Justin Remais,[1] Ying Zhou,[1] Uriel Kitron,[1] Joshua Fu,[2] John Drake,[2] Marie O'Neill,[3] Joel Schwartz,[4] and Antonella Zanobetti[4] *[1]Emory University, Atlanta, GA; [2]University of Tennessee, Knoxville, TN; [3]University of Michigan, Ann Arbor, MI; and [4]Harvard University, Boston, MA.*

Background/Aims: Climate change is likely to impose sizeable future health costs even in highly developed countries, such as the United States, caused by various adverse outcomes including elevated air pollution level. Previous research has focused on the health impact of individual stressors without considering their interactions and confounding factors. Yet a comprehensive approach is needed because environmental and public health authorities and affected communities must address a range of climate-sensitive health outcomes and their causative exposures in developing adaptation and mitigation programs.
Methods: We will model health risks associated with 3 groups of climate-related stressors: heat waves, air pollution, and Lyme disease. We will couple the Community Climate System Model and WRF/CMAQ system to generate exposure estimates under current condition and in the 2050s under various IPCC greenhouse gas emission scenarios.
Results: We will rely on epidemiological evidence to quantify the conresponse relations of each stressor on the general population and various susceptible subpopulations while controlling for the confounding or effect modification from other stressors. We will apply advanced NASA satellite data to verify simulated current exposures, and analyze the impact of each analytical step to the overall uncertainty in risk estimates.
Conclusion: Our analysis will serve as a model cumulative risk assessment characterizing the combined risks of 3 important climate-related stressors with complex interactions in geographic and demographic space. We will develop spatial representations of both hazard overlap and risk overlap. The spatial distribution of vulnerable populations will be examined with an emphasis on identifying potential response locations using geophysical, climatological, and demographic characteristics. Through current collaborations of our team members with local governments, we will not only advance climate-health science, but also develop relevant tools to guide policy decisions regarding the response and preparedness to climate change.

PP-30-073

The Effect of Climate Change and Environmental Pollution on Seasonal Fluctuations of Typhoid Fever

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Background/Aims: To study the effect of climate change and environmental pollution (with radioactive nuclides) on seasonal fluctuations of typhoid fever (TF).
Methods: The author used epidemiological, meteorological, microbiological, and neutron activation analyses in studying the effect of climate change and environmental pollution on seasonal fluctuations of TF. All patients with TF were allocated into following 2 groups: Group I comprised 244 patients admitted during the period 1997–2005 (June–November). Group II consisted of 341 patients admitted to the hospital during 2006–2009.
Results: In Group I, TF patients admitted in June encountered 4.9%; in July, 7.37%; in August, 9.42%; in September, 22.54%; in October, 48.36%, and in November, 7.37%. An average annual air temperature was 12.10°C ± 2.94°C (above-zero temperature values 15.73°C ± 2.47°C and below-zero temperature values 2.97°C ± 0.13°C, $P < 0.01$). The concentration levels of uranium in water were 2.8 μg/L, in silt, 2.67 μg/g; thorium, 0.025 μg/L and 2.8 μg/g, respectively. Cesium concentration values in silt were 86 Bq/kg (summer) and 98 Bq/kg (autumn). In Group II, TF patients admitted to the hospital encountered 5.7% − 6.1%. An average annual air temperature was 14.20°C ± 2.89°C (above-zero temperature values 15.16°C ± 2.47°C, below-zero temperature values 2.15°C ± 0.01°C, $P < 0.01$). Concentration levels of radioactive nuclides in water and silt increased 3–5 times. TB was encountered in 5.89% and 14.3% of silt samples.
Conclusion: Thus, high occurrence of TB in water and silt samples in winter can be explained by increase in average annual temperature by 2.1°C. Being close to radioactive nuclides, which "temperature is always higher than ambient temperature" TB receive the energy emitted by radioactive nuclides. After a while, an enthalpy of TB is observed. As a result, TB becomes resistant to external factors causing a number of pathologies.

PP-30-074

Climate and Environmental Change in Coastal Bangladesh and Seasonal (Pre)clampsia and Hypertension

Aneire Khan *Imperial College London, London, United Kingdom.*

Background/Aims: Drinking water for approximately 20 million people in coastal Bangladesh has become contaminated by salinity, due to local management, river flow changes, and sea level rise. As reported previously, there is a clear relationship between habitual sodium intake and high blood pressure. The World Health Organization recognized health impacts of long-term consumption of highly saline water as a priority for investigation under its public health initiatives. Our objective was to generate hypotheses on environmental factors, explaining an observed seasonal excess of (pre)eclampsia and hypertension in the region.
Methods: Data were collected from 800 pregnant women at Upazilla Health Complex, located in southwest Bangladesh, between July 2008 and December 2009. We calculated the hospital-based prevalence of (pre)eclampsia and hypertension, the amount of salt water consumed by the population per day, and measured sodium levels in 24 hours urine in a random sample of 96 healthy pregnant women.
Results: The average prevalence rate was 9.13% (95% Confidence Interval: 7.13–11.2) and was highest in the dry season (between 17% and 22%). Salt intake varied between 5.2 and 8.8 g/d from drinking water alone, depending on the source. Mean sodium levels in urine was 152 mmol/d, and 12 out of 96 women had levels greater than the upper limit for a normal population (220 mmol/d), with a maximum of more than 380 mmol/d.
Conclusion: (Pre)eclampsia and hypertension were the primary causes for pregnancy-related hospitalization. Their occurrence at the start of the dry season, when water salinity peaks, suggests a plausible link with salt intake. Salt intake of the population was found to be much higher than the limit of salt in drinking water recommended by the US Environmental Protection Agency. The problem of saline intrusion into drinking water has multiple causes and may be exacerbated by climate change. It potentially affects all 11 Asian megadeltas.

PP-30-075

Global Environment Change and Health

Tanvir Kaur *Indian Council of Medical Research, Delhi, India.*

Background/Aims: To study the effect of climate variability on health.
Methods: The epidemiological data of malaria from 2003 to 2005 indicate that the state of Mizoram reports maximum annual parasite incidence (10.88) and the state of Assam reports maximum number of deaths. Further, Assam witnesses outbreaks of malaria every year. Keeping in view the problem of severe malaria, Assam and Mizoram

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states will be selected for in depth studies. As a control, one site in Uttaranchal state which likely to be most affected by the adverse climate projections, will be selected. In each state, 2 districts—one with highest malaria endemicity and another with lowest malaria—will be selected. In each district, 2 Primary Health centres—one with highest malaria endemicity and another with least malaria—will be taken up.

Results: Study sites have been selected. Categorization of 4 study sites has been included. Meterological data of last 25 years have been procurred. Areas of high and low endemecity have been selected. An interesting correlation has been found .ical data. Based on average, annual parasite incidence maps were generated. Impact of rise in temperature has also been studied by comparing minimum, maximum, and average temperature data from 1981 to 2008.

Conclusion: It was found that there is rise in minimum temperature in the month of March and April. There is also reduction in minimum temperature during winter months. It is being analyzed minutely.

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PP-30-076

Climate Warming and Infectious Diseases Predicting for 2040–2050 in Taiwan

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Background/Aims: This study predicted future temperature and population changes in 2040–2050 and morbidities of gastroenteritis, skin infection, and eye infection.

Methods: We used meteorological data and population simulated for 2040–2050 by the Global Change Research Center, National Taiwan University, using Intergovernmental Panel on Climate Change Special Report on Emissions Scenarios A2 and B2 to predict excess clinical care for gastroenteritis, skin infection, and eye infection. Baseline data reimbursement claims data of these diseases for 1990–2000 obtained from the National Health Insurance Program of Taiwan were used for prediction and comparison.

Results: There will be less cold days but more heat events with the temperature greater than 40° by scenarios A2 than by B2 for 2040–2050 in Taiwan. Given the population growth little, the average patients with gastroenteritis will be almost doubled from 20,220 cases of baseline to 39,555 cases according to scenario A2 or 35941 cases according to scenario B2. Patients diagnosed with the disease will increased to 48,274 claims and 42,509 claims in 2040–2050 if the elderly population increases from 8% to 21%. We also predicted that the number of increased skin infection cases will be greater than that of gastroenteritis. The increase of eye infection will be approximately 20%–30% less than the increase of gastroenteritis.

Conclusion: The climate warming will increase clinic care for infectious disease in 2040–2050. There will be more skin infections than gastroenteritis and eye infection.

PP-30-077

Climate Warming and Cardiovascular Mortality in 2040–2050 in Taiwan

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Background/Aims: This study predicted future temperature and population changes in 2040–2050 and mortality from cardiovascular disease.

Methods: We used meteorological data and population simulated for 2040–2050 by the Global Change Research Center, National Taiwan University, using Intergovernmental Panel on Climate Change Special Report on Emissions Scenarios A2 and B2 to predict excess deaths from cardiovascular disease. Baseline data of 1990–2000 were used for prediction and comparison.

Results: The elderly population size will increase from 8% for 1990–2000 in all population to 21% for 2040–2050. There will be less cold days in Taiwan and lead to decreased mortality from cold spell. However, there will be more heat events with the temperature greater than 40° by scenarios A2 than by B2. We predicted that the mortality from cardiorespiratory diseases in the elderly due to heat events will be 2–3 times higher in 2040–2050 than in 1990–2000 under Special Report on Emissions Scenarios A2 and B2 scenarios. The risks will be 2.0–6.5 times higher in 2090–2100; the aging of population will make the situation more serious. We also predict excess morbidities in gastroenteritis, skin infection, and eyes infection.

Conclusion: Global warming is inevitable, and it will have various impacts on public health. It is necessary to establish emergency respondent work group, warning mechanisms, and capability to lower damages. (NSC Grant Number 98-2521-M-039-001, 2009)

PP-30-078

Heat Waves and Mortality in New York, NY

Brooke Anderson and Michelle Bell *Yale University, New Haven, CT.*

Background/Aims: Devastating health effects from recent heat waves (eg, Chicago 1995, Europe 2003), and projected increase in frequency, duration, and severity of heat waves from climate change, highlight the importance of understanding the health effects of periods of extreme temperature. We analyzed all-cause mortality risk for heat waves in New York, NY (1987–2005) and investigated how health effects relate to heat waves.

Methods: Heat waves were defined as periods of >2 days with temperature >95th percentile for 1 May–30 September. Using a generalized additive model, we estimated the relative risk during each heat wave compared to non-heat wave days, controlling for other factors (eg, day of the week, time trends). We combined individual heat wave effect estimates using a Bayesian hierarchical model to generate an average effect for New York, NY. Each heat wave was characterized by its intensity, duration, and timing in the summer. Using a Bayesian hierarchical model, we estimated the effects of each heat wave characteristic on heat wave mortality effects.

Results: During the study period, New York City had on average 1.7 heat waves/yr. Mortality increased 6.5% (95% interval: 2.0, 11.2%) during heat waves compared to non-heat wave periods. Relative risk increased 2.8% (1.4, 4.2%) for each 1 of (0.56°C) increase in heat wave intensity and 4.2% (1.1, 7.4%) for each extra day a heat wave lasted. On average, the first heat wave of the year increased mortality 11.7% (7.9, 15.7%), whereas later heat waves increased mortality 1.9% (−2.6, 6.6%).

Conclusion: We found increases in mortality during heat waves, with greater impacts from more intense, longer, or earlier heat waves. These findings have implications both for community planners and for researchers estimating potential health effects from climate change.

PP-30-079

Extreme Precipitation and Climate-related Infectious Diseases in Taiwan (1994–2008)

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Background/Aims: Events and intensities of extreme precipitation appeared to have increased over the recent time. Little characterization has been established between extreme precipitations and reporting climate-related infectious diseases in a subtropical region like Taiwan.

Methods: The daily precipitation, temperature data, and registry data of infectious diseases, including intestinal, vector-borne, and flood-related infections, were integrated from 352 townships in Taiwan. The study period spanned from 1994 to 2008. The daily accumulated rainfall of more than 130 mm, 200 mm, and 350 mm was categorized as heavy rain, torrential rain, and extreme torrential rain, respectively. The relationship between level of precipitation and reporting cases of specific infectious diseases was analyzed with generalized additive mixed model and further mapped by geographical information system.

Results: Preliminary suggested that increased precipitation was associated with the higher risk of reporting intestinal and flood-related infectious diseases. The daily accumulated rainfall up to 200–350 mm, the incidence of vector-borne infections would increase 2–10 folds; the same type of risk would, however, drop as the daily accumulated rainfall went more than 350 mm because the habitats of vectors could have been destroyed by extreme rainfall of this intensity.

Conclusion: Changing patterns of precipitation were shown to affect the occurrence of climate-related infectious diseases in Taiwan. However, variation in distributions of medical resources or sanitary infrastructures would have to be taken into account in further analyses before concluding the relationship between the climatic changes and infectious epidemics.

PP-30-080

Ambient Temperature and Mortality: An International Study in 13 Cities of East Asia

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Background/Aims: Extreme ambient temperature has been associated with increased daily mortality across the world. We describe the ambient temperature-mortality association for 13 cities in East Asia, Seoul, Incheon, Daejeon, Daegu, Gwangju, Busan (Korea), Hokkaido, Tokyo, Osaka, Fukuoka (Japan), Taipei, Taichung, and Kaohsiung (Taiwan), and identify a threshold temperature for each city and the percent increase in mortality. We looked at the effect by sex, age, and summer effect to support the more precise regional effect.

Methods: We adapted generalized linear modeling with natural cubic splines (GLM+NS) to examine the association between daily mean apparent temperature and total mortality, as well as mortality due to respiratory and cardiovascular causes in a threshold model. We also conducted a time-series analysis adjusting for day of the week, daily humidity, and long-term time trend.

Results: Our results confirm that elderly people are most at risk from temperature-mortality and, women seem to be at increased risk compared to men in Seoul, Daejeon, Daegu, and Japan. Generally, estimates were somewhat higher for cardiovascular compared to total mortality. Summer season showed the highest effect. Cities in lower region had higher threshold, in higher region had lower threshold because of acclimatization.

Conclusion: This study identified increased mortality due to exposure to elevated ambient temperature. Weather-mortality relationships from one city may not be applicable to another. Acclimatization, susceptibility, and city characteristics all affect heat-related effects on mortality. The importance of effects of daily mean temperature and age-specific threshold temperatures suggests that analyses of the impact of climate change should take regional differences into consideration.

PP-30-081

The Impact of Climate Change on Public Health in India: Future Research Directions

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Background/Aims: Global climate change and associated increases in climate variability will have severe implications for human health with disproportionate effects on countries such as India, which already face significant public health and health care delivery challenges including resource constraints, high rates of endemic infectious disease, and substantial inequalities in healthcare access. Innovative, applied research in low- and middle-income countries is critical in order to characterize these risks and identify the most effective strategies to address them.

Methods: This work builds on the September 2009 Joint Indo-US Workshop on Climate Change and Human Health, which focused on the current state of the science regarding climate change and human health in India. We review relevant published literature then outline knowledge gaps, discuss ongoing research efforts, and highlight specific high-priority research directions.

Results: Relevant research efforts underway in India focus on climate variability and heat-related mortality, air pollution and cardiovascular disease, waterborne disease, and vector-borne diseases such as malaria, dengue, Chikungunya, and Japanese Encephalitis. Proposed recommendations to advance relevant research include the following: (1) improve environmental monitoring and surveillance systems, (2) create uniform repositories for environmental and health data, (3) promote development and use of satellite and geospatial technologies, (4) merge and analyze diverse data using multidisciplinary/multidimensional approaches, and (5) enhance public health response capacity for health communications. Changes to the current information infrastructure needed for this effort will depend on new or enhanced collaborations across multiple disciplines and among diverse institutions.

Conclusion: Innovative, multidisciplinary investigations using environmental epidemiology to elucidate health risks posed by climate change in regions such as India are possible, but will require expanded partnerships among researchers, governments, and communities so as to develop a cobenefit strategy that addresses public health challenges while simultaneously ameliorating risks associated with climate change.

PP-30-082

Relationships Between Personal Exposure to Heat and Cold and Air Pollutants

Qingyu Meng and Joseph Pinto *US EPA, RTP, NC.*

Background/Aims: The adverse health effects associated with climate change have been well studied. However, because personal activity patterns could change with changing climate, personal exposure to ambient pollution would also change, thereby modifying these health effects. Time activity patterns and ambient concentrations of air pollutants

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determine the direct exposure to ambient air pollutants. People spend different amounts of time outdoors depending on the weather. In response to temperature changes, people use climate control systems in indoor environments, which in turn, modify the infiltration of air pollutants; in vehicles, people roll windows up or down, or turn on the air conditioner or heater, which in turn determines their exposure to on-road vehicle exhaust. The associations between personal exposure to heat and cold and to air pollutants are investigated in this study.

Methods: Personal activity information and residential household characteristics were obtained from questionnaires from the RIOPA study for homes in Elizabeth (NJ), Los Angeles (CA), and Houston (TX). The 48-hours average indoor and outdoor temperatures and air exchange rate were measured for each home. Meteorological parameters, including maximum daily temperature (Tmax) and relative humidity, were obtained from the nearest airport; data for ambient ozone and particulate matter ($PM_{2.5}$) concentrations were taken from the Environmental Protection Agency's Air Quality System.

Results: Statistically significant associations between ambient temperature and the time fraction people spent in various microenvironments were observed with Beta regressions. Heat and cold exposure was significantly associated with microenvironmental ventilation, using air conditioners or heating systems in indoor environments, and turning on air conditioners in vehicles. Personal exposures to ambient $PM_{2.5}$ and O_3 and to heat and cold were characterized with LOESS for subpopulations in each city.

Conclusion: In most cases, temperature is a significant predictor for personal activity patterns. Associations with air pollutants will also be presented.

PP-30-083

Association Study Between Transport Accident Mortality and Temperature in South Korea

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Background/Aims: As the issue of climate change is getting important, the recent studies report that temperature is associated with morbidity and mortality such as cardiovascular and respiratory diseases. Although injury is also associated with environmental conditions in recent study, relevant evidences are scarce. Furthermore, the sensitivity of physical adaptation in different has not been demonstrated enough.

Methods: The generalized additive models were used to evaluate the temperature-related variations in mortality from transport event between 2000 and 2007 with controlling for confounding factors such as amount of rainfall, amount of snow cover, relative humidity, national holidays, and long-term trends in major 6 cities in Korea. Mortality data were derived from Korean statistical information database of Korea National Statistical Office. We counted daily deaths by traffic events in V01–V89 code according to ICD (International Classification of Diseases)-10 classification in 6 major cities. We also performed subgroup analyses according to age, education, and sex.

Results: The city-combined percent change for the mortality in transport event showed that traffic-related mortality was significantly associated with outdoor temperature. There was statistically significant increase in mortality over threshold temperature. The city-combined overall percent change for the mortality showed 0.9% increase corresponding to 1°C increase in outdoor temperature. Male group showed 0.9% increase of relative risk and female group showed 0.7% increase of relative risk. The effects of temperature in age group were also different. Older group showed 1.2% increase of relative risk and younger group showed 0.7% increase of relative risk. There was difference of association in educational group. The estimated relative risks were 1.015 in lower educational group and 1.005 in higher educational group per 1°C increase in temperature. There was statistically significant increase in mortality over threshold temperature and decrease under threshold temperature.

Conclusion: This study supports the hypothesis that the traffic-related mortality is associated with outdoor temperature. The temperature effect on mortality increases over threshold temperature.

PP-30-084

Health Impact of Heat Waves in Urban Heat Islands: How to Estimate the Exposure of the Population?

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Background/Aims: Heat waves are particularly deadly in large cities where the distribution of surface heat fluxes is altered compared with natural areas. This could be reinforced by climate change. The objectives were to analyze the urban surface temperatures, and to build a new risk indicator of exposure according to the residence location.

Methods: The study is based on 61 thermal images at 1-km resolution, sensed by the NOAA-AVRR satellites during the 1–13 August 2003 heat wave, and a case-control study concerning 482 persons aged 65 or more, living in the Paris region (France) at that time. For each person, minimal, maximal, and mean temperature indices were built for different periods, and integrated into a conditional logistic regression model to test their use as exposure indicator and their effect on mortality. The model was adjusted on other risk factors such as age, sex, socioeconomic conditions, autonomy, behavior of heat adaptation, health problems, housing, and geographical district.

Results: The observed surface temperature amplitude ranged from 12.18°C to 45.41°C, with a median at 21.4°C at night and 34.2°C during day. The differences of surface temperatures between cases and controls ranged from −6.1°C to 8.4°C. The results of the analysis are statistically significant for minimal temperatures computed from 1st to 13th August, and for minimal temperature averaged on the period going from the day of the death to the sixth preceding day (OR of 2.57 and 2.22, respectively).

Conclusion: The results confirm the significant health effect of night-time high temperature, and point out the location and time of heat islands. Such data could be used for long-term prevention, by targeting the districts where intervention is a priority. Studying the links between night temperatures and urban characteristics should help public health authorities and planning agencies to determine the better actions for reducing heat islands.

PP-30-085

Climate Change and Health: An International Panorama

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Background/Aims: Several climate scientists and scientific bodies agree that climate change is a reality. Emissions of Greenhouse Gases (GHGs) resulting from different sources have gained considerable importance in the world today. According to the IPCC in 2010, the estimate is that there will be an increase of 32% of GHG emissions from energy generation by 2030, thus it is expected that significant changes occur in the pattern of morbidity and mortality of populations worldwide.

Methods: This study analyzed the current situation and future related to global emissions of GHGs generated from the production of energy in the variety of sources and the main effects of climate change on human health. Through a literature review, we aimed to quantify the role of each

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source of GHG emissions and project the possible changes in disease patterns, analyzing the emerging and re-emerging, and chronic diseases from climate change.

Results: According to the IPCC in 2010, the estimate is that there will be an increase of 32% of emissions from power generation by 2030. The global emissions will result in 11.4 GtCO2 in 2010, and by 2030, the increase in emissions will produce 15.77 GtCO2. The United States remains the largest emitters, but China is close behind and will pass the United States by 2010.

Conclusion: The main scenario projected by the IPCC, the chest shows an increasing pressure from energy production and emissions of GHGs form a new pattern of mortality and morbidity in the world, air pollution, heat waves, changes in population dynamics of vectors, environmental exposures in the life cycle, and natural disasters have created a scenario with the re-emergence of infectious and parasitic diseases followed by chronic and degenerative diseases as the main factors of morbidity and mortality worldwide.

PP-31-081

The Effect of Hot and Cold Temperatures on Emergency Hospital Admissions for Respiratory and Cardiovascular Diseases in Brisbane, Australia

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Background/Aims: Although the effect of temperature on mortality is well-documented, its association with morbidity has seldom been investigated. We assessed the potential effect of hot and cold temperatures on emergency hospital admissions for respiratory and cardiovascular diseases in Brisbane, Australia.

Methods: Between 2000 and 2005, the health effects of hot and cold temperatures by linking the daily respiratory and cardiovascular emergency hospital admissions with meteorologic conditions during summer (December–February) and winter (June–August) season were estimated. We used daily mean, maximum, and minimum temperatures as exposure indicators. We fitted Poisson regression models with regression splines to control for humidity, ozone, PM_{10}, and long-term trend. Day of week and holidays were also controlled as factor variables. We evaluated the effects of temperature among several age groups (0–14, 15–64, 65–74, and 75+).

Results: In summer, emergency hospital admissions for cardiovascular diseases increased monotonically with mean temperature and maximum temperature on the same day as admission, especially for the people aged >75 years, with a 1.9% (95% CI: 0.2%, 3.7%) increase for each degree above 29°C of mean temperature. There were also significant increases within a few days (lag 1–lag4) after exposure. Similar effects of mean temperature were seen for admissions for respiratory admissions; however, while the magnitude of the increase could be large, the increase was not significant. In contrast, negative but not significant effects for cardiovascular admissions were observed with mean temperature and minimum temperature in 15–64, 65–74, and 75+ year age groups in winter. There was no effect of temperature on respiratory emergency admissions.

Conclusion: Hot temperature is an important risk factor for cardiovascular emergency hospital admission in Brisbane. There were acute and short-term effects of high temperature on morbidity.

PP-31-082

Cooking in Burkina Faso: Traditional Fuels Versus Cleaner Alternatives

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Background/Aims: In rural areas of Burkina Faso, much of the fuel consumed by households is for cooking. The most common type of fuel used is biomass, such as wood. When these biomass fuels are burned in traditional inefficient stoves, pollutant levels within and outside homes can be very high, which has significant consequences for both health and climate change. Therefore, encouraging the use of cleaner fuels is advantageous. Nonetheless, there are several important aspects that should be considered when promoting the use of alternative types of fuel.

Methods: Using the semi-urban region of Nouna, Burkina Faso, as a case study, we investigated several aspects related to the promotion and use of different fuel types for cooking. By means of surveys, published and other available sources of literature, we assessed the effect of biomass and other forms of fuel in terms of consumption, energy, availability, pollution, and climate change.

Results: Wood and charcoal were the most common fuel types used in Nouna. Availability and price were found to be important factors in the types of fuels selected. Liquid petroleum gas and electricity were rarely used and relatively expensive with respect to cost per meal. Wood and charcoal are associated with high pollutant exposures and also the production of black carbon, which has implications for health as well as climate change.

Conclusion: We found that although solid biomass does offer some advantages over other types of fuel, these are greatly outweighed by the disadvantages. Lower energy efficiencies, higher pollutant emissions, serious health consequences, poor availability, and climate change effects favor the choice of cleaner fuels over biomass. It is also recommended that further studies specific to Burkina Faso, which are lacking in this region, should also be undertaken to aid in the development of policies addressing this issue.

PP-31-083

A Case-crossover Study: The Effects of Heat Waves on Daily Mortality Caused by Respiratory Disease in Beijing

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Background/Aims: To explore the effects of heat wave on daily mortality caused by respiratory disease in Beijing from 1 January, 1999 to 30 June, 2000, and to analyze the effect on death of chronic obstructive pulmonary disease (COPD).

Methods: Symmetrical bi-directional control case-crossover design was used to study the impact. The seventh day before and after death were chosen as its own self-control.

Results: There were significant effects on daily death counts on people suffering from the first, second, and third heat waves. The lag phase was 2–5 days. The OR values of daily death from respiratory disease for 5 heat wave events were 2.124 (95% CI: 1.643–2.746), 2.143 (95% CI: 1.034–4.439), 3.733 (95% CI: 2.890–4.823), 1.067 (95% CI: 0.452–2.516), and 1.091 (95% CI: 0.401–2.950), respectively. The OR values for COPD were 1.620 (95% CI: 1.165–2.253), 2.222 (95% CI: 0.903–5.469), 2.947 (95% CI: 2.106–4.126), 1.000 (95% CI: 0.342–2.926), and 1.500 (95% CI: 0.632–3.560), respectively. The OR values of women's daily death counts caused by respiratory disease were 3.300 (95% CI: 2.001–5.442) and 4.326 (95% CI: 3.013–6.209) for the first and the third heat wave events, respectively, which were higher than that of men's 2.080 (95% CI: 1.291–3.351) and 3.149 (95% CI:

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2.185–4.539), respectively. The OR values of daily death counts for individuals aged ≥65 years were 2.846 (95% CI: 1.976–4.099) and 3.753 (95% CI: 2.866–4.915), whereas the OR values of those aged <65 years were 1.167 (95% CI: 0.392–3.471) and 3.333 (95% CI: 1.459–7.617), respectively. The results indicated that the impact of heat wave event on elderly women (≥65 years) was greater than other subpopulation. The OR values were 2.909 (95% CI: 1.982–4.270) for the first and 4.474 (95% CI: 3.052–6.558) for the third heat wave.

Conclusion: (1) There was a significant increase in daily death counts as a result of respiratory disease, including COPD, in Beijing, in individuals suffering from the heat wave. The lag phase was 2–5 days. (2) In women, the risk of daily death for women caused by respiratory disease was greater than in men during heat wave. (3) The risk of respiratory disease death for elderly residents was greater, and the effect of heat wave on elderly females was the maximum.

PP-31-084

A Case-crossover Study: The Effects of Heat Waves on Daily Mortality Caused by Ami in Beijing

Ling Liu, Jinliang Zhang, Xiuge Zhao, and Mingyu Ding *Chinese Research Academy of Environmental Sciences, Beijing, People's Republic of China.*

Background/Aims: To explore the effects of heat wave event on daily mortality caused by acute myocardial infarction (AMI) from 1 January, 1999 to 30 June, 2000, in Beijing.

Methods: Case-crossover design was used to study the impact. The seventh day before and after death was chosen as its own bi-directional self-control. The OR was used to reflect the impact of heat wave on daily AMI death counts.

Results: There were 5 heat waves during the study period. The events lasted for a period of 3 to 9 days, and their maximum temperature ranged from 36.8°C to 41.5°C, average relative humidity from 31.9% to 61.0%. Among them, the first and third heat wave lasted for a longer period and showed greater increases in temperature. There was significant impact of heat waves on AMI death. The lag phase was 0–2 days. The OR values for 5 heat waves were 1.437 (95% CI: 1.066–1.937), 1.846 (95% CI: 0.671–5.076), 2.427 (95% CI: 1.825–3.229), 2.857 (95% CI: 1.088–7.506), and 1.500 (95% CI: 0.632–3.560), respectively. The OR values for men and women were 1.153 (95% CI: 0.756–1.758) and 1.818 (95% CI: 1.185–2.790), respectively for the first heat wave. The OR values were 1.200 (95% CI: 0.669–2.153) for individuals aged <65 years and 1.534 (95% CI: 1.083–2.173) for those aged ≥65 years. The OR for senior women (65 years and older) was 1.818 (95% CI: 1.109 – 2.981). The impacts of the third heat wave on men and women were greater than that of the first. The OR values were 2.392 (95% CI: 1.649–3.470) and 2.514 (95% CI: 1.613–3.919) for men and women, respectively. The OR was 2.000 (95% CI: 1.149–3.482) for those aged <65 years, and 2.623 (95% CI: 1.880–3.660) for those aged ≥65 years. The OR was 2.800 (95% CI: 1.676–4.678) for women aged ≥65 years.

Conclusion: There was a significant increase for daily death counts of AMI in Beijing during the heat wave. The lag phase was 0–2 days. The risks of daily death from AMI for women or for those residents aged ≥65 years were greater; however, the effect of heat wave on elderly females was greater than other subpopulations.

PP-31-085

A Typical Heat Wave Event and Daily Death Count in Beijing: A Case-crossover Study

Jinliang Zhang, Ling Liu, Yun Zhou, and Xiuge Zhao *Chinese Research Academy of Environmental Sciences, Beijing, People's Republic of China.*

Background/Aims: To explore and compare the effects of a typical heat wave event on daily death of different subpopulation in Beijing.

Methods: Case-crossover design was used to study the impact of the heat wave event occurred from 23 July to 29 July 1999, on the nonaccidental daily death and the daily death caused by cardiovascular disease, cerebrovascular disease, and respiratory disease. The target population was divided into different sub-group by the gender and age. The seventh day before and after death were chosen as its own bi-directional self-control.

Results: This heat wave sustained 7 days and the maximum temperature was 41.5°C and average humidity was 58.5%. The results showed that the OR values for the non-accident, cardiovascular disease, cerebrovascular disease, and respiratory disease death of women were 2.309 (95% CI: 2.081–2.561), 2.704 (95% CI: 2.146–3.407), 2.321 (95% CI: 1.803–2.989), and 4.326 (95% CI: 3.013–6.209), respectively, while the OR values of men were 1.950 (95% CI: 1.759–2.160), 2.123 (95% CI: 1.671–2.698), 2.375 (95% CI: 1.877–3.055), and 3.149 (95% CI: 2.185–4.539), respectively, which were relatively weaker. The effects of this heat wave event on 65 years and older residents were greater than those on 65 younger. The OR values were 2.318 (95% CI: 2.134–2.518), 2.462 (95% CI: 2.042–2.969), 2.624 (95% CI: 2.168–3.175), and 3.753 (95% CI: 2.866–4.915) for the elderly, and 1.566 (95% CI: 1.339–1.831), 2.214 (95% CI: 1.543–3.178), 1.407 (95% CI: 0.929–2.131) and 3.333 (95% CI: 1.459–7.617) for younger. The risk of daily death for 65 years and older women were the greatest among all sub-populations. The OR values were 2.482 (95% CI: 2.209–2.789) for no-accidental death, 2.769 (95% CI: 2.152–3.564) for cardiovascular disease death, 2.527 (95% CI: 1.920–3.327) for cerebrovascular disease death, and 4.474 (95% CI: 3.052–6.558) for respiratory disease death, respectively.

Conclusion: The impact of the heat wave event on daily death was greater in females than in males. The risk of death for elderly residents was greater than the younger. The elderly women are more vulnerable and merit attention.

PP-31-086

The Effects of Heat Wave Events on Nonaccidental Daily Mortality in Beijing by Case-crossover Study

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Background/Aims: To explore the effects of heat wave events on nonaccidental daily mortality in Beijing.

Methods: Symmetrical bi-directional control case-crossover design was used to study the impact of heat waves on the daily counts of nonaccidental death. The seventh day before and after death were chosen as its own self-control.

Results: There were 5 heat wave events during the study period. There were significant impacts of heat waves on the nonaccidental death in Beijing. The OR values for the 5 heat wave events were 1.469 (95% CI: 1.354–1.592), 1.239 (95% CI: 1.035–1.483), 2.113 (95% CI: 1.943–2.298), 1.414 (95% CI: 1.066–1.876), and 1.565 (95% CI: 1.188–1.2.062), respectively. Further analysis showed that the impact of heat waves on nonaccidental death of female residents was greater than male. The OR values of women and men were 1.594 (95% CI: 1.418–1.792) and 1.295 (95% CI: 1.156–1.450), respectively, for the first heat wave event; 1.508 (95% CI: 1.146–1.986) and 1.026 (95% CI: 0.805–1.307), respectively, for the second; 2.309 (95% CI: 2.081–2.561) and 1.950 (95% CI: 1.759–2.160), respectively, for the third, 1.577 (95% CI: 1.047–2.375) and 1.017 (95% CI: 0.655–1.578) for the fourth; and 1.574 (95% CI: 1.023–2.422) and 1.365 (95% CI: 0.926–2.012) for the fifth.

Conclusion: (1) There was significant increase for daily death counts of nonaccident in Beijing suffering the heat wave. The lag phase was generally 2–3 days. (2) The risk of nonaccidental death of women was greater than men during heat wave.

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PP-31-087

A Bidirectional Control Case-crossover Study: The Effects of Heat Waves on Daily Mortality Caused by Cardiovascular and Cerebrovascular Disease in Beijing

Jinliang Zhang and Ling Liu *Chinese Research Academy of Environmental Sciences, Beijing, People's Republic of China.*

Background/Aims: To explore the effects of heat wave on daily mortality caused by cardiovascular and cerebrovascular disease in Beijing from 1 January 1999 to 30 June 2000.

Methods: Symmetrical bidirectional control case-crossover design was used to study the impact of 5 heat waves on the daily death counts of cardiovascular and cerebrovascular disease. The seventh day before and after death are chosen as its own self-control. The OR value and its corresponding risk period is utilized to reflect the impact of heat wave on death, lag days, and duration.

Results: Results showed that there were significant impacts on daily death counts suffering the first, the third, and the fifth heat waves and the lag phase was 2–4 days. The OR for the cardiovascular disease and cerebrovascular disease death were 1.618 (95% CI: 1.354–1.932) and 1.627 (95% CI: 1.385–1.910), respectively, during the first heat wave; 0.973 (95% CI: 0.554–1.709) and 1.209 (95% CI: 0.743–1.968), respectively, for the second; 2.411 (95% CI: 2.044–2.843) and 2.355 (95% CI: 1.985–2.796) for the third; 1.455 (95% CI: 0.860–2.461) and 1.789 (95% CI: 0.930–3.443), respectively, for the fourth; 2.333 (95% CI: 1.353–4.025) and 1.583 (95% CI: 0.867–2.890) for the fifth. Compared with the one-way control, the OR of symmetrical bidirectional control was medium and more stable (confidence interval was narrower).

Conclusion: (1) Case-crossover design was feasible to explore the relationship between weather event and its health effects. The bidirectional symmetry control was proposed to choose for its higher statistics performance and more reliable results. (2) There was significant increase for daily death counts of cardiovascular and cerebrovascular disease in Beijing suffering the heat wave. The lag phase was 2–4 days. (3) The higher the fluctuations of daily maximum air temperature during the heat wave, greater the risk of daily mortality caused by cardiovascular disease.

PP-31-088

Cold and Winter Mortality From Cardiovascular Diseases in Guangzhou, China

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Background/Aims: Many studies have linked elevated ambient temperature and heat waves to cardiovascular deaths. However, despite of the enormity of winter excess mortality from cardiovascular diseases (CVD), the effects of cold exposure are not well documented. We assessed the cold-related mortality from CVD in Guangzhou, a subtropical city in southern China.

Methods: We obtained meteorological data from National Climatic Data Center and mortality data from Guangzhou Department of Health. The study included 43,401 cardiovascular deaths, accounting for 37% of all-cause deaths during the period of 2003 to 2007. Cold exposure was measured using the average ambient temperature over the proceeding 0–4 days. A time-stratified case-crossover design with conditional logistic regression modeling was conducted to examine the association between daily temperature and mortality from CVD during winter periods (December to March), after adjusting for day of the week and daily mean humidity. We considered the potential effect modification by individual characteristics, including age, sex, and education level.

Results: The mortality rate in winter was 15.13% higher than the average in the whole year. The winter excess mortality from CVD was up to 22.14%. We found that 1°C fall of daily mean temperature in winter was associated with a 2.44% (95% confidence interval [CI]: 1.88%–3.01%) increase in mortality from CVD. Very similar associations were found with mortality from stroke (2.26%, 95% CI: 1.30%–3.24%) and coronary heart diseases (2.53%, 95% CI: 1.52%–3.55%). The effects were greater in males than in females. The effects of cold exposure tended to increase with individual's education level. There was little evidence that the cold effects we found reduced over time.

Conclusion: Mortality from CVD presented a clear seasonality with dramatic rises in winter. Our results indicate that cold exposure is a main environmental cause of high winter mortality even in subtropics.

PP-31-089

Climate Events and Health Outcomes: Data Linkage From 2 Large National Databases

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Background/Aims: Current research on temperature variability and respiratory health has been sparse due in part to insufficient and unreliable climate and health data. We aimed to geospatially and temporally link 2 large US national databases and preliminarily analyze temperature variability and adult asthma over an 11-year period.

Methods: National Climatic Data Center provided meteorological data from 696 US weather stations from 1977 to 2008. Using 1997–2008 as our study period, we defined a county as being high for baseline if their daily maximum temperature (TMAX) exceeded 95% of the TMAX for the baseline period (1977–1987). We then counted the number of days per year, and average number of counties per study period that exceeded the baseline TMAX each year. The National Health Interview Survey provided health outcome information from a nationally representative population of adults collected between 1997 and 2008. Census state and county coding was used to geographically link both databases.

Results: Of the 379 counties with data for both time periods, 86.0% experienced at least 1 day where the TMAX exceeded 95th percentile of the baseline. Of the counties, 64.6% had a TMAX exceeding 95th percentile of baseline for more than 5 days a year. The Western Region of the United States had the greatest proportion of counties (90.3%) with a TMAX exceeding 95th percentile of baseline in the study period. In 1997, 9.96% of adults reported ever having been diagnosed with asthma, compared with 12.26% in 2008, a 2.30% rise. All 4 US regions had an increase percentage of reported adult asthma cases from 1997 to 2008. The Northwest Region experienced the largest increase in reported asthma (4.77%).

Conclusion: Climate and health databases were linked successfully. Analysis is currently ongoing to further explore the relationship between the meteorological variability and asthma exacerbation.

PP-31-090

Association Between Cardiovascular Indicators and Outdoor Temperature in the Elderly Panel Study

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Background/Aims: Seasonal variations have been evaluated by some studies in terms of cardiovascular system. Because the elderly has been known as a susceptible population to climate change, we are to investigate the relationship between cardiovascular indicators including blood pressure and ambient temperature.

Methods: A total of 411 elderly patients aged over 60 years from Seongbuk-gu, Seoul, Korea were enrolled from September 2008 through December 2008. We repeatedly visited them and evaluated their health status and environmental conditions in other 2 seasons until October 2009. We measured blood pressure and other cardiovascular indicators such as vital signs, electrocardiogram, blood chemistry, and heart rate variability for 3 times. We obtained weather data such as temperature, humidity, and amount of sunshine for that time. Other individual characteristics such as age, sex, smoking, and medical history were obtained by questionnaires and physical measurements at the same time.

A mixed linear regression model was used to evaluate the association between cardiovascular markers and ambient temperature.

Results: Mean ages of subjects were 71.1 (SD: 5.30, n = 411). The range of outdoor temperature is from −7.6°C to 28.1°C. In each visit, the association between temperature and blood pressure was inverse and statistically significant. In repeated panel study, both systolic and diastolic blood pressure had an inverse association with outdoor temperature. One degree Celsius increase in the mean of outdoor temperature was associated with decrease of 0.29 mm Hg ($P < 0.01$) in diastolic blood pressure after adjusting for age, sex, BMI, smoking, and humidity. Platelet count and heart rate were reduced; QT interval was prolonged with increasing temperature.

Conclusion: These results suggest that outdoor temperature is strongly associated with blood pressure.

S-29B1-1

Public Health Impacts of Strategies to Reduce Greenhouse Gas Emissions

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Background/Aims: The adverse health consequences of climate change, which are predicted to have greatest impact on populations in low income settings, provide an important rationale to pursue policies for the rapid reduction of greenhouse gas (GHG) emissions. Such policies also may have more immediate, local effects on population health.

Methods: Overview of recent research evidence about the likely health consequences of GHG reduction strategies.

Results: The evidence is now becoming increasingly clear that appropriately selected GHG mitigation policies in most sectors of the economy, including in power generation, household energy, transport, and food and agriculture, have the potential for substantial net benefit to population health through consequent reductions of exposure to environmental pollutants and promotion of healthier behaviors, though there are also potential negative health effects that need to be guarded against. Interventions in high-income settings have greater potential for GHG reduction and are vital for achievement of climate abatement targets worldwide but those in low-income settings generally would improve public health more. Example interventions that achieve large health gains include programmes to promote cleaner cookstove technology in poor countries such as India, and those to promote more sustainable transport based on increased participation in walking and cycling together with much lower car use, which may yield overall benefits of the order of 10,000 Disability Adjusted Life Years saved per million population in 1 year. Such interventions, as well as strategies to reduce saturated fat intake in populations with currently high average intake, might achieve around 10,000 Disability Adjusted Life Years saved per megatonne CO_2 emissions reduction.

Conclusion: Evidence of such near-term health impacts provides additional rationale for strategies to reduce GHG emissions beyond that of climate change mitigation alone, especially given the context of urgent international health priorities. But care is needed to choose policies that minimize possible adverse effects.

S-29B1-3

Adaptation to Climate Change at Population Level in Japan

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Background/Aims: At population level, the effect of ambient temperature can be observed using the relation between daily temperature level and mortality; the relation is V shaped. We found that the optimum temperature, at which the daily number of deaths is lowest, was higher for warmer climate area. As a matter of fact, we found that the optimum daily maximum temperature (OT) can be estimated with 80 percentile value of the daily maximum temperature, based on the V-shaped relations of 47 prefectures in Japan. This implies that an area with higher 80 percentile values would have higher OT than areas with lower 80 percentile values. It is of interest if this correspondence applies to the climate change.

Methods: We obtained mortality data from Japanese Ministry of Health, Labor, and Welfare and meteorological data from Japan Meteorological Agency. Both data covered 1972–2007. We observed the relation between crude daily number of deaths and daily maximum temperature for Hokkaido, the northernmost prefecture, and ascertained the relation was V-shaped. We then calculated year-specific OTs using smoothing spline with degree of freedom being 6. We also computed year-specific 80 percentile values of daily maximum temperature for Hokkaido.

Results: We observed the relation between the year-specific OT and 80 percentile value, and found a good correlation. Although the year-specific OTs varied widely from year to year, and we could not identify "lag period," ie, the initiation of 80 percentile elevation and delayed OT rise, this finding suggests that the climate change may raise the 80 percentile value of daily maximum temperature and OT.

Conclusion: Climate change may shift OT to a warmer side.

S-29B1-4

Study on Health Effects of Dust Storms (Asian Dusts) in China

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Background/Aims: In recent decades, the adverse impacts of sandstorm or sand-dust weather on human health were more and more concerned by the governments and the public in the world, especially for China, Mongolia, and also Korea and Japan, as well as other east Asian countries.

Methods: A series of studies on the health effects of dust storm (Asian dust) have been conducted in China in recent years. The fields for study were mostly located in Inner Mongolia, Xinjiang, and Guansu provinces in northwestern part of China, where from the dust sources come. The research approaches used in these studies included cross-sectional, time-series analysis, case-control, and panel study for the subject children, high exposure subpopulation in the community and in/outpatients in the hospitals by generalized additive model, Poisson regression, Linear mixed-effect models as data analysis, as well as health questionnaire interview and ambient monitoring for the level of PM_{10} and $PM_{2.5}$ during dust storm seasons of the year.

Results: The results show that a sharp increased levels of $PM_{2.5}$ and PM_{10} were observed and the most prevalent diseases among the study subjects were faucitis, tracheitis, keratitis, arthritis, and rhinitis in the community during the dust storm. The dust events were significantly associated with respiratory and cardiovascular hospitalization after

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adjusted the effect of SO_2 and/or NO_2. The mean peak expiratory flow rate of the exposed schoolchildren in dusty days was much lower than that in the control days ($P < 0.01$).

Conclusion: It suggests that PM_{10} and $PM_{2.5}$ derived from the dust events could adversely impact on the respiratory and cardiovascular health of the exposed schoolchildren and sensitive population in China.

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S-29B1-5

Different Mortality of Ischemic and Hemorrhagic Stroke in Relation to Outdoor Temperature

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Background/Aims: Outdoor temperature has been reported to have a significant influence on the seasonal variations in mortality of stroke, but different mortality of ischemic and hemorrhagic strokes in response to outdoor temperature was not evaluated. The main goal of the study was to examine the effect of temperature on ischemic and hemorrhagic strokes, particularly for extreme temperature.

Methods: We investigated the association between outdoor temperature and stroke mortality in Seoul during 1992–2007. We used time series analysis of the counts for ischemic and hemorrhagic stroke deaths by means of the generalized additive and generalized linear models, and estimated the % change of mortality associated with 1°C increase in outdoor temperature.

Results: The estimated % change of mortality for hemorrhagic cerebral disease were 0.36 (95% CI: −0.08, 0.81) below 10°C and −0.53 (−1.06, 0.0) at 10°C or higher with 1°C increase in outdoor temperature. For the ischemic cerebral disease, the estimated % changes were 0.59 (0.25, 0.93) below 23°C and 3.30 (2.22, 4.38) at 23°C or higher.

Conclusion: These findings support the hypothesis that mortality of ischemic and hemorrhagic strokes show different patterns in relation to outdoor temperature. The ischemic stroke is more responsive to outdoor temperature and both extreme temperatures, cold and hot, were harmful for ischemic stroke.

S-29B1-6

Temperature-related Mortality in Australian Cities

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Background/Aims: Deaths from heat extremes are already important in Australia, and will increase under global warming. In all, 1500 people die from heat extremes in Australian cities and this could treble by mid-century (Research Australia 2007). Many studies have quantified the increase of mortality in response to extremes of heat. Nicholls et al. (2007) found that when mean daily temperature exceeds a threshold of 30°C (mean of today's maximum temperature and tonight's minimum temperature), the average daily mortality of people aged 65 years or more is about 15%–17% greater than usual. Fewer studies have given equal attention to mortality arising from extremes of cold, which can be expected to fall under as the climate warms. The present study considered the effects of heat and cold on mortality in each capital city of Australia.

Methods: Daily all-cause mortality was modeled as a function of recent daily maximum and minimum temperatures. Linear and quadratic relative risk functions were compared. For each city, 2 threshold temperatures were estimated by maximum likelihood: one for cold and the other for heat. Variations in both thresholds and relative-risk parameters, by age-group and by season of the year, were investigated.

Results: Different mortality-temperature response functions were found in each capital city. The increase of risk in response to cold was well modeled by a linear function (ie, constant relative risk per degree), but the effects of extreme heat increase more rapidly than this, and were better modeled as proportional to the square of temperature above the local threshold.

Conclusion: In assessing the likely impacts of climate change on mortality, it is important to consider local conditions which affect the susceptibility of the local population to heat. It is also important to include in such calculations allowance for the ameliorating effects of reduced mortality from cold, which is not negligible even in the warmer northern cities of Australia.

WORK ENVIRONMENT AND RESPIRATORY EFFECTS

O-29A2-1

Early Symptoms of Airways Inflammation Among Young Bakers, Pastry Cooks, and Hairdressers

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Background/Aims: Bakery, pastry-cooking, and hairdressing are occupations at risk of asthma. Airways inflammation occurs soon after inception of exposure. This study assesses how asthma-like symptoms develop along the first years of activity among young workers.

Methods: Following a retrospective follow-up design, 6 cohorts of bakers or pastry cooks and hairdressers of increasing time since admission in 9 vocational schools (2001–2006) underwent telephone interviews on the occurrence of respiratory symptoms. A group of young workers who graduated in the same schools in 2001 and had occupations not exposed to known airways irritants or allergens served as a reference group.

Results: Eight hundred twenty-six subjects were interviewed (mean age of 25.5 years, 44.4% females). The prevalence of asthma-like symptoms is greater among bakers or pastry cooks and hairdressers than among the referent group (15.8% and 19.6% vs. 9.4%, respectively, $P = 5\%$), as well as ENT symptoms (11.3 and 12.8 vs. 2.1, $P = 1\%$). Asthma-like symptoms show an increasing trend with duration of exposure since entry in apprenticeship of bakers or pastry cooks (prevalences step from 11 to 21% along the 4 quartiles of the duration distribution [from 36 to 115 months], P for trend = 4%), with similar findings for ENT symptoms. Prevalences, already high in the first exposure duration category, stay even long time among hairdressers. In a subsample of subjects who underwent home medical visits (n = 165), fractional concentration of exhaled nitric oxide values are greater among subjects exposed to flour dust (17.3 ppb [SE = 14.0], 11.6 [7.0] and 9.8 [4.5], respectively, across the 3 occupation categories, $P = 0.001$).

Conclusion: Incidence of asthma-like symptoms starts soon after engaging in bakery, pastry cooking, and hairdressing, especially early among subjects in the latter whose activity entail exposure to low molecular weight agents, and with some delay among the former, an observation that might express different underlying mechanisms.

O-29A2-2

Considerations of Peak Exposure Indices for the Epidemiology of Beryllium Sensitization

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Background/Aims: Short-term "peak" exposures can potentially overwhelm the capacity of normal defense mechanisms and induce adverse health effects. Peak exposures may be particularly relevant to susceptible beryllium-exposed individuals as exceeding an exposure threshold may activate an immune response that leads to beryllium sensitization (BeS). Exposure indices currently used in epidemiologic studies of BeS generally do not reflect peak exposures. There is little consensus in the literature as to what constitutes a biologically-relevant peak exposure. Furthermore, real-time monitoring methods are lacking for beryllium requiring alternative methods for investigating peak exposures.

Methods: A stochastic approach was used to develop measures of peak exposure using full-shift beryllium exposure data (n = 4026) collected for 269 jobs at a beryllium manufacturing facility. The geometric standard deviation (GSD) was used as an indicator of the likelihood that a specific job could experience exposure excursions. This was combined with the geometric mean (GM), an indicator of the likelihood that a job exposure will exceed a biologically-relevant threshold. The combined GM-GSD measure indicates the likelihood that workers in a job will experience peak exposures. Additional indices of peak exposure for jobs include: the 95th percentile; and the fractions of job-specific measurements that exceeded occupational exposure limits (0.2 $\mu g/m^3$ or 2 $\mu g/m^3$). The relationships among these indices of peak exposure were evaluated using correlation coefficients and kappa statistics.

Results: The combined GM-GSD metric and the categorized 95th percentile showed poor agreement (κ = 0.04). Pearson correlation coefficients for the 2 exceedance fractions and the 95th percentile ranged from 0.33 to 0.65. The degree of agreement among these exposure metrics suggests that each may reflect different aspects of peak exposure, and therefore could prove useful in exploring exposure-response relationships in epidemiologic studies of BeS.

Conclusion: Understanding peak exposures and the relationship of such exposures to immune-mediated biological responses may permit a more effective and targeted prevention strategy.

O-29A2-3

Respiratory Health and the Effectiveness of an Intervention Programme on Printing Workers Exposed to Organic Solvent

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Background/Aims: A prospective study was carried out to determine the status of lung functions among printing workers who are exposed to solvent. An intervention program was carried out in order to educate the workers on the hazards of solvent.

Methods: Of the 60 workers, 54 were followed up for their lung functions, as another 6 had left factory. These workers worked in the production line. They were exposed to solvent for almost 2 years from the last measurement of the lung functions. Questionnaire was used to obtain information on sociodemographic background. Spirometer model Chestgraft HI-101 was used to execute the lung function test. Validated questionnaire on knowledge and practices were used for the intervention program.

Results: Lung function parameters: FEV1% predicted, FVC% predicted, and FEV1/FVC% predicted showed significant difference between previous data and present findings ($P < 0.001$, $P = 0.011$, $P = 0.004$) before and after the intervention.

Conclusion: The comparison between previous lung functions with the present data showed significant impairment. The respondents were identified as having obstructive lung functions over 2 years' exposure to the organic solvent. The effectiveness of the intervention program was proven as there was a significant difference in the scores obtained before and after the intervention.

O-29A2-4

Mortality Among Brazilian Miners During 1979–2005

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Background/Aims: In Brazil, a great variety of minerals are extracted and processed in different regions of the country. This occupational activity may expose workers to some risk factors such as coal dust, noxious gases, lack of oxygen, high temperature, and radioactivity. The aim of this study was to evaluate the mortality by respiratory disease (RD) and lung cancer (LC) among Brazilian miners, during 1979–2005. In addition, we compared this mortality with that experience by 2 reference populations: Brazilian general population and Brazilian occupied population.

Methods: To do so, we calculated the mortality odds ratio (MOR) stratified by age (20–39; 40–59; 60+ yrs old) and periods of death (1979–1987; 1988–1996; 1997–2005).

Results: The results showed that, when compared to the general population, youngsters miners had an increased risk of dying by RD, along all 3 periods of analysis (1979–1987: 0; 1988–1996: MOR, 31.95; 95% confidence interval [CI] 8.69–81.80; 1997–2005: MOR, 36.57, 95% CI: 11.85–85.21). On the other hand, in the total population of miners, a decreased risk of RD was observed when compared to the reference populations in all 3 periods of analysis (1979–1987: MOR, 25.55; 95% CI: 16.20–38.32; 1988–1996: MOR, 13.99, 95% CI: 10.38–18.46; 1997–2005: MOR, 9.40; 95% CI: 7.38–11.94). Moreover, when compared to the general population, Brazilian miners also showed an increase in the risk of death by lung cancer across the studied period (1979–1987: MOR, 1.14; 95% CI: 0.72–1.72; 1988–1996: MOR, 1.60; 95% CI: 1.18–2.11; 1997–2005: MOR, 1.53; 95% CI: 1.25–1.86).

Conclusion: Our results suggest that, when compared to general population, Brazilian miners are at increasing risk to die by RD and LC.

O-29A2-5

Microbial Exposure Assessment in Sawmill, Livestock Feed Industry, and Metal Working Fluids Handling Industry

Hyunhee Park, Haedong Park, and Inseop Lee *Occupational Safety and Health Research Institute, Incheon, Republic of Korea.*

Background/Aims: The objective of this study is to investigate the distribution patterns and exposure concentrations of bioaerosols in industries suspected to high levels of bioaerosol exposure.

Methods: We selected 11 plants including 3 livestock feed plants, 3 metal working fluids (MWFs) handling plants, and 5 sawmills and measured total airborne bacteriae, fungi, endotoxin as well as dust. Airborne bacteriae and fungi were measured with 1 stage impactor, 6 stage cascade impactor, and gelatin filters. Endotoxin was measured with polycarbonate filters.

Results: The geometric means (GM) of a airborne concentration of bacteriae, fungi, and endotoxin were 1864, 2252 CFU/m^3, and 31.5 EU/m^3,respectively, at the saw mill industry, followed by the livestock feed industry (535, 585 CFU/m^3, and 22.0 EU/m^3,respectively) and MWFs handling industry (258, 331 CFU/m^3, and 8.7 EU/m^3,respectively). They were statistically significantly different ($P < 0.01$). The ratio of indoor to outdoor concentration was 6.2, 1.9, 3.2, and 3.2 for bacteria, fungi, endotoxin, and dust in livestock feed industry, 5.0, 0.9, 2.3, and 12.5 in MWFs industry, 3.7, 4.1, 3.3, and 9.7 in sawmill. The respiratory fractions of bioaerosols were differed by bioaerosol types and industry types: respiratory fraction of bacteria comprised 59.4%, 72.0%, and 57.7% in livestock feed industry, MWFs handling industry and sawmill industry respectively. For fungi, respiratory fraction occupied 77.3%, 89.5%, and

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83.7% in livestock feed industry, MWFs handling industry and sawmill industry, respectively.

Conclusion: We found that bioaerosol concentration was the highest in sawmill industry followed by livestock feed industry and MWFs handling industry. The indoor/outdoor ratio of microorganisms was larger than 1 and respiratory fraction pattern of microorganisms was more than 50% which indicate that occupational environment control for preventing worker's respiratory disease was necessary.

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AIR POLLUTION - LONG-TERM HEALTH EFFECTS

O-29A3-1

Association Between Long-term Exposure to Outdoor Air Pollution and Mortality in China: A Cohort Study

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Background/Aims: Long-term exposure to outdoor air pollution has been associated with increased cardiopulmonary mortality in developed countries, but there exists no prospective evidence in China, the largest developing country. We aimed to examine the association between long-term exposure to outdoor air pollution and mortality in a nationally representative cohort in China.

Methods: We studied 98,904 middle-aged men and women in the China National Hypertension Survey and its follow-up study. Baseline data on the participants'demographic characteristics, medical history, lifestyle-related risk factors, blood pressure, and body weight were obtained in 1991 with the use of a standard protocol. The follow-up evaluation was conducted in 1999 and 2000. Annual average air pollution exposure between 1991 and 2000, including total suspended particle (TSP), sulfur dioxide (SO_2), and nitrogen oxides (NO_x), were estimated by linking fixed-site monitoring data with resident zip code. We examined the association of air pollution with mortality, using proportional hazards regression models, with adjustment for a wide range of individual risk factors.

Results: We found significant associations between air pollutants (TSP, SO_2, and NO_X) and mortality from all nonaccidental causes and from cardiopulmonary diseases and lung cancer. Each 10 $\mu g/m^3$ elevation of TSP, SO_2, and NO_x was associated with a 0.2% (95% CI: −0.1%, 0.5%), 1.9% (95% CI: 1.4%, 2.3%), and 1.4% (95% CI: 0.4%, 2.4%) increased risk of all-cause mortality, respectively. We found significant effects of gaseous pollutants (SO_2 and NO_x) on mortality after adjustment for TSP. Our analysis also provided preliminary, but not conclusive, evidence that females, never-smokers, and obese people might be more vulnerable to air pollution than males, current or past smokers, and people who are not obese.

Conclusion: Our study generated the first prospective evidence of the association between air pollution and mortality in China. These data contribute to the scientific literature on long-term effects of air pollution for high exposure settings typical in developing countries.

O-29A3-2

Association Between Black Smoke and SO_2 Air Pollution Exposures in 1971 and Mortality 1972–2007 in Great Britain

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Background/Aims: Few studies have focused on very long-term health effects of air pollution.

Methods: Land use regression was used to model concentrations of Black Smoke (BS) and SO_2 concentrations on 1 km grids in Great Britain for 1971. Validation against an independent subset from the national monitoring station networks gave r^2 values of 0.492 for BS and 0.61 for SO_2. Validated concentrations were linked to 1971 address of Longitudinal Study (LS) cohort participants. The LS is a 1% anonymized sample of the UK population Census that have been followed up in national registers for mortality and cancer registrations since the 1971 Census and subsequent Censuses, providing information on deprivation, occupation, and area of residence (but not individual risk factors such as smoking or diet).

Results: Logistic regression analyses adjusted for deprivation, age, sex, and area for all LS individuals present at the 1971 Census who had not emigrated showed significant associations between 1971 air pollution exposures and mortality 1972–2007: for all cause mortality and BS RR = 1.03 (95% CI: 1.02–1.05) and SO_2 RR = 1.01 (95% CI: 1.02–1.03); for cardiorespiratory and for cardiovascular disease mortality BS RR = 1.04 (95% CI: 1.02–1.06) and SO_2 RR = 1.02 (95% CI: 1.01–1.03), all results expressed per 10 $\mu g/m^3$ pollutant.

Associations were reasonably similar across decade of death (1972–1980 to 2000–2007). When both pollutants were entered in the model, the coefficients of each reduced and became borderline or nonsignificant.

Conclusion: Results suggest possible long-term associations of air pollution with respiratory disease, but need confirmation in cohorts with information on smoking.

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O-29A3-3

Air Pollution From Traffic and Risk for Lung Cancer in 3 Danish Cohorts

Ole Raaschou-Nielsen,[1] Steffen Loft,[2] Helle Bak,[1] Mette Sørensen,[1] Steen Jensen,[3] Matthias Ketzel,[3] Martin Hvidberg,[3] Peter Schnohr,[4] Anne Tjønneland,[1] and Kim Overvad[5] *[1]Institute of Cancer Epidemiology, Danish Cancer Society, Copenhagen, Denmark; [2]Section of Environmental Health, Department of Public Health, University of Copenhagen, Copenhagen, Denmark; [3]Department for Atmospheric Environment, National Environmental Research Institute, Aarhus University, Roskilde, Denmark; [4]Bispebjerg University Hospital, Copenhagen, Denmark; and [5]Department of Epidemiology, Institute of Public Health, Aarhus University, Aarhus, Denmark.*

Background/Aims: Air pollution is suspected to cause lung cancer. The purpose was to investigate whether the concentration of nitrogen oxides (NO_x) at the residence, used as an indicator of air pollution from traffic, is associated with risk for lung cancer.

Methods: We identified 679 lung cancer cases in the Danish Cancer Registry from the members of 3 prospective cohorts and selected a comparison group of 3481 persons from the same cohorts in a case-cohort design. Residential addresses from 1 January 1971 were traced in the Central Population Registry. The NO_x concentration at each address was calculated by dispersion models, and the time-weighted average concentration for all addresses was calculated for each person. We used Cox models to estimate incidence rate ratios (IRRs) after adjustment for smoking (status, duration, and intensity), educational level, body mass index, and alcohol consumption.

Results: The IRRs for lung cancer were 1.30 (95% CI: 1.07–1.57) and 1.45 (95% CI: 1.12–1.88) for NO_x concentrations of 30–72 $\mu g/m^3$ and >72 $\mu g/m^3$, respectively, when compared with <30 $\mu g/m^3$. This corresponds to a 37% (95% CI: 6%–76%) increase in IRR per 100 $\mu g/m^3$ NO_x. The results showed no significant heterogeneity in the IRR for lung cancer between cohorts or between strata defined by gender, educational level or smoking status.

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Conclusion: The study showed a modest association between air pollution from traffic and the risk for lung cancer.

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O-29A3-4

Long-term Exposure to Traffic-related Air Pollution and the Risk of Coronary Heart Disease Hospitalization and Mortality

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Background/Aims: Epidemiologic studies have demonstrated that exposure to road traffic is associated with adverse cardiovascular outcomes. To support evidence-based policy-making and cost-effective air pollution intervention, this study aimed to identify the specific traffic-related air pollutants that are associated with the risk of coronary events.

Methods: This population-based cohort study included a 5-year exposure period (January 1994–December 1998) and a 4-year follow-up period (January 1999–December 2002). Metropolitan Vancouver residents aged 45–85 years without known coronary heart disease (CHD) at baseline (January 1999) were included in this study (N = 418 826). Individual exposures to traffic-related air pollutants including black carbon, fine particles (aerodynamic diameter, $\leq$2.5 μm; $PM_{2.5}$), NO_2, and NO were estimated at subjects' residences using land use regression models and integrating changes in residences during the 5-year exposure period. CHD hospitalizations and deaths during the 4-year follow-up period were retrieved from provincial hospitalization and death registration records.

Results: An interquartile range increase in the 5-year average concentrations of black carbon was associated with a 4% increase in CHD hospitalizations (95% CI: 1.02–1.06) and a 6% increase in CHD mortality (95% CI: 1.02–1.09) after adjustment for age, sex, pre-existing comorbidities, neighborhood socioeconomic status, and co-pollutants ($PM_{2.5}$, NO_2, and NO). There were clear exposure-response relationships between black carbon and coronary events but no robust associations were found with $PM_{2.5}$, NO_2, or NO.

Conclusion: Long-term exposure to particulate black carbon was associated with increased risks of coronary morbidity and mortality, which may partly explain the observed associations between exposure to road traffic and adverse cardiovascular outcomes.

O-29A3-5

Effects of Ultra-fine Air Pollution on Systemic Inflammation in a Large German Cohort

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Background/Aims: Prior cross-sectional analyses revealed a short-term association of ambient particle number concentration with markers of systemic inflammation in a population-based sample. We extended this former analysis by adding follow-up data.

Methods: We used data from the baseline (2000–2003) and first follow-up examination (2006–2008) of the Heinz Nixdorf Recall Study, an ongoing cohort study of 4814 participants in 3 large adjacent cities in Germany. A chemistry transport model was applied to model daily urban background concentrations of PN, $PM_{2.5}$, and PM_{10} on a grid of 1 km^2. Concentrations were linked to the participants' home addresses. Repeated measures of participants' high-sensitivity C-reactive protein (hs-CRP) and fibrinogen were analyzed by mixed models with random participant intercept. Short-term exposure was assessed for single day lags and averaging times of up to 28 days before examination. We adjusted for meteorology, time trend, season, age, BMI, sex, medical history. Nonlinearity was considered by natural splines. Estimates are given per interquartile range (IQR) of the exposure metric with their 95% confidence intervals. Participants with acute inflammatory diseases (hs-CRP >100 mg/L) were excluded.

Results: Median hs-CRP and fibrinogen levels for repeated measurements of 3452 included participants were 1.5 mg/L (IQR: 2.2 mg/L) and 336 mg/dL (IQR: 114 mg/dL), respectively. Median daily concentration of PN, $PM_{2.5}$, and PM_{10} were 79 × 106/mL (IQR: 43 × 106/mL), 13.4 $\mu g/m^3$ (IQR: 11.1 $\mu g/m^3$), and 17.3 $\mu g/m^3$ (IQR: 13.6 $\mu g/m^3$), respectively. PN levels averaged up to 7 days were positively associated with hs-CRP with the highest increase for 6-day average PN (4.3% [0.8%, 7.8%]). Averaging times up to 28 days were positively associated with fibrinogen levels (highest increase of 1.6% [0.7%, 2.5%] for 28-day average). No associations were found for $PM_{2.5}$ and PM_{10} with hs-CRP and fibrinogen.

Conclusion: This extended analysis showed a consistent association of urban short- to medium-term ultrafine particle air pollution with markers of systemic inflammation. Traffic exposure, a major source of urban PN, might be responsible for this effect.

ENHANCING EXPOSURE ASSESSMENT FOR AIR POLLUTION HEALTH STUDIES: EPA/NERL COOPERATIVE AGREEMENT PROGRAM

S-29A4-1

Overview of EPA/NERL Cooperative Agreement Research Program on Air Pollution Exposure and Health

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Background/Aims: US Environmental Protection Agency's National Exposure Research Laboratory recently initiated a 2-year Cooperative Agreement Research Program between EPA and 3 academic institutions: Emory University, Rutgers University, and University of Washington. The overall goal of this "Air Pollution Exposure and Health Program" is to enhance the results from epidemiologic studies of ambient particulate matter (PM) and gaseous pollution by using refined measurement and modeling-based approaches for characterizing personal and population exposures in evaluating health effects of ambient air pollution.

Methods: The methodologies for each of the 3 groups are complimentary. The Emory-Georgia Tech group is developing and evaluating 5 exposure metrics for examining acute morbidity effects of ambient traffic-related (CO, NOx, $PM_{2.5}$, and $PM_{2.5}$ EC) and regional (O_3 and SO_4) pollutants in Atlanta. These will be applied during time series analysis of ED visits and case-crossover analysis of ICD cohort data bases from Atlanta, GA. The Rutgers/EOHSI-LBL group is examining associations between $PM_{2.5}$ mass and species and adverse health outcomes using logistic regression analysis with birth outcomes and case-crossover analysis with myocardial infarctions data in New Jersey using 4 different exposure tiers. The University of Washington team is conducting research to improve epidemiology study health effect estimates under the MESA Air and other air pollution cohort studies by fine-scale spatiotemporal modeling of ambient $PM_{2.5}$ and NOx.

Results: An overview of results derived from application of alternative air quality and exposure predictors using monitoring or modeling (CMAQ, AERMOD, SHEDS, APEX) information will be presented. Application of selected lower and intermediate tier exposure metrics in some of the recent epidemiological conducted will be briefly described.

Conclusion: Depending on the study design, uncertainties in estimating exposures to air pollution can influence the results derived from epidemiologic studies that rely on available ambient monitoring data. These may be especially important for individual level studies examining health effects due to $PM_{2.5}$ species and copollutants.

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S-29A4-2

Comparison of Exposures Estimated Using Ambient $PM_{2.5}$ Concentrations With Those Estimated by the Stochastic Human Exposure and Dose Simulation Model for Two New Jersey Cohorts

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Background/Aims: Concentrations from multiple central-site particulate matter ($PM_{2.5}$) monitors across New Jersey were used to estimate exposures to outdoor-generated PM for 2 cohorts. The myocardial infarction (MI) cohort used hourly concentrations from 2004 to 2006 to estimate exposures 24 hours prior to an MI, and the adverse birth outcome cohort used daily concentrations from 1999 to 2003 to estimate trimester concentrations. Central-site monitors do not account for factors that could influence exposures to outdoor-generated PM, such as variations in building ventilation characteristics (eg air exchange rates) that can affect the infiltration of particles indoors or human activity patterns. The Stochastic Human Exposure and Dose Simulation model (SHEDS), a population based exposure model, was used to estimate personal exposures to $PM_{2.5}$ for the 2 New Jersey cohorts. In this analysis, we compare the SHEDS personal exposure estimates with concentrations measured at the central-site monitors.

Methods: SHEDS simulated populations using US Census tract-level demographic information. Each simulated individual is then matched to a time activity diary from the Consolidated Human Activity Database. These diaries contain data on the time spent and activities performed in various microenvironments. SHEDS computed an outdoor-generated $PM_{2.5}$ concentration for each microenvironment, and then weighted each by the time spent in that microenvironment resulting in a total $PM_{2.5}$ exposure for the individual. We then calculated SHEDS exposure estimates-ambient concentration ratios.

Results: For the MI cohort, the average (standard deviation) exposure-concentration ratio was 0.51 (0.10) and ranged from 0.32 to 0.75. We also observed seasonal differences with average ratios of 0.49, 0.52, 0.60, and 0.45 for the winter, spring, summer, and fall, respectively.

Conclusion: Future work includes analyzing the exposures from the adverse birth outcome cohort, determining the major factors (eg, air exchange rates, penetration factors, decay rates, and activity patterns) affecting the ratios, and examining the effects of averaging times (ie, hourly estimates vs. average trimester exposures).

S-29A4-3

Application of Refined Exposure Surrogates in Ambient $PM_{2.5}$ Epidemiology Studies: Accounting for Temporal/Spatial Variations in Particulate Matter Infiltration

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Background/Aims: In particulate matter (PM) epidemiology, outdoor fine PM ($PM_{2.5}$) mass/species concentrations are frequently used as surrogates of exposure to outdoor-generated $PM_{2.5}$. The penetration of outdoor particles into indoor spaces and their persistence indoors varies due to variations in air exchange rate/housing stock/ventilation practices and variations in particle properties/source mix. Exposure to outdoor-generated PM also depends on time-activity patterns. We hypothesized that accounting for human activity patterns and outdoor-to-indoor particle transport would result in less exposure error and bias than the use of central site $PM_{2.5}$ alone, resulting in larger risk estimates, narrower confidence intervals, and better model fits.

Methods: To test this hypothesis, we used case-crossover methods to estimate the risk of myocardial infarction associated with the ambient $PM_{2.5}$ concentration in the previous 24 hours. Here, we compare results from epidemiological analyses where $PM_{2.5}$ was measured at a central site (Tier 1) to those where population mean $PM_{2.5}$ exposures were estimated using the Stochastic Human Exposure and Dose Simulation model (Tier 2), a probabilistic model that introduces temporal variability in exposure estimates by accounting for time-activity patterns and seasonal differences in residential air exchange rates.

Results: In Tier 1 analyses, each interquartile increase in $PM_{2.5}$ concentration in the previous 24 hours was associated with a significantly increased risk of a transmural myocardial infarction (odds ratio = 1.10; 95% confidence interval = 1.00, 1.20). In Tier 2 analyses, each interquartile increase was associated with a similarly sized effect (odds ratio = 1.09; 1.00, 1.19). AIC values for each model were also similar.

Conclusion: Future work will further refine exposure estimates to account for spatial and temporal variability in residential air exchange rates. Comparisons between Tier 1 and 2 models within a cohort study estimating the risk of a newborn infant being small for gestational age associated with mean first and third trimester $PM_{2.5}$ concentrations will also be evaluated and presented.

S-29A4-4

Associations Between Spatially Resolved Estimates of Traffic-related Pollution and Acute Morbidity: Assessing Agreement of Results Among Multiple Exposure Assignment Approaches

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Background/Aims: A common method for assigning exposure in population-based epidemiologic studies of air pollution is to use surrogate measurements from central monitoring sites. This practice may introduce exposure misclassification in epidemiologic analyses for pollutants that are spatially heterogeneous (ie, nitrogen dioxide, elemental carbon, carbon monoxide). To investigate the potential impact of misclassification within observed health risk estimates, we created several tiers of exposure refinement to estimate daily ambient concentrations at 225 Atlanta-area ZIP code centroids. These tiers include estimates that vary in their approaches for modeling pollutant spatial heterogeneity, as well as surrogates of pollutant infiltration.

Methods: The current analysis presents results using the following 6 exposure tiers: (i) central site monitoring data, (ii) spatially interpolated monitoring data, (iii) Community Multiscale Air Quality model outputs, (iv) AERMOD atmospheric dispersion modeling outputs, (v) Community Multiscale Air Quality-AERMOD hybrid and blended model outputs, and (vi) spatial and temporal surrogates of air exchange rates. Each metric was applied in (1) a daily time-series study of emergency department visits and (2) a case-crossover study of cardiac events in patients with implantable cardioverter defibrillators.

Results: Varying degrees of spatial and temporal variability were observed for different exposure metrics. Variability was more pronounced for traffic-related (CO, NO_X) versus regional (O_3, $PM_{2.5}$) pollutants.

Conclusion: Preliminary analyses obtained for each exposure metric show that finer spatial resolution in ambient concentrations and incorporation of exposure factors in analyses yield different pollutant exposure estimates

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compared to ambient monitoring data alone. We will also discuss the interpretations and limitations of each exposure assignment method for air pollution epidemiology.

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S-29A4-5

Influence of Network Design on Health Effect Estimates From Predicted Exposures

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Background/Aims: A typical approach to estimating the effect of long-term average air pollution exposure on health in cohort studies is to condition on exposures predicted from long-term averages of air pollution monitor measurements. Such health effect estimates may be sensitive to the monitoring network design and study subject residence locations. We explored by simulation the impact of network design for both monitors and subjects on estimates of relative risks for particulate matter ($PM_{2.5}$) exposures in 33 US cities.

Methods: We assumed an underlying geostatistical model for exposure, and a relative risk model for health outcomes, conditional on true exposure. We used exposure simulated at monitor locations to predict exposure at subject homes; these predicted exposures were assumed known in the subsequent health analysis. We assessed the impact of network design by repeating our simulations, changing the relative distances between monitors, subjects, and monitors and subjects. We studied many relative configurations within a single area (LA) and then extended this work to 33 Women's Health Initiative study cities, conditioning on the sample size, subject residential patterns, and actual monitor locations in each city.

Results: We found that in general, as average distances increased between monitors, or between monitors and subjects, health effect estimates were more biased and variable, leading to poorer coverage probabilities. As average distances between subjects increased, coverage also tended to decrease, but there was less consistency between the results within the single area and across the Women's Health Initiative areas.

Conclusion: These simulation studies suggest that in general, air pollution cohort studies that are carried out in areas with denser monitoring networks and with monitors situated closer subjects will give more accurate and precise health effect estimates than studies with sparser monitoring networks or with monitors situated farther from study subjects.

S-29A4-6

Measurement Error in Air Pollution Cohort Studies

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Background/Aims: The target of inference in air pollution cohort studies is the association between exposure to air pollution and disease outcomes. Exposures are typically predicted from monitoring data by means of a "land use" regression model that may incorporate spatial or spatiotemporal smoothing. Predicted exposures do not correspond exactly to the true exposures, and the resulting measurement error affects health effect estimates and their confidence intervals. The standard measurement error paradigm distinguishes between Berkson error and classical error. These categories are not directly applicable for air pollution cohort studies, so it is important to characterize the measurement error in this setting and to propose appropriate correction methods.

Methods: We characterize the measurement error by decomposing it into Berkson-like and classical-like components. Both components change the variability of the health effect estimates, and in a linear disease model, the classical-like component can introduce bias while the Berkson-like component does not. We describe the impact of ignoring the measurement error and propose 2 correction methods, the parametric bootstrap based on a Gaussian process data-generating mechanism and a less computationally intensive approximation termed the "parameter bootstrap." The parameter bootstrap is motivated by the decomposition of the measurement error into Berkson-like and classical-like components. We compare these 2 correction methods on simulated and real data.

Results: The parametric bootstrap reliably gives valid inference, but it is very computationally intensive. The parameter bootstrap gives similar results at a significantly reduced computational burden.

Conclusion: Measurement error in air pollution cohort studies is a complex mixture of Berkson-like and classical-like components. Under the assumption of a Gaussian process data-generating mechanism and a linear disease model, it can be corrected using a parametric bootstrap or a less computationally intensive approximation termed the parameter bootstrap. Extensions to more general settings are expected to hold and will be developed in future work.

BIOMARKERS AND BIOMONITORING

O-29A5-1

The Acrylonitrile Hemoglobin Adduct Cyanoethylvaline as a Long-time Biomarker to Assess Exposure to Environmental Tobacco Smoke: Results From a Field Study in the German Hospitality Sector

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Background/Aims: In Biological Monitoring nicotine and its metabolites cotinine and 3OH-cotinine are regularly used to estimate short-term exposures to environmental tobacco smoke (ETS). As ETS exposure often occurs intermittent, a long-term biomarker for ETS exposure is desirable, especially to differentiate between private and occupational exposure. Acrylonitrile is an integral constituent of tobacco smoke and its urinary mercapturic acid N-acetyl-S-(2-cyanoethyl)cysteine (CEMA) and its hemoglobin adduct cyanoethylvaline (CEV) have already been used to assess active smoking. This study was aimed to investigate whether CEMA and CEV are also useful ETS biomarkers reflecting short and long-term exposure, respectively.

Methods: Within this study, we examined 37 non-smoking hospitality workers regarding their external (personal air monitoring) and internal exposure to nicotine and acrylonitrile. Nonsmokers with little or no exposure to ETS (N = 43) as well as active smokers (N = 17) served as controls.

Results: Nicotine (1.6–145 $\mu g/m^3$) and acrylonitrile (0.26–6.3 $\mu g/m^3$) in air showed a strong correlation (r = 0.91). The extent of external exposure depended on various factors like smoker density or ventilation. Nicotine metabolites (data not shown here) and CEMA were found in all urinary specimen and showed significant differences between smokers (median CEMA 72.5 $\mu g/L$), hospitality workers (5.7) and non-smoking controls (1.1). For CEV we could not observe significant differences between hospitality workers (median, 3.3 pmol/g globine) and controls (3.4) (smokers: 116). Nevertheless, the subpopulation of discotheque employees had strongly elevated CEV values (N = 5; mean, 16.1). Airborne concentrations showed good correlations to the corresponding biomarkers as well as parameters of Biological Monitoring among each other.

Conclusion: The mercapturic acid and the hemoglobin adduct of acrylonitrile emerged to be suitable biomarkers to assess ETS exposure specifically. Within this context, CEV reflects the mean internal ETS

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exposure of the last 4 months. To differentiate between private and occupational ETS exposure, it is necessary to use a panel of long- and short-term biomarkers.

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O-29A5-2

Gene Expression Analysis of PCB Exposed Children: Understanding Toxicity and Disease Process

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Background/Aims: To understand the molecular mechanism of PCB-related toxicities and the basics of pathophysiology in association with high PCB exposure, we studied the differential global gene expression profile of children (mean age, 45 month) of East European descent from Slovakian Republic in a well-defined study cohort.

Methods: An unsupervised microarray based gene expression analysis was performed on the subset of children having high blood PCB concentration (>75 percentile) against their low PCB counterpart (<25 percentile). The mean lipid adjusted PCB values in 2 groups were 3.16 ± 1.2 and 0.06 ± 0.03 ng/g of serum lipid, respectively. Total RNA from peripheral blood mononuclear cells were isolated and the microarray was conducted using Affymetrix platform (GeneChip Human genome U133 Plus 2.0 Array). The data obtained from microarray were analyzed by Genespring GX10.

Results: A highly significant set of 162 differentially expressed genes between high PCB and low PCB group was observed ($P < 0.00001$). The subsequent Ingenuity Pathway Analysis on this set of genes implicated different compromised molecular and cellular function in higher PCB exposure included: Cell-to-Cell Signaling and Interaction, Cellular Movement, Cellular Assembly and Organization, Cellular Function and Maintenance, and Carbohydrate Metabolism. The analysis conducted on children with high PCB exposure also indicated perturbed expression of genetic pathways related to cardiotoxicity, hepatotoxicity, and nephrotoxicity. These uncharacteristic effects on gene expression may play a role in development of major diseases and disorders in population, including cancer. Some of the relevant genes reported in relation to PCB-related toxicities were subsequently validated through quantitative RT-PCR.

Conclusion: Our results provided a molecular insight in understanding the associated mechanism of this complex gene environment interaction. The future endeavor of supervised genotyping of pathway-specific molecular epidemiological study would reveal the individual risk factor in PCB exposure.

O-29A5-3

Evaluation of 1,4-dichlorobenzene Exposure and Associated Health Effects: Hematologic, Kidney, and Liver Functions in Moth Repellent Workers

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Background/Aims: 1,4-Dichlorobenzene (1,4-DCB) has been widely used as toilet deodorizer, repellent, and mothballs. Because of its high volatility, human may expose to 1,4-DCB through inhalation, and eye/upper respiratory tract irritation and abnormal liver/kidney functions have been reported in occupational exposure. It is desired to find suitable biomarkers of 1,4-DCB exposure and health effects for the workers in the repellent product plants. In this study, we established a novel method to measure the metabolites of 1,4-DCB, provided their profiles in urine, and then conducted an exposure assessment to clarify the relationship between 1,4-DCB exposure and the health effects.

Methods: We synthesized 2,5-dichlorophenol glucuronide (2,5-DCPG) and 2,5-dichlorophenol sulfate (2,5-DCPS) for sample analysis and developed a method to analyze the urinary metabolites of 2.5-dichlorophenol (2,5-DCP), 2,5-dichlorohydroquinone (2,5-DCHQ), 2,5-DCPS, and 2,5-DCPG simultaneously with solid-phase extraction and ultra-high performance liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS) with negative electrospray ionization. For exposure assessment, the exposed group is the workers in moth repellent manufactories (n = 46) and the control group is the non-1,4-DCB exposure workers (n = 29).

Results: A gradient elution with aqueous ammonium acetate buffer and methanol was used to separate the metabolites and offered the best signal intensity of the analytes. All the correlation coefficients (r^2) of calibration curves were greater than 0.995. The concentrations of 2,5-DCPG in urine (20–350 μg/mL) were found much higher than those of 2,5-DCP/2,5-DCPS (70–1050 ng/mL). For health effect, the biochemical indices such as white blood cell count (WBC), blood urea nitrogen (BUN) level, and BUN/creatinine ratio were positively correlated with the urinary metabolite concentration of 2,5-DCPG ($P < 0.05$).

Conclusion: Our method successfully measured urinary metabolites of 1,4-DCB with high throughput and good sensitivity. The 2,5-DCPG was found to be the major metabolite of human exposure to 1,4-DCB. Exposure to 1,4-DCB may increase the levels of WBC and BUN in blood.

O-29A5-4

Data Comparability Between Biomonitoring Studies for PCDD/Fs—Issues for the Use of the National Health and Nutrition Examination Survey (NHANES) Data

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Background/Aims: The goal of this study was to examine data from other case studies that used National Health and Nutrition Examination Survey (NHANES) data to compare individuals or populations for blood levels of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs). Our aim was to evaluate whether the data collected from a number of studies could be correctly compared to NHANES data.

Methods: The methods used in the collection and analysis of samples for both NHANES and other case studies were examined to determine if methodologies were similar enough to conduct direct comparisons of blood PCDD/F data.

Results: Numerous considerations and issues were discovered when examining other studies and their comparison to NHANES data. These included detection limits from their results being higher than those generated by Centers for Disease Control and Prevention (CDC). These artificially amplify the calculated toxic equivalents (TEQs) for individuals. NHANES uses enzymatic lipid determinations to calculate blood lipids and many studies still use gravimetric lipid determinations. This further amplifies perceived TEQs for individuals being compared to NHANES. These errors combined with other data quality issues are exacerbating exposure scenarios and potentially causing a misclassification of individuals or study cohorts.

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Conclusion: Many studies that are comparing their data to NHANES data are doing so incorrectly. They are either not conducting the appropriate statistical treatment of the NHANES data or they have results from laboratories that are not capable of producing the quality of data required to compare with the NHANES dataset and therefore, misrepresenting the exposures that they are reporting in their studies.

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O-29A5-5

Is the Control of Benzo(a)Pyrene Enough in the Products of the Fishing?

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Background/Aims: There are different ways of exposure to Polycyclic Aromatic Hydrocarbons (PAHs); certainly the main source is air, but we believe interesting dietary exposure. Daily intake of PAHs in humans is highly variable. The measure of PAH mixtures in food as a risk factor for human cancer is very important, it's known that PAHs express an important toxicity and mutagenicity, so several of them were classified as probable (2A) or possible (2B) carcinogenic by the International Agency for Research on Cancer. In particular, we evaluated the concentration of PAHs in fish caught in the Mediterranean Sea. European legislation provides for the implementation of the Directive 1881/2006, which sets a limit only for Benzo(a)Pyrene (BaP) of

Methods: We have analyzed 30 samples of fish by Sicily channel; every analysis has been repeated 3 times and the result has been mediate. In detail, the fish sample is extracted by sonication with organic solution, purified by C18 SPE and analyzed by HPLC UV-FL. Sixteen PAHs were analyzed: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)Anthracene, Chrysene, Benzo(b)Fluoranthene, Benzo(k)Fluoranthene, Benzo(a)Pyrene, Dibenz(a,h)Anthracene, Benzo(g,h,i)Perylene, and Indeno(1,2,3-cd)Pyrene.

Results: BaP is always less than the limits prescribed by law; were detected in traces in all the analytes considered. In detail, the molecules more concentrated are Naphthalene and Acenaphthylene. The sum of the PAHs analyzed ranges from 4 to 13.8 ppb. The results of this study underline and confirm the homogeneous presence of numerous PAHs in samples of fish.

Conclusion: Our results comparing with European law suggest to estimate and set a maximum concentration of PAHs in food. Further studies are necessary to improve the state of knowledge on the relative potency of individual PAHs and to estimate their toxicity and/or carcinogenicity.

O-30B3-1

Human Biomonitoring of Environmental Chemicals in the Canadian Health Measures Survey—First Results

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Background/Aims: Biomonitoring is used increasingly as an indicator and quantitative measure of human exposure to environmental chemicals. Biomonitoring contributes to policy decisions mandated by various regulatory, environmental, and public health frameworks in Canadian and international contexts. Although targeted biomonitoring studies have been conducted in Canada since the 1960s, national population-based biomonitoring studies have only recently been initiated in Canada.

Methods: The biomonitoring component of the 2007–2009 Canadian Health Measures Survey, conducted by Statistics Canada in partnership with Health Canada, is the most comprehensive nationally-representative biomonitoring initiative undertaken to date. In this survey, 91 different chemicals were measured in blood and urine specimens collected from approximately 5600 Canadians, ages 6–79 years. These chemicals included metals, pesticides, persistent organic pollutants, and plasticizers.

Results: Preliminary results based on 2678 participants reported that lead, total mercury and cadmium in blood were above detection limits (DL) in 99% (DL = 0.02 μg/dL), 90% (DL = 0.10 μg/L) and 98% (DL = 0.004 μg/L) of Canadians, respectively. The geometric mean blood concentrations for lead, total mercury, and cadmium were 1.37 μg/dL, 0.76 μg/L, and 0.35 μg/L, respectively, in 6–79 year olds. Blood lead concentrations have fallen substantially since 1978, when national levels were last measured. Fewer than 1% of 6–79 year old Canadians now have blood lead concentrations above 10 μg/dL compared with 25% in 1978. Similarly, less than 1% of Canadian adults have total mercury concentrations above the Health Canada guidance value of 20 ug/L for adults. Full biomonitoring results will be released in July 2010.

Conclusion: Canadian Health Measures Survey data will be used to assess current population levels for a broad range of environmental chemicals; to provide baseline data to track trends and to enable comparisons with sub-populations in Canada and internationally; and to provide data to explore relationships between environmental chemicals, other physical measures, and self-reported questionnaire information collected in this survey.

O-30B3-2

2,5-Hexanedione in the General Population: Environmental Exposure or Endogenous Production?

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Background/Aims: The hydrocarbon solvent n-hexane is well known to cause polyneuropathy and its neurotoxicity is linked to the metabolite from the liver 2,5-hexanedione (2,5-HD). Increased urinary concentrations of 2,5-HD are shown in workers occupationally exposed to n-hexane. However, low urinary concentrations of 2,5-HD have also been detected in the general population possibly related to lipid peroxidation within the body or through microexposure to n-hexane in the environment. Less is known about the distribution of 2,5-HD within the general population and the relation to environmental exposures.

Methods: Out of randomly selected referents in the general population from a previous survey 227 persons nonoccupationally exposed to n-hexane (age, 46–85 years) agreed to cast a morning urinary sample for analysis of 2,5-HD. The samples were analyzed after acid hydrolysis at the laboratory of Medicina del Lavoro in Perugia, Italy. Information on life style factors were collected through a questionnaire. A multiple linear regression analysis included as determinants liver toxic exposure, that is, organic solvents in occupation and leisure time, alcohol, drugs, and anesthesia during surgery at least once in the lifetime.

Results: The mean 2,5-HD urinary concentration for women (n = 117) was 0.36 ± 0.23 mg/L and for men (n = 110) was 0.45 ± 0.27 mg/L. Men had significantly higher levels than women, hence the analysis was stratified for sex. The linear regression showed an inverse relation to age and a higher excretion in persons who never underwent general anesthesia. No other risk factor in the multiple linear regression was

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significant. None of these risk factors were significant for women in this regression.

Conclusion: 2,5-HD is excreted in the urine in persons from the general population. Young men had consistently higher excretion than women in all the multivariate analyses. The background is still intriguing and the relevance as an etiology for development of polyneuropathy is unknown.

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O-30B3-3

German Initiative to Support Human Biomonitoring: Co-operation Project Between the German Chemical Industry Association and the Federal Ministry for The Environment, Nature Conservation and Nuclear Safety

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Background/Aims: The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the German Chemical Industry Association e. V. (VCI) representing over 90% of the German chemical industry agreed to work on the goal to increase the knowledge on the internal exposure to chemicals of the general population. The Federal Environment Agency will play a vital role in this cooperation. Emphasis will be placed on substances with either a potential health relevance or to which the general population might potentially be exposed to a considerable extent.

Methods: Markers to investigate population's internal exposure to chemicals by human biomonitoring (HBM) will be identified and new analytical methods will be developed. It is planned to work on 50 chemicals during 10 years with a 3-year pilot phase after which the project will be evaluated. The work is supported by an advisory panel consisting of scientists from academia, industry, and administration. Strategic decisions will be made by a management committee including representatives from industry, the Ministry, and the Agency.

Results: VCI agreed to take over the responsibility and the funding for developing the new HBM methods, BMU for applying them in population-based HBM studies. Thus, separate responsibilities and promises of financing were arranged. Communication of project-related issues will be done after consultation of the respective project partner. An initial list of potential substances has already been prepared. It was agreed to publish the resulting chemical-analytical methods and exposure data in scientific journals.

Conclusion: The agreement was signed in February 2010. Based on the advice of the scientific panel, the management committee will decide in May 2010 upon the first 5 substances to start with. Substances were proposed by the advisory panel. This project will contribute to a realistic estimation of internal exposure to relevant chemicals in the German population.

O-30B3-4

The German Environmental Specimen Bank—An integrative Tool for Human and Environmental Monitoring in Chemical Risk Assessment

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Background/Aims: The German Environmental Specimen Bank (ESB) is a permanent monitoring instrument investigating time trends and sources of environmental pollution, as well as the contamination and fate of chemicals in environmental and human media. It is run jointly by the German Federal Ministry for the Environment, the Federal Environment Agency, and research institutes with special competencies in relevant fields of research (eg, sampling of human, biological, and abiotic material, trace analysis of pollutants, and bio banking).

Methods: Exposures to different chemicals (lead, PFOS/PFOA, PCB, arsenic) were investigated in samples from 1985 until today, that is, in human blood, spruce shoots, bream muscle, blue mussels, and herring-gull eggs. The results were used for comparing exposure of wildlife and man, analyzing redundancy of information, elucidating accumulation along food chains and exposure pathways for human exposure, describing spatial differences, assessing risks for human health and the environment, and developing monitoring standards and quality criteria.

Results: Lead, for example, decreased in spruce shoots as well as in humans due to regulatory measures. In contrast, levels in blue mussels remained constant. As lead is a health-relevant pollutant, the exposure for human and predators in the ecosystem has to be further investigated. PFOS decreased in human blood plasma, but not in herring-gull eggs. This indicates the persistence of PFOS in aquatic surroundings and the need for further analyses of exposure pathways. Constant levels of PFOA in blood plasma as well as in herring-gull eggs might be due to an insufficient voluntary agreement for exposure reduction.

Conclusion: The ESB generates a broad perspective on a wide range of specimen with different functions in ecosystems. It supports the assessment of regulatory measures on health and the environment, and the identification of priority areas for future regulation. Thus, the German ESB constitutes an example for an integrated specimen bank, based on long-term experience.

O-30B3-5

Communicating Individual Level Biomarker Data to Participant Families in Epidemiological Studies

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Background/Aims: The US Breast Cancer and the Environment Research Centers (BCERC) include studies of determinants of puberty in girls, with a focus on exposures to hormonally active agents (HAAs). Urine and serum biospecimens were collected to measure cotinine, phenols, phytoestrogens, phthalates, PCBs, PBDEs, pesticides, and perfluorinated compounds. Although individual results were not promised to the 440 families at the California site, staff felt there were ethical imperatives for providing them. Communicating technical results on a sensitive population (children) poses many challenges, particularly when health ramifications are not established. Therefore, we conducted focus groups with parents to gauge their level of interest in receiving individual results, to determine preferences for content of report-back materials and method of receipt, and to assess their understanding of biomonitoring.

Methods: Four focus groups were held (one in Spanish) of 8–12 participants randomly recruited from the study cohort. Participants answered demographic and literacy questions and participated in a scripted discussion. The study team used the focus group results to design study-specific report-back materials.

Results: Of the 35 attendees, 89% were female, with a mean age of 45. Participants overwhelmingly wanted to receive their daughters' biomonitoring results, even if little corresponding health information was available. Other dominant themes included preferences for seeing their daughter's levels compared to other girls in the study and to other cohorts, receiving detailed information on the chemicals, including sources and ways to limit exposure, and the opportunity to speak individually with investigators.

Conclusion: Findings confirmed prior research regarding the value of involving study participants in the design process for reporting results from biomarker studies in order to best address the unique perspectives of each study population and circumstances. Designing appropriate materials

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and providing results requires a substantial commitment of resources that should be included in the initial study plan.

INDOOR AND BUILT ENVIRONMENT

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O-29A6-1

Health and Wellbeing in Relation to the Quality of Ventilation Systems in Newly Built Dwellings in the Netherlands

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Background/Aims: The Netherlands is situated in a moderate maritime climate in Western Europe, where most houses today are built with thermal insulation and mechanical ventilation. Mechanical ventilation can be subdivided in systems which combine natural supply and mechanical exhaust and systems with mechanical supply and exhaust with heat recovery. In 2007, a Municipal Health Service reported health complaints of residents in dwellings with the latter type of mechanical ventilation system. Residents reported nonspecific health complaints such as respiratory, nose, and eye complaints; fatigue; and sleep problems attributed to the ventilation system. As stricter requirements for energy performance are expected in the future, mechanical ventilation with heat recovery will become more common. Therefore, understanding the relationship of mechanical ventilation and health complaints is needed. This study aimed to investigate the relationship between the quality of mechanical ventilation systems and health complaints and wellbeing in private homes.
Methods: One hundred fifty newly built houses with natural supply and mechanical exhaust ventilation and 150 newly built houses with mechanical supply and exhaust with heat recovery throughout the Netherlands were selected from an existing database. A structured home inspection by trained surveyors aimed at the ventilation system was combined with a questionnaire survey among the 300 residents. The ventilation system was checked for ventilation capacity, noise levels, construction flaws, internal cleanliness, and maintenance state, etc. The questionnaire contained questions about nonspecific health complaints, sleep quality, noise annoyance, thermal comfort, environmental sensitivity, and coping strategies.
Results: This paper will present results about the association of different mechanical ventilation systems with health complains and well-being. The role of perceptions and environmental sensitivity will be discussed.
Conclusion: Home inspection reveals that a priori 20% of both types of ventilation systems have insufficient ventilation capacity. In working conditions, an additional 60% does not have a sufficient ventilation capacity and might result in adverse health effects.

O-29A6-2

Ventilation and Indoor Air Quality in 40 Small and Medium Sized Commercial Buildings in California: Ventilation Measurements Methods and Findings

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Background/Aims: Building energy consumption and indoor air quality (IAQ) linkages become more critical as global carbon emission mitigation trumps energy costs. Forty Californian (CA) small and medium sized commercial buildings (SMCBs, 1000–50,000 sq ft, 90–4,600 m^2) were surveyed to characterize their ventilation rates and IAQ. The CA energy code (Title 24) prescribes building ventilation rates (VR), and must optimize ventilation for occupant health and comfort while reducing energy waste.
Methods: SMCB types in the study varied widely, including retail, grocery, hair and nail salons, restaurants, offices, etc. The building heating, ventilation, and air conditioning (HVAC) systems were examined and characterized. The presence and quality of the filtration system was assessed. The widely diverse buildings in this study required a broad set of methods to measure VRs. These methods included perfluorocarbon tracer for whole building VR measurement (PFT); sulfur hexafluoride injection and decay measurements (SF6); and indoor occupant CO_2 mass balance (CO_2). Air exchange rates were calculated from these measurements.
Results: Building management often lacked understanding of their HVAC system. HVAC filters often needed replacement. Many buildings had no outdoor air provision in their air handlers, with little or no intentional natural ventilation. Data from 21 of the 40 buildings are discussed here. Average building VRs differed somewhat by measurement method: 590 ± 1220 CFM (PFT); 1380 ± 1370 CFM (SF6); and 1870 ± 1870 CFM (CO_2). Similarly, calculated air exchange rates were: 1.5 ± 3.2 h-1 (PFT); 1.5 ± 1.0 h-1 (SF6); and 3.0 ± 4.4 h-1 (CO_2) using these methods.
Conclusion: Ventilation provided to SMCBs varied widely across the study. The VR and air exchange rates measurements yielded somewhat different results. Overall, the SMCB ventilation systems needed maintenance. CA State standards could address improving HVAC system selection, operation, and maintenance, to avoid wasting energy while providing healthier indoor environments.
Funding: California Air Resources Board and Energy Commission; views are those of the authors not the funding agencies.

O-29A6-3

Comparative Study of Resuspension Rate of Dust Particles Due to Human Walking

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Background/Aims: Particle resuspension due to human walking accounts for a substantial portion of both PM_{10} and $PM_{2.5}$ that is breathed by people indoors. A number of studies have investigated particle resuspension in residences and experimental chambers by measuring increases in particle concentration from human walking. Resuspension rates have been found to vary over several orders of magnitude due to the large number of factors affecting particle resuspension, such as flooring type, particle type, particle size, absorbing time, shoe type, and walking speed (Qian et al, 2008; Manthena et al, 2008; Zhang et al, 2008; Hu et al, 2008). The goal of this study is to determine if these factors or their interactions have significant impacts on the resuspension rate of particles. Previous research (Qian et al, 2008) shows a high person-to-person variability for resuspension as a result of different walking styles.
Methods: In order to improve experimental reproducibility, a comparative experiment was designed and then conducted using a mechanical resuspension mechanism in a controlled indoor chamber instead of involving human participant. Developed by the Lawrence Berkeley Laboratory, the resuspension mechanism is comprised of heel and toe plates controlled by electric actuators to simulate the human foot step.
Results: This study directly compares the results of the resuspension mechanism and of a human participants obtained by Qian and Ferro (2008) and Manthena et al (2008) to validate the method. The data are statistically analyzed to determine the effects of the factors tested.
Conclusion: Conclusion will be draw based on the results.

O-29A6-4

Environmental Assessment of the Operating Rooms: Microclimatic Measurements

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Background/Aims: Among the physical risks in the operating room thermohygrometric conditions and degree of thermal comfort environment are of great significance. It is a quality requirement that the microclimatic conditions must meet the needs of operators as well as of users.

The aim of this study was to verify the significant parameters for the correct functioning of the complex hygienic, technical, and structural in operating rooms for implement corrective and preventive actions in order to perform adequate and appropriate standards.

Methods: The microclimatic parameters considered, ambient temperature forced air (°C), relative humidity (%), mean radiant temperature (°C), speed area m/s, turbulence intensity (%), were detected by "TECORA HSA-832 microclimatic station." Monitoring was performed every 6 months in 13 operating rooms of 2 operating blocks in a Sicilian Hospital. For the assessment of staff thermohygrometric comfort, the environmental audits were carried out during operation; the air flow from each air conditioning vent in operating rooms, for determining the number of air changes per hour, were made under conditions of operating room ready or "at rest." These methods were performed as indicated by the "guidelines ISPESL" standards of safety and hygiene in the surgery department.

Results: The air temperature was maintained in the reference limits (20°C–24°C). The relative humidity for 80% of the cases is within the reference values (40%–60%), while the air velocity is under reference value (0.05 m/s) in 8 rooms. The remaining values are satisfactory. In all the rooms sampled, the air changes/hour meet the guidelines of DPR 14.01.97 (15 parts/h).

Conclusion: The results do not always show satisfactory microclimatic parameters. In these cases, after a review of ventilation systems, was provided a further assessment of close periodic environmental microclimatic parameters.

O-29A6-5

Nucleation of Nanosized Particles (3–100 nm) From Ozone and D-Limonene Reaction

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Background/Aims: Indoor aerosol particles have been shown to contribute to building occupants' health issues, such as asthma or airway irritation. Currently, a considerable effort has been devoted to understand how health effects associated with aerosol exposure, especially with nano-sized particles. Nevertheless, until recently, there was little information regarding freshly nucleated particles with diameters less than 10 nm due to instrumentation limitation.

Methods: Taking advantage of the latest Scanning Mobility Particle Sizer (SMPS) technology (Model 3936, TSI), which provides real-time particle number and size distribution in the range from 3 to 100 nm, this study characterizes the chemistry of D-limonene reacting with ozone as a source of indoor nucleated particles. A series of experiments were conducted in a 4-L glass chamber with various reactant concentrations (2–4 ppbv for Limonene and 3–20 ppbv for ozone). The study also looked at the effects of cyclohexane, used to suppress the influence of OH radicals produced from limonene and ozone reaction, on particle size.

Results: The study results show a significant effect of reactant levels on particle mass and size. Higher ozone concentration led to an increase in particle number. However, higher limonene levels led to a considerable increase in mass while particle number remained the same. One possible reason for that effect is excess limonene partitioning on to newly formed particles. In addition, more small new particles were formed with the presence of cyclohexane. The formation of nano-sized particles as low as 4.0 nm was observed with the mode growth rate of 10 to 15 nm per 2.5-minute scan during the first 10 to 15 min after limonene was introduced.

Conclusion: The experimental results indicate that at lower levels of limonene and ozone, even smaller particles would be formed with a higher chance of nucleation (3 to −0 nm).

O-30A7-1

Assessment of Indoor Air Quality in US Homes With Infants

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Background/Aims: Infants spend most of their indoor time at home. Residential indoor air quality is not regulated, and the levels of indoor pollution are not widely known. This study investigates air quality of homes with infants and the factors that impact indoor air quality, including the extent that renovation is done in preparation for newborns, in the New England area of the United States.

Methods: In June–October 2009, an assessment of residential indoor air quality was conducted using air monitoring and a survey in the New England area of the United States. Participants were parents of infants aged 0–6 months. All 53 participants completed a phone survey to identify the pollutant sources in the home. Total volatile organic compounds ($TVOC_s$), carbon dioxide (CO_2), carbon monoxide (CO), and particulate matter with aerodynamic diameter $_{0.5}$ levels were monitored in the room where the infants spend the most time in 10 homes over 3–7 days.

Results: Air monitoring data showed no typical pattern of any pollutants measured in the home, except that no homes had high CO levels. All homes monitored had at least 1 day with a daily $PM_{0.5}$ >11 $\mu g/m^3$, which is 1 non-governmental threshold for recommended action in homes with sensitive populations. Thirty percent of homes had at least 1 $PM_{0.5}$ daily average >35 $\mu g/m^3$. Half had at least 1 daily average CO_2 level >750 ppm. For 40% of homes, daily TVOC levels were >3000 $\mu g/m^3$, a threshold for recommended action. TVOC levels rose above the recommended threshold for sensitive groups (1500 $\mu g/m^3$) at least 1 day in the monitoring period in 70% of the homes.

Conclusion: While there are no standards for indoor residential air quality, these measured levels suggest that additional research is needed to assess indoor pollution exposure for vulnerable or sensitive populations.

O-30A7-2

The German Environmental Survey for Children (GerES Iv): Plasticizers in House Dust of German Homes With Children

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Background/Aims: The German Environmental Survey for Children (GerES IV) is a nation-wide population study aiming at generating representative data on the exposure of German children to environmental pollutants. GerES IV was conducted from 2003 to 2006 and was performed jointly with the National Health Interview and Examination Survey for Children and Adolescents (KiGGS), conducted by the Robert Koch Institute.

Methods: A total of 1790 children, aged 3–14, from 150 communities participated in GerES IV. The research program comprised of monitoring of the domestic environment and standardized interviews of the parents. In a sub-sample of 600 homes 11 phthalate and 7 non-phthalate plasticizers were quantified in house dust samples (content of vacuum cleaner bags, 63 μm fraction).

Results: On average, dust samples contained 500 mg/kg Di(2-ethylhexyl)phthalate and 119 mg/kg Diisononyl phthalate. The concentrations of all other 9 phthalates summed up to 129 mg/kg. On the whole, the concentration of all 7 non-phthalate plasticizers was 3 mg/kg.

Nevertheless, GerES IV data indicate a profound increase of phthalate substitutes like Diisononyl 1,2-cyclohexanedicarboxylic acid in dust samples, even within the survey period (maximum value 110 mg/kg). Moreover, comparisons to other studies suggest a decline of traditional phthalates, eg n-dibutyl phthalate (n-DBP), in house dust. Bivariate

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evaluations revealed spatial differences of the phthalate content in house dust within Germany.

Conclusion: GerES IV data representatively describe the concentration of various plasticizers in the house dust of German homes with children. House dust monitoring is appropriate for detecting new plasticizers in home environments and may in addition represent 1 exposure pathway relevant for children.

We thank all children and parents who participated in GerES IV. The financial support of the Federal Ministries for the Environment, Nature Conservation and Nuclear Safety and of Education and Research is gratefully acknowledged. GerES IV field work was carried out by the Robert Koch Institute.

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O-30A7-3

Estimating the Indoor Levels of Decabromodiphenyl Ether

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Background/Aims: Since 1970s, polybrominated diphenyl ethers (PBDEs) were widely used as fire retardant for various products, and PBDEs tended to leach out during product usage, thus causing pollution in the ambient environment. Because PBDEs-containing products are often used in offices, cars, homes, and other indoor environment, direct exposure to PBDEs appeared likely in the general population. Among all congeners, decabromodiphenyl ether (BDE-209) is the most stable and most widely used compound in all PBDE congeners; however, in past studies relatively little information was available for BDE-209 due to difficulties in analytical procedures.

Methods: In this study, we analyzed BDE-209 with high-performance liquid chromatography equipped with an ultraviolet detector (HPLC/UV). Indoor dust samples were collected to estimate levels of BDE-209 from local homes, offices, research laboratories, and automobiles. The samples were collected with a vacuum cleaner, dried and screen-sieved before taken to microwave extraction with HPLC-grad acetone. Instrumental settings included the use of Zorbax Eclipse XDB-C18 column (4.6 × 150 mm, 3.5 μm), 100% HPLC-grade methanol as the mobile phase at 1 mL/min, a sample injection volume of 10 μL via autosampler, and a sample analysis time of 12 minutes, and the UV-detector wavelength set at 290. BDE-209 appears at approximately 8.9 minutes after injection, and the instrumental calibration was carried out for 0.6–60 μg/mL range.

Results: In all, 34 valid dust samples were collected and analyzed. The samples came from private homes, offices, laboratories, and cars. All samples were detected with BDE-209, and the concentrations ranged between 1100 and 16,000 ng/g (dry weight).

Conclusion: Overall, the concentration ranges overlap among different indoor environmental settings, but dust samples from various cars appeared to have higher levels than from other indoor environments. Further studies are warranted to examine whether the pollution levels obtained in this study is adequately representative of indoor environmental levels in southern Taiwan.

O-30A7-4

Wheeze During the First 18 Months of Life: A Prospective Cohort Study to Explore the Associations With Indoor Nitrogen Dioxide and Formaldehyde—Preliminary Results

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Background/Aims: To examine whether exposures to nitrogen dioxide (NO_2) and formaldehyde at home increase the risk of wheezing in the first 18 months of life.

Methods: Young infants born in Hong Kong during 1 April 2008 to 31 March 2009 were recruited from Maternity and Child Health Centers into a prospective cohort. Parents were interviewed with the modified International Study of Asthma and Allergies in Childhood questionnaire to obtain baseline information on respiratory health, as well as family and home environment characteristics when the infants were 4 months old. The indoor air levels of NO_2 and formaldehyde were measured in the bedrooms of the infants at 5 months. With the aid of a respiratory health diary parents recorded and reported respiratory symptoms and illnesses of the infants until they were 18 months old through monthly telephone interviews. New onset wheezing was used as outcomes, and Cox proportional hazards model was used to document the effects of NO_2 and formaldehyde on the risk of wheeze after adjusting for possible confounders.

Results: Of the 544 infants recruited into the cohort with baseline exposure measurements on NO_2 and formaldehyde, 179 have been followed up to 18 months by mid-March 2010, and 31 (17.3%) reported new onset wheezing during follow-up. In the Cox model adjusted for gender and family history of asthma, exposure to indoor formaldehyde was significantly associated with new onset wheezing. The result indicated that for every 10 $\mu g/m^3$ increase in formaldehyde concentration, the risk of new onset wheezing increased by 5.1% (95% CI: 1.1%–9.3%). NO_2 did not appear to have an independent effect on the outcome.

Conclusion: Indoor formaldehyde exposure was associated with the new development of wheezing in the first 18 months of life.

O-30A7-5

Sources of Glycol Ether Exposure at Home

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Background/Aims: Glycol ethers are a group of globally consumed high-production-volume chemicals with wide uses in consumer products and building materials. Despite their well-demonstrated endocrine disrupting properties in several animal species, possible human health effects remain mostly unknown. Furthermore, indoor sources and occupant behavior that modify emission and/or retention have never been examined. Thus, we investigated indoor sources and lifestyle practices that contribute to an elevated indoor level of glycol ethers within 390 homes of preschool age children in Sweden.

Methods: In a case-control investigation of 198 cases with multiple allergic symptoms and 202 healthy controls, air samples were collected in the room where the child spent most time. The air samples were analyzed for the levels of 8 classes of volatile organic compounds. Six home environment inspectors visually examined each home for water damages, presence of mold odor, building's structural characteristics, indoor temperature, relative humidity, and air exchange rate.

Results: Frequent use of water-based cleaning agent and recent history of repainting at least 1 of the rooms significantly contributed to an elevated glycol ether concentrations at home. When the subjects were restricted to those who live in concrete-based structure, self-reported dampness in the concrete-based homes were associated with an elevated mean GGE concentrations. The indoor concentration of glycol ethers were further elevated in homes with highest quartile relative humidity or temperature.

Conclusion: Multiple sources and human behavior contribute to home glycol ethers levels. Intervention efforts targeting behavior change of residential occupants might reduce glycol ether concentrations in the indoor air.

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PP-29-130

Effects of Emissions From Cedar Timber on Psychological and Physiological Factors in Indoor Environment

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Background/Aims: Improvements in health conditions or symptoms of occupants have been observed after installing indoors the natural wood timber not laminated or composited. However, the scientific evidence has not been almost cleared. Effects of cedar timber as a material for controlling humidity and contamination in indoor environment have been reported. Effects of components extracted from cedar timber on reducing human stress have also been reported. Hence, if positive influence due to cedar timber in indoor environment could be scientifically available, indoor environment that contributes to health improvement or promotion could be proposed. Our purpose of this study is to evaluate the effects of emissions from cedar timber on psychological and physiological factors in indoor environment.

Methods: A case control study was conducted in which 10 subjects on crossover design occupied in 2 rooms controlled on interior materials, indoor climate, and room size. Cedar timber was installed in one of the rooms and covered by curtain so that the subjects could not notice it. Salivary amylase, salivary cortisol, blood pressure, and heart rate variability were measured, and a questionnaire survey on psychological factors was conducted. Indoor volatile organic compounds were also measured.

Results: We found higher mean concentrations of cedrol and β-eudesmol in indoor air among cases than among controls (4.5 vs. 0.08 $\mu g/m^3$ and 6.3 vs. 0.02 $\mu g/m^3$, respectively). No significant differences were found in amylase activity, cortisol concentration, blood pressure, and heart rate variability between both subjects. In a questionnaire survey on psychological factors, no significant differences were also found in tension, depression, anger, vigor, fatigue, and confusion. A significant decrease in vigor was found in the control subjects between before and after entering the room but such decrease was not found in the case subjects.

Conclusion: Our result showed a slight change on vigor in short-term exposure to cedar timber.

PP-29-131

Dampness, Food Habits, and Sick Building Syndrome Symptoms Among Elementary School Pupils

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Background/Aims: We investigated the dampness/mold in schools and dwellings, food habits, and presence of subjective symptoms among elementary school pupils in Japan in order to clarify the relationship between dampness and food habits on subjective symptoms in elementary school pupils.

Methods: Questionnaires were used to investigate the dampness in classrooms and dwellings in Hokkaido, Japan, and its effect on subjective symptoms involving 1077 pupils in 8 elementary schools. A dampness index for both the home and classroom was estimated by the sum of the presence of 4 dampness indicators: (1) visible mold, (2) moldy odor, (3) water leakage, and (4) condensation on windowpanes. The Questionnaire contained queries about food habits as follows: the frequency of eating breakfast, whether the energy provided by school lunch was sufficient, and whether too many snacks and/or sweets were consumed.

Results: The home dampness index was significantly related to cough, general symptoms, and any symptoms; the classroom dampness index, the number of positive classroom dampness indicators were significantly related to nose symptoms in fully adjusted models. In addition, usually not eating breakfast was significantly related to eye symptoms, and having too many snacks and/or sweets was significantly related to eye, nose, and general symptoms.

Conclusion: Both home and classroom dampness can affect pupils' health. Home dampness, in particular, was significantly related to cough and general symptoms, and classroom dampness was significantly related to nose symptoms. Furthermore, favorable food habits have a positive effect on pupils' subjective symptoms. However, further studies are required to investigate the dampness environment and lifestyle factors to improve pupils' health.

PP-29-132

Evaluation of Formaldehyde Guideline Values for Indoor Air

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Background/Aims: Among the large variety of gaseous indoor pollutants, formaldehyde has always had an exceptional position. In recent years, many countries and organizations have developed concepts for the evaluation of indoor air quality. At present, a number of highly visible, indoor-related formaldehyde guidelines exist worldwide, but the problem is that different criteria are applied by different bodies.

Methods: In this study, available guideline values are critically compared and discussed. Guidelines are generally based on toxicological or statistical criteria. Health-related values can be roughly categorized into 2 groups based on exposure durations. The short-time levels are used for preventing acute effects on individuals, whereas long-term levels are used for preventing the chronic effects of formaldehyde. The statistical evaluation requires representative data sets.

Results: Formaldehyde allowable concentrations proposed by guidelines continuously decreased with time, but current recommendations range from approximately 0.001–0.15 ppm. It is, however, interesting to note that Germany and the World Health Organization recently confirmed their values of 0.1 ppm (from 1977) and 0.08 ppm (from 1987), respectively. Emission of formaldehyde from building products and consumer goods has also been limited by authorities and by voluntary criteria. An evaluation of recent emission studies and indoor surveys carried out in industrialized countries has demonstrated that the situation has improved due to the efforts done over recent decades. An examination of international studies indicates that the average exposure of the population to formaldehyde seems to lie generally below 0.05 ppm and it seems questionable whether formaldehyde concentrations lower than 0.02 ppm can be permanently achieved under normal living conditions.

Conclusion: No one will reasonably doubt that formaldehyde is a relevant indoor pollutant. Regulations are urgently required, but it should be discussed if the lower guideline value is always the most appropriate one. Focusing too much on a single compound could also be counterproductive for human health.

PP-29-133

Effect of Essential Oil on Heart Rate and Blood Pressure Among Healthy Subjects in Classroom

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[3]*Department of Cosmetic Application and Management, St. Mary's Medicine, Nursing and Management College, Yilan, Taiwan.*

Background/Aims: The purpose of this study was to investigate the effect of essential oil on heart rate and blood pressure in healthy subjects.

Methods: We recruited a panel of 60 healthy students from a university in Taipei. Between July and August 2009, 3 measurements were made in each student of heart rate (HR), systolic pressure (SBP), and diastolic blood pressure (DBP). Participants exposed to essential oil vapor generated from an ultrasonic atomizer in the classroom for 30 minutes. Total volatile organic compounds (VOCs) were measured in the classroom during the study periods. We used linear mixed-effects models to associate total VOCs with HR, SBP, and DBP.

Results: We found that increases in levels of essential oil exposure were associated with decreases in HR, SBP, and DBP. For an interquartile increase in total VOCs, there were 2.2 beats/min decreases in HR, 2.1 mmHg decreases in SBP, and 1.3 mmHg decreases in DBP.

Conclusion: Exposure to essential oil was found to be an effective method of relaxation, as indicated by decreases in HR and BP of young healthy students.

PP-29-134

A Follow-up Study on Mood States, Symptoms, and Chemical Exposure Levels of Multiple Chemical Sensitivity Patients

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Background/Aims: Various studies about multiple chemical sensitivity (MCS) have been conducted until now. However, the association between chemical exposure and MCS remains unknown. The objective of this study was to examine the relationship between the patients' personal exposure levels (aldehydes and volatile organic compounds [VOCs]) and the recuperation of MCS symptoms, and examine whether mood states affect the relationship.

Methods: MCS patients who were diagnosed at Kitasato Institute Hospital between January and March 2007 are the study subjects. Indoor and personal exposure measurements of VOC and aldehydes during 1 week had been conducted every month since January to September 2007, and also MCS-related symptoms and mood states of the patients were investigated by using QEESI (the Quick Environmental Exposure and Sensitivity Inventory) and POMS (Profile of Mood States) questionnaire, respectively.

Results: No positive relationship was observed between the exposure levels and the recuperation of MCS symptoms. It might be due to the seasonal variation of Masking Index score or the autonomic nervous system function. It was suggested that 4 moods, such as tension-anxiety, depression-dejection, fatigue, and confusion, were related to the reduction in MCS symptom score.

Conclusion: The effect of moods on the relation between exposures and symptoms was not found.

PP-29-135

Primary Products Emitted From Evaporating Essential Oils and Potential Secondary Pollutants From Their Reactions With Oxidants

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Background/Aims: Essential oils, predominantly comprised of a group of aromatic chemicals, have attracted increasing attention as they have been applied into indoor environments through various forms of consuming products by different venues. Studies suggested that high levels of terpenes would be emitted into indoor air and easily interact with oxidants in general environments to generate consequently a variety of secondary organic pollutants in gas and particle phase. Our study therefore used a chamber study to characterize primary volatile organic compounds emitted by evaporating essential oils and potential secondary pollutants including SOAs and formaldehyde yielded from interaction with airborne oxidants.

Methods: A chamber, equipped with heating plate controller, was adopted for this study. Lavender oil was selected in first-phase test for it was the best-sold oils in Taiwan. Two different levels of ozone (18 and 36 ppb), which represent the general indoor ozone levels, were injected into the chamber and following with evaporating essential oils. Particles size and concentrations were continuously monitored during mixing process using aerodynamic particle seizer. Volatile organic compounds and formaldehyde were sampled by using Tedlar bag and DNPH tube and analyzed by Gas Chromatograph-Mass Spectrometer and HPLC.

Results: Our findings indicated the size distribution of SOAs when mixed with essential oils and ozone were mostly fine particles with about 99% particles $\leq$ 2.5 μm and 96% $\leq$ 1 μm. The maximum aerosol number concentrations could reach to 6×10^3 and 10 particles/cm^3 and maximum formaldehyde reach to 4.59 ppm and 10.67 ppm during the reaction process in 18 ppb and 36 ppb ozone levels.

Conclusion: Our study provided a strong evidence to suggest that high levels of fine particle and formaldehyde might be produced when coexisting with emission of essential oils emissions and low concentration oxidants in the air, and consequently result in adverse health concerns for those using essential oils in general indoor environments.

PP-29-136

Prevalence of Asthma, Atopic Dermatitis, and Rhinitis and MVOC Exposure in Single Family Homes—A Survey in 6 Cities of Japan

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Background/Aims: Microbial volatile organic compounds (MVOC) are a range of volatile organic compounds produced by microorganisms. According to previous reports, exposure to various MVOC at school was associated with asthmatic symptoms in pupils and a history of asthma among school employees. However, the relationship between MVOC exposure at home and allergies in inhabitants remains unknown. The aim of this study was to investigate the relationship between allergic symptoms and selected MVOC exposure in single family homes.

Methods: This study is based on a survey conducted in 2006. Subjects were 624 inhabitants of 182 detached houses in 6 cities of Japan. Air samples were collected using diffusive samplers for 48 hours, and the concentrations of 8 selected compounds were analyzed by Gas Chromatograph-Mass Spectrometer (SIM). All inhabitants of the dwellings were given a self-administered questionnaire on age, sex, and medications for bronchial asthma, atopic dermatitis, and allergic rhinitis within the past 2 years. Adult inhabitants were also asked to fill out questions regarding housing characteristics.

Results: The most frequently detected MVOC was 1-pentanol at a median concentration of 0.60 μg/m^3. Among the 609 subjects who completed

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questions about allergies, the prevalence of asthma, atopic dermatitis, and allergic rhinitis was 4.8%, 9.9%, and 18.2%, respectively. No difference was found among genders, but a higher prevalence was obtained among younger subjects. A significant association between rhinitis and 1-octen-3-ol (per log10-unit: odds ratio, 2.02; 95% confidence interval: 1.05–3.87) was obtained after adjusting for age, sex, environmental tobacco smoke, and dampness index. No MVOC was related to asthma or atopic dermatitis after adjustment.

Conclusion: According to the results of experimental volunteer 1-octen-3-ol exposure, mucosal irritation of airways was observed. Although indoor air concentrations of 1-octen-3-ol in this study were relatively low, exposure may cause irritation in inhabitants and evoke a rhinitis.

PP-29-137

Relationship Between Building Materials, Structure and Volatile Organic Compounds Indoor Air

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Background/Aims: Sick Building Syndrome is a series of symptoms such as eye irritation, headache, and throat ache caused in newly built or remodeled buildings. The major causes of sick building syndrome are suspected to be volatile organic compounds (VOCs) indoor air. To solve this problem fundamentally, we built a model town called "Chemiless Town" in the university campus.

Methods: In all, 78 indoor air samples were collected at 8 rooms in 4 experimental houses for over 3 years of period, and 116 VOCs (63 VOCs, 42 SVOCs, and 11 aldehydes) were analyzed and calculated. The structural and interior materials of House A are light gauge steel and gypsum plaster. Those of House B are wood and spruce treated with high temperature. Those of House C are wood and plaster, and those of House D are wood and spruce.

Results: The total of 116 VOCs (TVOCs) in the House A were 520 $\mu g/m^3$ in April 2007, 225 $\mu g/m^3$ in April 2008, and 37 $\mu g/m^3$ in May 2009. The TVOCs in the House B were 1178 $\mu g/m^3$ in March 2007, 560 $\mu g/m^3$ in April 2008, 133 $\mu g/m^3$ in May 2009. The TVOCs in the House C were 2151 $\mu g/m^3$ in April 2007, 661 $\mu g/m^3$ in April 2008, 296 $\mu g/m^3$ in May 2009. The TVOCs in the House D were 14,776 $\mu g/m^3$ in April 2007, 1046 $\mu g/m^3$ in April 2008, 306 $\mu g/m^3$ in May 2009.

Conclusion: It became clear that the effect of structural and interior material of a house on TVOC is extremely big. The TVOC of House A was the lowest among the 4 houses because the structural material is steel, and the wall is made of gypsum plaster. The highest TVOC was found in House D since the structural and interior materials are all spruce. On the other hand, in the House B, the spruce of interior was treated with high temperature and the TVOC was decreased.

PP-29-138

Confort in the Hospitalization Rooms

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Background/Aims: In the process of hospitals accreditation, which aims to improve the quality of services provided to users, inside structural requirements that need attention, there are the microclimatic conditions in the hospitalization rooms to guarantee the best comfort possible to patients. Do not exist at the present uniform quality standards for hospital rooms. It was therefore appropriate to conduct a study on the actual state of microclimatic conditions existing in hospitals in Italy with the aim of monitoring the status quo and identify the possibility of the adoption of measures to ensure or improve the quality of the environment residence of patients, and derive the standard of microclimatic comfort to propose.

Methods: The study, which involved hospitals in Rome, Cosenza, Sassari, Palermo, Catania, Messina, was conducted during the winter and summer from 2005 to 2008 with the adoption of an operational protocol, which has defined the procedures to conduct monitoring. The recorded parameters were temperature, air velocity, relative humidity, lighting, and through appropriate software, the microclimatic indexes PMV, PPD, TOC, and TE. Finally, the opinion provided by the objective indexes of thermal comfort was compared with the subjective sensation of comfort expressed by patients. The principal hospital rooms monitored were reanimation, surgery, and internal medicine.

Results: The results evidenced that average temperatures are around 23°C–24°C with increases of about 1°C–2°C during the summer, humidity values are generally within the limits of normality. The values of PMV often results in negative values indicating a high degree of dissatisfaction. In contrast, the majority of patients indicated a comfort sensation.

Conclusion: The obtained values were processed to set optimum range for hospitalization rooms to be included in the Italian legislation.

PP-29-139

A Study on the Formaldehyde Removal Efficiency Using Nano-sized Carbon Colloids

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Background/Aims: In this study, a carbon nanocolloid based on water was produced by an electrochemical method that is relatively simple and cheap. Then, the removal efficiency assessment of formaldehyde, which is an indoor air pollutant, was studied through filter tests using a chamber.

Methods: Three kinds of carbon nanocolloids produced in this study were treated on medium filters made of nonwoven fabric. After the treated filter was fixed in the middle of the chamber (made of stainless use steel), 5 ppm of formaldehyde standard gas and zero gas (9:1) flow into the chamber. Gas penetrated through the filter was collected, and its formaldehyde concentration was analyzed by high performance liquid chromatography. In addition, field applicability was evaluated through a comparison study using a normal carbon filter.

Results: Distilled water was used as an electrolyte, and the density of graphite used for the electrodes was 1.65 g/cm^3. The carbon nanocolloids were produced through electrolysis under 15–30 V. Resulting from transmission electron microscopy analysis, sonication-treated carbon nanocolloids showed the clearest images. Through filter tests using a chamber, which is made of stainless use steel, filters damped in carbon nanocolloids treated by sonication indicated the best formaldehyde removal efficiency, 44.47 μg of HCHO removed/g of carbon and 19.28 μg of HCHO removed/g of carbon, compared to the control experiment using a normal carbon filter, 1.45 μg of HCHO removed/g of carbon.

Conclusion: In conclusion, carbon nanocolloids were applicable in the removal of formaldehyde, one of the most harmful substances indoors, which means carbon nanocolloids can be used for the removal of other indoor air pollutants, such as radon, Volatile organic compounds, or odors.

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PP-29-141

Indoor Air Pollution in Different Mongolian Dwellings and Children's Health in Ulaanbaatar (Mongolia)

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Background/Aims: The capital city of Mongolia, Ulaanbaatar, has experienced a recent period of urbanization and population growth, which has resulted in increased pressure on the environment and public health, and on the city to provide necessary infrastructure. Survey data indicated that air pollution in Ulaanbaatar is higher in the winter months. High levels of emissions from the increased burning of fossil fuels over the winter, contribute to the outdoor and indoor air pollution.

Objective: The aim of the study was to determine the prevalence of asthma, bronchitis, and other respiratory symptoms in children, and to identify factors that may affect the indoor air quality in different types of dwellings.

Methods: A cross-sectional study was designed to determine the prevalence of respiratory diseases in children, and describe some of the environmental factors to which those children are exposed (for example, type of residence, type of heating used, levels of indoor smoking). A modified questionnaire of the *American Thoracic Society* 3 was used with questions including age, gender of the child, education of parents, family income, health status of parents and siblings, parental and maternal smoking, ventilation, and type of heating and cooking.

Results: The study recorded high levels of diagnosed bronchitis (19%) and reported respiratory symptoms (77.8%). Results indicated that more than 50% of households' burnt fossil fuels on a daily basis and almost 60% reported regular smoking indoors. There were 59.2% of households with at least one smoker; of these, 86% smoked every day. Almost one-third of households had smoking visitors at home. Despite major differences in the use of fossil fuels, respiratory symptoms were similar across all dwelling types. The high prevalence of respiratory symptoms and bronchitis in this study suggests that indoor air pollutants are probably having a detrimental effect on the respiratory health of children in Ulaanbaatar. Wood and coal were the main source of cooking and heating fuels in Mongolian dwellings, electricity was used for cooking in 38% of ghers and houses.

Conclusion: The rates of diagnosed bronchitis and reported respiratory symptoms reported in this study indicate that these are major health problems in Ulaanbaatar. Questionnaire results indicated that more than 50% of households burnt fossil fuels on a daily basis, almost 60% of dwellings had regular cigarette smoking and almost all dwellings had no active ventilation in winter time. All of these factors can contribute to the production of air pollutants such as SO_2, CO, PM_{10}, and nitrous oxides. The major health effects of these common indoor air pollutants, expected from the burning of fossil fuels and cigarette smoke, are respiratory effects. The high prevalence of bronchitis and respiratory symptoms in this study suggests that indoor air pollutants may be having a detrimental effect on the respiratory health of children in Ulaanbaatar. The level of bronchitis and respiratory symptoms in apartments indicates that factors other than the burning of fossil fuels within the dwelling, such as smoking and outdoor air pollution, need to be considered.

PP-29-142

Investigation of Flooring and Particle Composition Factors in Human Activity Induced Resuspension

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Background/Aims: Because people spend most of their time indoors, identifying the sources and concentrations of indoor pollutants is important to understand human exposure. Resuspension of settled particles through human activities is known to be an important source of indoor particulate matter. Previous studies have found that resuspension rates vary by several orders of magnitude depending on the type of activity, and there is large person-to-person variability within a given activity. This study standardizes the resuspension mechanism by using a mechanical foot device to resuspend particles and test the effect of various factors.

Methods: Factors tested include 4 types of flooring (wood, vinyl, low density carpet, and high density carpet), 2 types of particles (common house dust and Arizona ultrafine test dust), 2 absorption times (short and long), and 2 types of shoe bottom (rubber with grooves and hard flat). The flooring is seeded with the test particles and the mechanical device that mimics a person walking is used in the chamber. The particle concentration is measured with size-resolved, semi-continuous optical particle counter.

Results: Resuspension rates are calculated and the effects of each factor and 2-factor interactions are identified.

Conclusion: Comparisons are made to resuspension wind tunnel studies performed using the same floorings and particle types.

PP-29-143

Indoor Air Quality Improvement Following Interventions in Wood Stove Homes

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Background/Aims: This study uses in-home wood stove interventions to assess the effect of indoor biomass smoke on asthmatic children. Indoor air exposure assessment results from the first group of participating homes are presented here.

Methods: Baseline and post-intervention indoor air sampling measures were conducted in 11 homes during the 2008/2009 and 2009/2010 winters. Homes were randomized to 1 of 3 interventions: new wood stove, air filter, or inactive (placebo) filter. New Environmental Protection Agency-certified wood stoves were successfully installed in one-third of homes, and residents were trained in the proper usage of the new product. Filtrate units (3 m) with either high-efficiency particulate air or placebo filters were placed in homes according to their assignment and monitored for compliance using voltage meters and vibration counters. Air sampling included continuous monitoring of $PM_{2.5}$ mass in the common area and the child's bedroom using DustTrak (TSI). Particle counts of various size fractions were also collected using Lighthouse meters (TSI).

Results: The mean (standard deviation) $PM_{2.5}$ concentration during the pre-intervention winter for all homes was 36.6 (20.6) $\mu g/m^3$. Pre-intervention measures did not differ between homes assigned to air filter (29.3 [6.8] $\mu g/m^3$) and placebo interventions (26.1 [12.7] $\mu g/m^3$), but homes assigned to the woodstove intervention had higher baseline $PM_{2.5}$ concentrations (52.5 [26.1] $\mu g/m^3$). Post-intervention, homes receiving the active filter intervention demonstrated a greater reduction in $PM_{2.5}$ concentrations (74.3%, 95% confidence interval [CI]: 22.1%, 126.6%) relative to placebo homes. Homes receiving wood stoves also saw substantial $PM_{2.5}$ reductions (26.9%, 95% CI: −21.5%, 75.2%). Similar findings were observed for $PM_{2.5}$ particle counts.

Conclusion: In this study, results for the first wave of homes enrolled in this 108-home randomized trial are presented. With so few observations, imprecision in preliminary comparisons was anticipated, but these initial findings indicate interventions will achieve intended improved indoor air quality.

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PP-29-144

Distribution of Airborne Bacteria and Fungi in the Korean High-speed Train Indoor

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Background/Aims: It is known that the airborne bacteria and fungi can be the cause of a variety of infectious diseases as well as allergic and toxic effects. The purpose of this study is to find the typical concentration levels of bacteria and fungi in Korean high-speed train between Seoul and Busan (408.5 km).

Methods: Samples were taken using MAS-100 Eco (MBV AG) air sampler (sampling flow rate 100 L/min) located in the cabin aisle (3 points), passageway (1 point), and toilet (1 point) at a height of 1.0 m above the floor. The 6-stage Andersen impactor was also used to figure out the size distribution of airborne bacteria and fungi. All the measurements were conducted in spring time of Korea (March 2010).

Results: It was found that the concentration level of airborne bacteria was 98–173 CFU/m^3 (average 148 CFU/m^3) and airborne fungi was 64–98 CFU/m^3 (average 86 CFU/m^3) in the train indoor. The concentration of airborne bacteria was higher than that of fungi by 1.7 times. The highest concentration of bacteria was observed in the cabin aisle, 173 ($\pm$ 109) CFU/m^3, and the similar level of fungi was observed in the passageway and toilet as 97 ($\pm$ 39) and 98 ($\pm$ 63).

Conclusion: In the Korean high-speed train, the concentration level of airborne bacteria was less than 200 CFU/m^3 and the level of airborne fungi was less than 100 CFU/m^3 in spring time. More surveys in different seasons are undergoing to evaluate the typical level of airborne bacteria and fungi in the train.

PP-29-145

Analytical Methods for Personal Exposure to $PM_{2.5}$, Particulate Polycyclic Aromatic Hydrocarbons, and Solanesol

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Background/Aims: The health effects of airborne particulate is concerned recently. There are many emission sources of particulate. Among them, environmental tobacco smoke (ETS) is one of the important sources. Polycyclic aromatic hydrocarbons (PAHs) are the typical carcinogens in the air, and they are detected in ETS. But PAHs generate from incomplete combustion such as boilers, cars, cooking, and so on. Solanesol is an aliphatic alcohol that is emitted mainly from burning of tobacco, and therefore it is one of the marker of ETS. To estimate ETS contribution of exposure amounts to $PM_{2.5}$, solanesol concentration will be a useful marker. Thus, we have developed simultaneous determination of $PM_{2.5}$, PAH, and solanesol.

Methods: $PM_{2.5}$ are collected by cascade impactor with personal low-noise pump. PAHs and solanesol are extracted with dichloromethane in a ultrasonic bath. For analysis of PAH, solvent of a part of the solution exchange to acetonitrile, and for analysis of solanesol, solvent of another part of the solution exchange to methanol. PAHs are separated and analyzed with HPLC/spectroflurometer. Solanesol is separated and analyzed with HPLC/spectrometer.

Results: We have investigated them in and out of the smoking room in Japan. These compounds can be detected in smoking room, but solanesol cannot be detected out of the smoking room.

Conclusion: We conclude that we can develop useful method for $PM_{2.5}$ and its ETS contributions. We have also confirmed the effectiveness of the separate smoking room.

PP-29-147

An Overview on Indoor Air Pollution, Its Adverse Health Effects, and Intervention Measures in Rural China

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Background/Aims: To understand the status of indoor air pollution (IAP), its adverse health effect and the intervention measures against IAP in rural China, and provide a clue for the further research and prevention.

Methods: Literatures about IAP, its adverse effect and related intervention measures in rural areas of China published in Chinese language from 1999 through 2010 were collected and summarized.

Results: In rural areas of northern China, coal burning for household heating in winter is the major impacting factor of IAP for the moment. Moreover, type of fuels, status of combustion and ventilation, and house structure can also put an important influence on indoor air quality. For this reason, the level of IAP in rural areas of China may vary in regions and seasons. It is concluded that there is certain relationship between IAP and the prevalence of COPD, lung cancer, as well as some respiratory symptoms and decrease of women lung function. When it comes to intervention actions, using improved stoves and clean energy can directly and effectively improve indoor air quality. Furthermore, health education, behavior intervention, and social mobilization were provided to achieve the purpose of improving indoor air quality by helping people change unhealthy lifestyle.

Conclusion: Household fuel burning is the main source of IAP in rural China. IAP can affect the residents' health, causing diseases such as COPD, lung cancer, and so on. The measures such as furnace and stove improvement, health education and behavior intervention, development and use of clean energy, social mobilization can attenuate indoor air pollution.

PP-29-148

The Prevalence Rates of Reported SBS Symptom and Gender: A Case Study in a Middle School

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Background/Aims: To describe the gender difference on the reported SBS symptom in a middle school case study.

Methods: All students in Grade 1 and Grade 2 were selected in middle school A, Beijing. The SBS symptoms in past 1 year and in past 1 week were reported by the self-filling questionnaire. Finally, 385 students finished. Of them, 50.9% were boys and 49.1% were girls. A total of 165 students in Grade 1 finished reporting on 6 main SBS symptoms at exactly same point in 3 successive days in spring, summer, and winter. Database was established with Epidata 3.0. Logistic regression and fitted hybrid linear model provided by SPSS/PC13.0 were used.

Results: Reported prevalence rates of SBS symptom both in past 1 year and past 1 week were closely related to the gender. After controlling other factors, reported prevalence rates of fatigue, eye itch or dry, overall SBS symptoms for girls in the last year were 1.851 times (OR = 1.851, P = 0.007), 1.672 times (OR = 1.672, P = 0.055), 1.600 times (OR = 1.600, P = 0.070) of those for boys, respectively; and the reported prevalence rates of fatigue, headache for girl in the last week were 1.871 times (OR = 1.871, P = 0.007), 1.685 times (OR = 1.685, P = 0.089)of those for boys, respectively. These results were similar to investigations on foreign adults' SBS symptoms. Fitted hybrid linear model analysis on repeated measure in different seasons indicated that gender was one of the impact

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factors related to the reported strength of SBS symptoms. After controlling other factors, the reported strength of eye itch or dry, concentration difficult, throat sore or dry, stuffy nose, overall SBS symptoms for boys were higher than those for girls, which were not seen any report before.

Conclusion: Gender was related to SBS symptoms. Girls more likely suffered higher reported rates on SBS symptoms, while boys more likely suffered higher reported strength on SBS symptoms. All these indicated that girls had higher reported rates with lower strength threshold, while boys had lower reported rates with higher strength threshold.

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PP-29-149

Survey on the Prevalence Rates of SBS Symptoms in a Middle School, Beijing

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Background/Aims: To understand the reported prevalence rates of SBS symptom of students at the school time, and provide the clue for the improvement of indoor environmental quality of the classroom and the studying efficiency.

Methods: We used self-fill questionnaire to inquiry 385 junior high school students in Grade 1 and Grade 2 on their prevalence of SBS symptoms in the last week and the last year. The survey was conducted on 28 May 2007. We input and manipulated the raw data with Epidata 3.0 software and calculated the prevalence rates for each SBS symptom.

Results: The students who reported the SBS-like symptom in the last year and in the last week account for 70.39% and 58.70% of the total students finished the survey. The most reported symptoms are fatigue (50.13%), concentration difficulty (29.62%), nose stuffed (28.90%), headache (25.45%), and eye dry or itching (25.20%) in the last year. Meanwhile the most reported symptoms are fatigue (47.79%), concentration difficulty (26.50%), eye dry or itching (17.40%), headache (15.84%), and dizziness (15.33%) in the last week.

Conclusion: The prevalence rate of SBS symptoms reported in junior students was very high and most reported symptoms were fatigue, concentration difficulty, eye dry or itching, and headache.

PP-29-150

The Analysis on the Impact Factors of SBS by Using Fitted Hybrid Linear Model

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Background/Aims: To analyze the risk factors of the prevalence of reported SBS symptom for junior students at school, and to provide the clue and evidence to improve the health and study efficiency of adolescent students.

Methods: We selected 165 junior students in Grade 1 of School A, Beijing to repeated inquiry their sensory intensity about indoor environmental quality and microclimate of classroom, and the prevalence and the intensity of SBS symptoms (including fatigue, headache, eye itch or dry, concentration difficulty, throat sore, or dry and nose stuffed) at exactly same point in 3 successive days in spring, summer, and winter, respectively. At the same time, we measured the temperature, relative humidity, wind speed, CO, CO_2, PM_{10}, formaldehyde, VOCs, NO_2, and SO_2 in 2 successive days in each season.

Results: The air quality index of classroom in School A was 0.60, 0.72, 1.72 in spring, summer, winter. The air quality classroom was worst in winter. The potential risk factors for SBS symptoms are gender, season, quality of sleep, mental condition, subjective sensation to microclimate of classroom (including temperature and relative humidity), sensation to the indoor air quality (including off-odor and air quality). The risk for increasing reported intensity of SBS symptoms were male, winter, bad sleeping in last night, less than 8 hours sleeping last night, bad mental condition that morning, bad feeling on the temperature and the humidity of classroom, peculiar smell heavily in the classroom, and the bad air quality in classroom.

Conclusion: There is higher prevalence of SBS symptoms in boys than in girls; and the SBS-like symptoms were negatively associated with the indoor air quality in classroom. We should take measures to improve the indoor air quality in the classroom and the quality of students' sleep to reduce the intensity of SBS symptoms.

PP-30-137

Ventilation and Indoor Air Quality in 40 Small and Medium Sized Commercial Buildings in California: Indoor Air Quality Methods and Findings

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Background/Aims: As buildings become increasingly conscientious about energy use related to heating and cooling, it become more important to raise awareness of potential sources of indoor sources of both VOCs and particulate matter. A survey of forty of California's (CA) small and medium sized commercial buildings (SMCBs, 1000–50,000 sq ft, 90–4600 m^2) was conducted to characterize their ventilation and indoor air quality (IAQ).

Methods: The study was designed to include a wide variety of building types, such as offices, retail, restaurants, grocery stores, beauty salons, gas stations, and other building types. A suite of VOCs, aldehydes, and particulate matter were measured inside and outside the buildings over several hours.

Results: Based on the results from the first 21 buildings, mean indoor concentrations for some of the traditionally measured compounds include 0.8 $\mu g/m^3$ for benzene, 9.5 $\mu g/m^3$ for toluene, 22 $\mu g/m^3$ for formaldehyde, and 13 $\mu g/m^3$ for acetaldehyde. The study also included compounds only more recently measured in indoor spaces, reported as median values, such as 2-butoxy ethanol (3.9 $\mu g/m^3$), d-limonene (6.4 $\mu g/m^3$), TXIB (1.0 $\mu g/m^3$), and D5-Siloxane (24 $\mu g/m^3$). There was a considerable range in the actual concentrations for each of the contaminants. The majority of the buildings had indoor/outdoor ratios less than 1.0 for both ultrafine and $PM_{2.5}$. However, some of the buildings had clear indications of indoor PM sources with higher indoor levels than outdoor levels. Results on all 40 buildings will be presented at the conference.

Conclusion: There is considerable variability in the levels of indoor air pollutants across the wide range of building types found in the small and medium commercial building stock. The views expressed are those of the author and not necessarily those of the funding agencies, California Air Resources Board and California Energy Commission.

PP-30-139

Modeling Indoor Air Pollution Concentrations From Stove Emissions Using a Monte Carlo Single-box Model

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Background/Aims: A simple Monte Carlo box model is presented as a first approach toward examining the relationship between emissions of pollutants from fuel/cookstove combinations and the resulting indoor air pollution (IAP) concentrations.
Methods: The model combines stove emissions rates with expected distributions of kitchen volumes and air exchange rates to produce a distribution of IAP concentration estimates. The resulting distribution can be used to predict the likelihood that IAP concentrations will meet air quality guidelines, including those recommended by the World Health Organization (WHO) for fine particulate matter $PM_{2.5}$ and carbon monoxide (CO). The model can also be used in reverse to estimate the probability that specific emissions factors will result in meeting air quality guidelines.
Results: Based on emission factors for an improved wood stove and an improved charcoal stove, the modeled distributions of indoor PM concentration resulted in means of 200 and 1620 $\mu g/m^3$, respectively, with the WHO Interim-1 annual PM guideline of 35 $\mu g/m^3$ exceeded in >99% of model runs for both fuel/stove combinations. Estimates of CO emissions from the improved wood and charcoal stoves resulted in exceeding the WHO 8-hour CO guideline of 10 mg/m^3 in 96% and 98% of model runs, respectively. In contrast, modeled estimates using LPG emission factors resulted in exceeding the same WHO PM and CO guidelines in only 4% and <1% of model runs, respectively.
Conclusion: Comparisons of modeled estimates with measured concentrations of CO indicate the initial model overestimated CO concentrations by 3–8 times, which was thought to be due to incomplete mixing of emissions as the initial model version assumed complete mixing. To address this problem, a study was conducted in rural Indian homes where CO emissions were simultaneously measured with vertically and horizontally stratified concentrations of CO in the kitchen. Results of modeled CO concentration estimates incorporating a mixing factor will also be presented.

PP-30-140

A Study on Concentration of Volatile Organic Compounds at the Senior Facility

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Background/Aims: Due to the centralization of population into the cities and overcrowding of urban population in accordance with industrialization, certain change has come to the environment of residence. Indoor dwelling space has been increased rapidly due to construction of various indoor space, affirmative utilization of basement, and public and private transport (The Ministry of Environment, 2001). WHO (World Health Organization) suggested that the dead by indoor air pollution was up to 50% of outdoor air pollution, and this means that pollutants by indoor air pollution can be transmitted to our lungs 1000 times easier than outdoor air pollutants. The indoor air pollutants such as indoor constructing materials, furniture and living appliances, many cases of research have been performed related to VOCs (Volatile Organic Compounds) occurring hazard and cancer (Cho, Jang-je, 2004, Yang, Ji-yeon, 2007). In case of domestic studies, researches for the indoor air quality at the multiple utilized facilities (2006) and schools, housings, and offices where children and juveniles are living (Jang el, 2006; Son el, 2006) have been performed. However, the domestic researches for senior citizens are insufficient. Therefore, in this study, the author comprehends that the concentration of VOCs identifies the influential factor on their concentration for the senior citizens nursing facilities in Korea.
Methods: (1) Objects of Research: In this study, the author surveyed the characteristics of the facilities and indoor environment for the senior citizens nursing facilities of Kyeonggki and Seoul-total 30 facilities; 10 facilities in Seoul and 20 facilities in Kyeonggki from January to December in 2007. 2. Sample Method: The author collected VOCs of 100 mL/min with MP-S30H (Sibata, Japan) pump twice for 30 minutes, making use of a solid suction tube Tenax-Ta of 200 mg is charged. The suction tube used in this study used high purified nitrogen under the condition of 100 mL/m at 320°C, making use of tube conditioner(ATC 1200, ACEN), an automatic preprocessing device for 2–3 hours. After collecting the samples, the author kept the suction tube cold in vial of 50 mL, below 4°C. (3) Analyzer: The author used the standard sheet of 5 stages at the calibration curve to estimate the concentration of VOCs, making use of the standard substance of liquid state. The author used GC/MS (Shimadzu, GC-2010, and Japan) system.
Results: (1) Concentration of VOCs according to Estimated Places: The results of concentration of VOCs according to bedroom, living room and restaurants. In case of benzene, toluene and ethyl benzene, the average geometric concentrations at the bedroom are 4.73 $\mu g/m^3$, 29.24 $\mu g/m^3$ and 5.43 $\mu g/m^3$. In case of living room, 3.68 $\mu g/m^3$, 22.26 $\mu g/m^3$, 4.42 $\mu g/m^3$, in case of restaurant, 3.65 $\mu g/m^3$, 22.92 $\mu g/m^3$ and 5.30 $\mu g/m^3$, and in case of TVOCs, 228.79 $\mu g/m^3$ at the bedroom, 230.51 $\mu g/m^3$ at the living room, and 235.56 $\mu g/m^3$ at the restaurant. No statistical significance was seen. (2) Concentration of VOCs According to the Probability of Existence of Carpet: According to the probability of existence of carpet, there's any statistical significance among toluene, ethyl benzene, m.p-xylene, and o-xylene. In this study, the place where carpet exists showed thicker concentration of VOCs. As the senior citizens have insufficient immune power in case of senior citizens facilities and carpet influences on the facility, the carpet should be managed in the senior citizens facilities.
Conclusion: In this study, the author surveyed the characteristic of the facilities and indoor environment for the senior citizens nursing facilities of Kyeonggki and Seoul-total 30 facilities; 10 facilities in Seoul and 20 facilities in Kyeonggki from January to December in 2007. In the result of surveying indoor and outdoor pollution degree of 30 senior citizens nursing facilities, the average geometric concentration of indoor and outdoor TVOCs were 230.69 $\mu g/m^3$ and 135.26 $\mu g/m^3$, respectively. The concentration ratio of indoor and outdoor air pollutants were 1.21, 1.23, 1.62 for benzene, toluene, TVOCs, respectively. In the facilities using carpet or not, the concentration of toluene, TVOCs were 37.62 $\mu g/m^3$, 300.65 $\mu g/m^3$, respectively, in the facilities using carpet. On the other hand, the concentration of toluene and TVOCs were 22.39 $\mu g/m^3$ and 228.60 $\mu g/m^3$, respectively, in the facilities using no carpet. The concentrations were presented higher in the facilities where carpet exits.

PP-30-141

The Association of Subjective Symptoms of Students and Indoor Air Quality in Private Academic Facilities

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Background/Aims: To evaluate the current indoor air quality condition of private academic facilities in Korea and investigate their association with subjective symptoms of student residing at the same academic facilities.
Methods: Air quality monitoring was carried out in total of 20 academic facilities located in Seoul, Daejon, and Chungnam from the beginning of January to the end of April, 2009. For the air quality condition of academic facilities, 6 air pollutants with temperature and humidity were measured simultaneously inside and outside of academic facilities.
Results: The rate of exceeding the Indoor Air Quality(IAQ) guideline concentrations in 6 air pollutants were 5%, 85%, 15%, 5%, 10%, and 30% in CO, CO_2, PM_{10}, HCHO, TVOCs, and TBC, respectively. The most frequent symptom of students was "I feel easily tired or sleepy," and followed by "I feel muscular pain or stiffness on shoulder, back, and

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neck." In logistic analysis using proportional odds method, the students whose indoor air concentration of HCHO was ≥60 $\mu g/m^3$ had significant odds of having more subjective symptoms of "My eyes are dry or feel irritated or itching" (OR = 5.026; 95% CI: 1.587–15.911), "I feel easily tired or sleepy" (OR = 2.956; 95% CI: 1.072–8.152), "I lose my concentration and I feel my memory is falling" (OR = 7.745; 95% CI: 1.938–30.955), and "I feel dizzy" (OR = 4.424; 95% CI: 1.292–15.149) than those of <60 $\mu g/m^3$.

Conclusion: We confirmed that the indoor air qualities of private academic facilities in Korea were not in optimum conditions for the students. Among 6 air pollutants, high concentration of formaldehyde in the academic facilities associated significantly with 4 symptoms out of 16 air pollution-related subjective symptoms.

PP-30-142

A Study of the Effectiveness of Indoor Plants for Removal of Volatile Organic Compounds in Indoor Air in a 7-story Office Building

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Background/Aims: People have been intrigued by the use of potted plants indoors for air cleaning since a 1984 publication of NASA research claiming that certain plants can remove formaldehyde from indoor air. A study was conducted in a 7-story, 4600 M2 office building in a highly polluted Asian city. The building, housing 500 workers, contains about 900 plants from 5 carefully selected species. The plants are integrated into the building ventilation strategy, with the expectation that they remove a wide range of Volatile Organic Compounds (VOCs). The aim of this work was to ascertain whether VOCs are effectively removed by the indoor plants.

Methods: Measurements of a range of 29 VOCs commonly found in office buildings (carbonyls; cleaning solvents, bathroom products; office products and supplies; building materials; plant materials and wood; plasticizers; outdoor air) were made outdoors, in the rooftop greenhouse, on 2 floors, and in the building exhaust air, following the sequential flow of ventilation air through the building. An air washer is installed between the ventilation air inlet and the greenhouse to clean outdoor air. Particulate matter ($PM_{2.5}$) was also measured indoors and outdoors.

Results: Indoor formaldehyde levels in the building increased by almost 5-fold from ambient levels to 30 $\mu g/m^3$ (chronic 8 hours reference exposure level = 9 $\mu g/m^3$) on floor 3, doubling during transit through the greenhouse containing 160 plants. Hexanal, nonanal, and octanal, odorous VOCs, were measured on floors 3 and 5 at roughly 10 times documented odor thresholds. Methylene chloride increased about 30-fold in the indoor air. 1,4-dichlorobenzene, bathroom deodorizer, was measured throughout the building, increasing by a factor of 10 between the greenhouse and floor 5. $PM_{2.5}$ indoors was reduced to 7% (30 $\mu g/m^3$) of the outdoor 380 $\mu g/m^3$ due to efficient HVAC filters.

Conclusion: Overall, VOC and aldehyde concentrations increased despite the use of selected potted plants, suggesting low overall effectiveness for VOC air cleaning.

PP-30-143

The Assessment of Survey on the Indoor Air Quality of Children Care Centers in South Korea

Young Rim Jung, Youn Hee Oh, Hyun Hee Park, Won Choi, Yun Yong Joo, Jung Tae Kwon, and Jong Ryeul Sohn *Krea University, Seoul, Republic of Korea.*

Background/Aims: Children in child care facilities may spend 100% of their day indoors, yet indoor air can be more harmful to their health than the air outdoors. The effects of indoor air pollution are of special interest in relation to respiratory health and allergic disorders including asthma. Here, the main concern centers around the question as to what extent different exposures give rise to different effects and to what extent these effects in turn translate to health risks.

Methods: Therefore, this study was performed to investigate the characteristics of IAQ (indoor air quality) in 70 children care centers in South Korea. We measured indoor air pollutants (PM_{10}, CO_2, HCHO, total bacteria colony [TBC], and TVOCs) and physical factors (temperature and relative humidity) with necessary of management for IAQ in children care centers.

Results: This study is conducted as a part of efforts to provide a foundational data for further relative researches on management of IAQ of children care centers.

Conclusion: Therefore, we suggest that country plan for management of IAQ in children care centers should be established through long-term and continuous investigation for assessment on IAQ in children care centers and health risk assessment for children.

PP-30-144

Association Between Volatile Organic Compounds and Particulate Matters in Microenvironments

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Background/Aims: Constant exposure towards environmental stresses often results in adverse effects to human health. Presence of contaminants in the indoor environment, particularly particulate matters and organic chemicals, mostly originated from building materials, furnishings, and human behavior. Volatile organic compounds (VOC) are widely known as the main contributor towards Sick Building Syndrome (SBS). Particulate matters (PM) are more synonymous with various respiratory symptoms or illnesses, depending on its composition and/or sizes which determine its severity. To-date, indoor experts are giving more emphasis on VOC and its effects on health. Studies on the possibility of PM playing a role in the occurrences of SBS and the connection between VOC and PM concentration in the indoor environment are virtually not available at present. Our research attempts to find the correlation between VOC and PM in 2 different microenvironments which were selected based on its diverse number of occupants and activities conducted. An apartment was selected for residential building and a cafeteria was chosen for non-residential building.

Methods: Environmental measurement and sampling were conducted at these 2 sites via direct reading equipments and sampling pumps both in indoor and outdoor. Residential sampling was conducted during day-time (12.00–4.00 PM) and night-time (12.00–4.00 AM), while sampling for the cafeteria was conducted during lunch time (11.00 AM–2.00 PM). The parameters measured were total VOC, total dust, fine particles (0.3, 0.5, 0.7, 1.0, 2.0, and 5.0 μm), relative humidity, and temperature.

Results: TVOC and total dust in both apartment and cafeteria show negative correlation ($P < 0.01$).

Conclusion: The positive correlation found between the 2 parameters suggests that fine particles may potentially be associated with VOC in the indoor environment.

PP-30-146

The Efficiency of Chemical Sensitivity Screening Test in Japanese, Korean and English to Prevent Sick Building Syndrome

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Preventive Medical Science, Chiba University, Chiba, Japan; [3]Center for Environment, Health and Field Sciences, Chiba University, Chiba, Japan; and [4]Department of Architecture, Graduate School of Engineering, Chiba University, Chiba, Japan.

Background/Aims: "Chemiless Town Project" of Chiba University is one of the projects of preventive medicine that tries to prevent Sick Building Syndrome (SBS) by improving indoor air quality. Through this project, we have tried to find out the health effect of indoor environment.

Our previous studies revealed that people who are sensitive to chemicals tend to claim some symptoms of SBS. It means that in order to prevent SBS, more sensitive people had better avoid chemical exposure as much as possible.

Methods: we developed software of self-check to screen sensitive people to chemicals. This test, "Chemiless Necessity Test" consists of 2 parts, first is condensed QEESI and another is the questionnaire to ask their anamnesis about SBS. By answering the questions, people will be judged if their necessity of Chemiless is high or low. After knowing the judgment, they are asked to answer a questionnaire voluntarily if they thought that they would be more careful in daily life not to be exposed to chemicals to prevent SBS. This test has been uploaded on the website since April 2009 and up to now, the number of subjects reached more than 5800.

Results: As a result, the percentage of high-risk group to have SBS was 62% and low-risk group was 38%, respectively. Among high-risk group, more than 84% people estimated as SBS and Chemical Sensitivity. After knowing their own sensitivity, more than 79% of people answered that they would become more careful to chemical exposure.

Conclusion: It means that recognition is important to take actions to prevent SBS. We translated this software to Korean and English and they have been uploaded since April 2010, because there are many people in the world who have interest in this project and some of them actually accessed to the test from all over the world.

PP-30-148

Exposure to Semi Volatile Organic Compounds Including Flame Retardants Indoor Air From the Floor

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Background/Aims: Sick Building Syndrome (SBS), caused by volatile organic compounds (VOC) indoor air has been a problem in Japan. Ministry of Health, Labour and Welfare set the guideline values about 13 VOCs to improve the indoor air quality in 2003. However, there are many more chemicals in the actual indoor air. One such group is semivolatile organic compounds (SVOC) which exists at extremely low concentration level and cause health problem. In Chemiless Town in Chiba University, a room in a 2-story reinforced concrete building was remodeled, and 19 SVOCs (8 phthalates and 11 phosphoric acid compounds used mainly as flame retardants) were analyzed and calculated.

Methods: In March 2009, the interior materials of 5 rooms in a reinforced concrete building in Chemiless Town were remodeled. The interior materials of the 5 rooms are as follows. Room 1 and 2: ceiling: sound absorbent tile, wall: polyvinyl chloride (PVC) sheets and starch adhesive, floor: tile carpet; Room 3: ceiling: sound absorbent tile, wall: PVC sheets and starch adhesive, floor: PVC tile; Room 4: ceiling: sound absorbent tile, wall: PVC sheets and starch adhesive, floor: PVC tile; Room 5: ceiling and wall: diatomite tile, floor: tile carpet. In April, the indoor air was collected in each room and the 19 SVOCs were analyzed and calculated. Room 2 was remodeled again in September and the floor carpet was changed. Then the indoor air of Room 2 was collected and the 19 SVOCs were analyzed and calculated.

Results: The concentration level of 19 SVOCs of the 5 rooms were about the same in April 2009. However, in Room 2, the level of Tri (2-chloroisopropyl) Phosphate was increased from 442 to 1240 ng/m^3, and the level of diethylhexyl phthalate was decreased from 308 to 34.4 ng/m^3.

Conclusion: It became clear that the level of SVOC differs with the change of interior materials.

PP-30-149

A Study on Characteristics of Particulate Matter in the Seoul Metropolitan Subway

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Background/Aims: Seoul Metropolitan Subway is currently being used by 4 million people since its line 1 opened to the public in 1974 with a 1-day average usage of 230 thousand citizens. In this way, the subway has become a favorite mode of public transportation for the modern people of Korea. However, most underground subway stations are sensitive to indoor air pollution and are likely to adversely affect national health. Therefore, in May 2003, the Ministry of Environment of the Republic of Korea enacted the law, "Indoor Air Quality Management of Multi-Use Facilities" to control air pollutants in subways and other such indoor facilities. The target pollutants consist of a total of 10 pollutants including PM_{10}, formaldehyde, and CO_2. According to precedent studies, particle concentration significantly affects human health. Among them, the effect of PM_{10} is greater than TSP (Total Suspended Particulates) and the effect of $PM_{2.5}$ greater than PM_{10} on human health. However, the environmental standard for $PM_{2.5}$ has not been legislated yet.

Methods: In this study, we analyzed measured pollution levels and concentration changes at subway platforms, ventilation areas, tunnels, and the ambient outdoors by utilizing 3 source classifications. The 3 cases are production of pollutants by passengers, by the influx of particulate matter contained in outside air due to ventilation, and by actual train operation. Sampling was performed using a cyclone (URG-2000-30ENB, URG, Chapel Hill, NC) by gravimetric method.

Results: The average concentration of PM_{10} at each sites was tunnel > platform > waiting room > outside. The concentration of PM_{10} in tunnel was higher than indoor air quality standard (150 μg/m^3) promulgated by the Ministry of Environment of the Republic of Korea during sampling period.

Conclusion: In this study, we assume the pollution source contribution of $PM_{2.5}$ as well as PM_{10} and suggest specific control measures and reduction strategies for air quality improvement in subway stations. The intermediate results of this study will be presented.

PP-30-150

Comparison of the Characteristics of VOC Emitted From Building Materials

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Background/Aims: Recently interest in indoor air quality (IAQ) has been increasing, as people spend indoors more and more, also as air pollutants

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have increased significantly indoors. One of the major indoor air pollutants is volatile organic compound (VOC) emitted from furniture, building materials, and living goods. Therefore, considerable researches on VOCs emitted from building materials and their influence have been.

Methods: This study was carried out with respect to elapsed time and VOC emissions from several lumbers, wood-based panels, and indoor embellished lumbers. The quality and quantity of VOC emission were sampled by Tenax TA/Cabotrap and measured by GC-MS and GC-FID.

Results: A comparison was made based on total VOC (TVOC), Natural VOC (NVOC), and composition ratios of NVOC from the above materials. The concentrations of TVOC emitted from the lumber of *Chamaecyparis obtusa* was the highest as 17,325 $\mu g/m^2$-h. It was also revealed that emissions of NVOC were much higher than other VOC (OVOC). However, NVOC was less emitted from wood-based panels than lumbers. NVOC concentrations from ecological building materials were the highest as 73% of TVOC. Furthermore, this research revealed that monoterpenes were mainly emitted from lumbers. Major VOC components were monoterpenes such as α-pinene, β-pinene, d-limonene, camphene, α-terpinene and etc.

Conclusion: It was concluded that the composition rates of VOCs emitted from building materials were remarkably different from the raw material of products and making methods.

PP-30-153

A Comparison of Measurement Methods of Indoor Ammonia in New Buildings

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Background/Aims: Ammonia, which is emitted from concrete and other building materials, causes skin irritation and headache to humans and emits bad odor smell (Z. Bai, 2005, H. Jarnstrom, 2006). Therefore, it is possible that the substance is being produced more in Korea, where most of buildings are made of concrete. However, few investigations about the exposure limit of the substance have been made in Korea. Ammonia has been sorted as a non-regulated substance in the indoor air quality Control Act of Public Facilities and housing in Korea. Therefore, it is required to monitor the concentration of ammonia in new buildings by reliable protection policy. This study includes sampling strategy of ammonia in new buildings.

Methods: After extracting a sample to the absorption tube, the analysis method was compared by using Ion Chromatography, both NIOSH 6016 and OSHA ID 188. For indoor ammonia analysis by ion chromatography (ICS-2000, Dionex, Sunnyvale, CA), 2 kinds of H_{2SO_4}-treated carbon beads tube (ORBO 77, Supelco, Bellefonte, PA) and H_{2SO_4}-coated silica gel tube (ORBO 554, Supelco) were selected. Flux, which was 0.5 L/min each were chosen to prepare the samples.

Results: The coefficient of variation in 2 different sampling tubes prepared by total air sampling volume of 15, 30, 60, 120, and 240 L showed less than 40% in case of carbon beads tube and as high as 20% for silica gel tube. The lowest coefficient of variation was 13% for carbon beads tube in 120 L of sampling volume and 4% for silica gel tube in 240 L of sampling volume. Also, silica gel tube of indoor ammonia sampling showed the similar results as 12% of carbon beads tube when it was extracted by more than 120 L.

Conclusion: Air sampling volume for indoor ammonia measurement should be at least 120 L. Carbon beads tube and silica gel tube also showed good correlation of ammonia concentration when they are sampled over 120 L of sampled air volume.

PP-30-154

Evaluating the Characteristics of Chemical Emissions From Wood-base Furniture in Korean Market

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Background/Aims: Recent research is saying that the contaminants such as volatile organic compounds (VOCs) and formaldehyde emitted from furniture, building materials, and electrical products are the main causes of indoor pollution. VOCs strongly intoxicate the respiratory, cardiovascular, and nervous system, degrades peripheral nervous system senses and contains genotoxic and carcinogenic substances. Formaldehyde has sufficient evidence for being carcinogenic from the animal experiment and limited evidence for human body. In the indoor environment, living goods are very diverse and widely applied. Because these products could affect the residents continuously, the pollution from living goods has to be managed. In Europe and United States, they adopted systems such as product certification system for low pollutant emissions to reduce pollutants emitted by daily products.

Methods: However, the basic data of pollutant emission from household goods is lacking in Korea, because testing methods and evaluation criteria for products have not established. In this study, VOCs and carbonyl compounds emitted from 53 types of domestic wood-based furniture which had been manufactured in Korea were investigated using 1, 5, and 24 m^3 full-scale chambers for 14 days. The emission test was carried out from January, 2007 to November, 2009.

Results: On seventh day's test result, the average TVOC and formaldehyde emission rate of 53 wood-based furnitures were 5.003 and 0.666 mg/unit.h, respectively. For the single material, TVOC emission rate was 9.028 mg/unit.h and formaldehyde emission rate was 0.581 mg/unit.h. Furthermore, the furniture with wood and mixed material, such as fabrics and leather, had average of TVOC emission rate 3.695 mg/unit.h and 0.693 mg/unit.h average formaldehyde emission rate.

Conclusion: For individual VOCs in both single and mixed material, Toluene emission rate was the highest, styrene rate in single material and xylene rate in mixed material were the second highest.

With the result of this study, protection and management policy for pollutant emission of furniture is required.

ARSENIC CRISIS IN THE GANGES DELTA: WHAT HAVE WE LEARNED? (PART I)

S-29A7-1

Health Effect of Arsenic Longitudinal Study—Recent Findings

Habibul Ahsan,[1,2] Yu Chen,[3] Faruque Parvez,[2] Maria Argos,[1] Paul Rathouz,[1] Muhammad Kibriya,[1] Vesna Slavkovich,[2] Tariqul Islam,[4] Rabiul Hasan,[4] Rakib-Uz Zaman,[4] Alauddin Ahmed,[4] Lex van Geen,[2] and Joseph Graziano[2] *[1]The University of Chicago, Chicago, IL; [2]Columbia University, New York, NY; [3]New York University School of Medicine, New York, NY; and [4]Columbia University Arsenic Research Project, Dhaka, Bangladesh.*

Background/Aims: Arsenic exposure from drinking water is a major public health concern to millions of people in different parts in the world. Long-term exposure to arsenic has been associated with elevated risks of cancers, cardiovascular diseases, and other diseases. However, the underlying dose-response relationship, molecular basis, genetic susceptibility, and prevention strategies of these diseases largely remain unknown.

Methods: Using unique study resources and multidisciplinary collaborations that we established over the past 10 years in Bangladesh, we are conducting a range of studies to comprehensively evaluate these research questions.

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Results: To date, we identified and described full dose-response relationships of arsenic exposure with the risk of chronic disease mortality, cardiovascular and respiratory diseases, premalignant lesions, as well as levels of several novel molecular biomarkers related to these diseases. We have also evaluated and identified potential prevention and mitigation strategies to reduce arsenic exposure and its fatal and non-fatal consequences.

Conclusion: These findings have important public health, socioeconomic, and policy implications for a large number of arsenic exposed populations worldwide.

S-29A7-2

Age and Gender Modifies Dose-response Relationship Between Tubewell Arsenic Exposure and Toenail Arsenic Concentration

Hyunok Choi,[1] Molly Kile,[1] Elaine Hoffman,[1] Ema Rodriguez,[1] Quazi Quamruzzaman,[2] Mahmuder Rahman,[2] Golam Mahiuddin,[2] Li Su,[1] and David Christiani[1] *[1]Harvard School of Public Health, Boston, MA; and [2]Dhaka Community Hospital, Dhaka, Bangladesh.*

Background/Aims: Although arsenic exposure from drinking water has been significantly associated with toenail arsenic (As) concentrations in adults, similar association in young adults and children, particularly at low exposure range, remains unknown. Thus, we tested a hypothesis that the dose response in adolescents and children due to As intake from drinking tube-well water and toenail As concentration is linear without threshold.

Methods: In an As-endemic area of Bangladesh, all members of 50 families (n = 254) were enrolled in a prospective, repeated measures biomonitoring study. Inorganic As intake from drinking water was examined for its ability to predict the toenail As. Samples of drinking water and toenails were collected every 3 months during a 4-year period and analyzed for As using inductively coupled plasma-mass spectrometry. As concentrations in toenail were modeled using linear mixed effects models with regression splines.

Results: As concentrations in drinking water varied by >1000-fold among the 254 persons (range, below detection limit—751.50 μg/L). Overall, the shape of the dose response was S-shape, with 3 distinct coefficients of association at low (<10 μg/L), medium (10–200 μg/L), and high (200–751.50 μg/L) exposure range. Water intake at medium As concentration range was associated with an 80% increase toenail As concentrations ($P = 0.02$). However, high water As exposure range was associated with 21% increase in toenail As concentration ($P > 0.05$). Furthermore, while no association was observed at the low range of water-level As concentration among boy <18 years of age, same range of exposure was associated with 68% higher toenail As level among girls <18 years old.

Conclusion: Present results suggest that the dose-response relationship between tube-well As concentration and toenail concentration might significantly differ by age group, gender, and concentration range.

S-29A7-3

Arsenic and Manganese Exposure and Children's Intellectual Function in Bangladesh

Joseph Graziano,[1] Faruque Parvez,[1] Xinhua Liu,[1] Abu Siddique,[2] Tariqul Islam,[2] Vesna Slavkovich,[1] Pam Factor-Litvak,[1] Diane Levy,[1] and Gail Wasserman[1] *[1]Columbia University, New York, NY; and [2]Columbia University Arsenic Project, Dhaka, Bangladesh.*

Background/Aims: Recent studies of school-aged children have reported associations between neurobehavioral function and exposure to arsenic (As) through drinking water. Other work suggests that excessive exposure to manganese (Mn) is also associated with deficits in neurobehavioral functioning.

Methods: We designed a 2 × 2 study (Low, High As; Low, High Mn) to assess the impact of each exposure, and of both exposures, on children's intellectual function. The study was conducted in Araihazar, Bangladesh. We defined low water As as <10 μg/L, and low water Mn as <500 μg/L. A total of 310 children (roughly 76 per group), ages 8–11 years, were recruited for the study.

Results: The concentrations of As in water, urine, blood, and nails were all significantly correlated (r between 0.52 and 0.84); however, water Mn was only weakly associated with blood Mn (BMn) ($r = 0.11$; $P = 0.06$). Water As concentrations ranged from 0.1 to 464 μg/L, while water Mn concentrations ranged from 40 to 3442 μg/L. Before adjustment for covariates, both blood As and BMn were negatively related to all measures of children's intellectual function; these findings were significant for Full Scale, Verbal Comprehension, Working Memory, and Perceptual Reasoning (BMn only). When both measures of exposure and sociodemographic features were added to the models, sociodemographic factors made consistent contributions to measures of intellectual function. With adjustment, the strength of the associations with blood As and BMn was attenuated, and the significance was reduced in most instances to $P < 0.07$. The negative association between Perceptual Reasoning and BMn retained significance even with adjustment for covariates ($P < 0.05$). As by Mn interactions were not significant.

Conclusion: These findings reinforce the recent findings concerning adverse effects of As and Mn exposure on children's intellectual function, and suggest that the effects of combined exposure to both elements are additive.

ARSENIC CRISIS IN THE GANGES DELTA: WHAT HAVE WE LEARNED? (PART II)

S-29B7-1

Arsenic-related Lung Disease and Susceptibility Associated With Metabolism and Early Life Exposure

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Background/Aims: The human lung appears to be particularly susceptible to the toxic effects of ingested arsenic. Two recent studies were performed in arsenic-exposed regions in South America on 2 potential susceptibility factors, which may play a role in arsenic-related lung disease risks. These include interindividual differences in arsenic metabolism and arsenic exposure in early life.

Methods: In the first study, urinary arsenic metabolites including monomethylarsonic (MMA) were assessed in 45 lung cancer cases and 75 matched population controls from Cordoba, Argentina. In the second study, lung function and respiratory symptoms were measured in 32 adults exposed to >800 μg/L of arsenic before age 10 and 65 adults without high early life exposure, selected using a non-random convenience sample in northern Chile.

Results: In the first study, in analyses limited to subjects with metabolite concentrations above detection, the mean %MMA was higher in lung cancer cases than in controls ($P = 0.01$), and the lung cancer odds were about 3 times higher in subjects with %MMA in the upper tertile than in those in the lower tertile ($P < 0.05$). In the second study, early life arsenic exposure was associated with about a 10% decrease in pulmonary function parameters ($P = 0.02$) and a 5-fold increase in dyspnea, decades after high exposure ended. The decrease in lung function observed was similar in magnitude to that reported for a 35 pack-year smoking history, although further research is needed to confirm these findings.

Conclusion: As a whole, these 2 studies provide evidence that the risks of arsenic-associated lung disease may be related to exposure in early life and interindividual differences in arsenic metabolism.

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S-29B7-2

The Dose-response Relationship Between Urinary Arsenic Metabolites and Skin Lesions Using a Pathway Approach

Molly Kile,[1] Elaine Hoffman,[1] Quazi Quamruzzaman,[2] Mahmuder Rahman,[2] Golam Mahiuddin,[2] Yu-Mei Hsueh,[3] and David Christiani[1] *[1]Harvard School of Public Health, Boston, MA; [2]Dhaka Community Hospital, Dhaka, Bangladesh; and [3]Taipei Medical University, Taipei, Taiwan.*

Background/Aims: Inorganic arsenic (As) is metabolized to monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA). Limited evidence suggests that an individual's ability to fully metabolize MMA to DMA influences susceptibility to As-induced health effects including cancer. A case-control study conducted in Bangladesh (2001–2003) was used to evaluate the association between metabolism and skin lesions, an early symptom of As toxicity.

Methods: A subset of individuals diagnosed with keratosis, melanosis, Bowen disease, or squamous cell carcinoma (n = 881) and individuals without these conditions (n = 868) were used in this analysis. The percentage of each urinary As metabolite was log10 transformed and used as a biomarker of methylation capacity. A novel pathway analysis was used to simultaneously evaluate the association between all urinary arsenic metabolites and the odds of skin lesions using PROC CALIS and Mplus. Additional covariates, including drinking water arsenic, age, creatinine, sex, education, chewing betel nut, and body mass index were also included as covariates.

Results: The path analysis explained 44%, 13%, and 8% of the variance in %DMA, %MMA, and %iAs, respectively. We found that the odds of skin lesions was significantly associated with log10%MMA (ORadj: 1.62; 95% confidence interval [CI]: 1.07, 2.47) but not log10%iAs (ORadj: 1.20, 95% CI: 0.78, 1.84) nor log10%DMA (ORadj: 1.46, 95% CI: 0.36, 5.89).

Conclusion: This analysis confirmed that individuals who excrete higher levels of MMA have a greater risk of skin lesions while adequately controlling for current arsenic exposure, all urinary arsenic metabolites, and other risk factors.

S-29B7-3

A Dose-response Study of Arsenic Exposure, Folate, and Genomic Methylation of Peripheral Blood Mononuclear Cell DNA in Bangladesh

Megan Niedzwiecki,[1] Megan Hall,[2] Xinhua Liu,[3] Julie Oka,[1] Vesna Slavkovich,[1] Vesna Ilievski,[1] Diane Levy,[3] Abu Siddique,[4] Faruque Parvez,[2] Joseph Graziano,[2] and Mary Gamble[2] *Departments of [1]Environmental Health Sciences, [2]Epidemiology, and [3]Biostatistics, Mailman School of Public Health, Columbia University, New York, NY; and [4]Columbia University Arsenic Project, Dhaka, Bangladesh.*

Background/Aims: Chronic arsenic exposure is associated with increased risk for cancers of the skin, lung, liver, and bladder; however, the mechanism(s) underlying arsenic-induced carcinogenesis are poorly understood. Animal and in vitro data suggest that chronic arsenic exposure induces genomic hypomethylation of DNA. In contrast, our previous study in adults chronically exposed to arsenic-contaminated drinking water in Bangladesh suggested that arsenic exposure is associated with increased genomic methylation of total leukocyte DNA, and that this association is contingent on adequate folate.

Methods: We undertook a cross-sectional study specifically designed to evaluate the dose-response relationship between arsenic exposure and genomic methylation of peripheral blood mononuclear cell DNA. We recruited 375 participants between 30 and 65 years of age, including 75 for each of 5 categories of water arsenic: 0–50, 51–100, 101–200, 201–300, and >300 μg/L. Genomic DNA methylation was measured using the [3]-methyl incorporation assay; results of this assay are inversely related to DNA methylation.

Results: Water arsenic was associated with increased DNA methylation, and this association was influenced by folate nutritional status (Spearman correlations −0.24, $P = 0.007$, and −0.08, $P = 0.2$ for folate-sufficient and folate-deficient respectively). Mean DPM values (in thousands) by increasing categories of water As for folate-sufficient participants were 172, 169, 154, 145, and 139, P for trend = 0.001; a statistically significant ($P = 0.02$) but weaker trend was observed for folate-deficient participants. The results were unchanged after further adjustment for age and other covariates.

Conclusion: Arsenic exposure is associated with dose-dependent increases in peripheral blood mononuclear cell DNA methylation, and this association is somewhat stronger among folate sufficient participants. Differences between experimental studies and our work may be related to the dose and duration of arsenic exposure. The implications of increases in genomic DNA methylation are unclear; we propose this may be an adaptive response to an upstream event. Additional studies are underway to identify potential mechanisms underlying these observations.

WHAT DO WE KNOW ABOUT MODES OF INFLUENZA TRANSMISSION?

S-29A8-1

The Mechanics of Influenza Transmission: An Overview and Discussion of Uncertainties

Rachael Jones *University of Illinois at Chicago, Chicago, IL.*

Background/Aims: Influenza transmission may occur through 4 exposure routes—contact, direct spray, inhalation, and inspiration or airborne virus-laden particles—though the magnitude of exposure and infection risk from each route is uncertain. The aim of this presentation is to describe the transmission routes, uncertainty in factors influencing the environmental-mediation of influenza transmission, and integrate this information using a mathematical model to highlight uncertainties in our understanding of influenza transmission from person-to-person through the environment.

Methods: Uncertainty and variability in factors influencing influenza transmission is quantified using 2-stage Monte Carlo analysis. Using the mathematical model described by Nicas and Jones (2009), Monte Carlo simulation incorporates uncertainty and variability in parameters in estimates of exposure and risk for each exposure route.

Results: Uncertainty in factors influencing influenza transmission is large, due in part to lack of data, study design, or limited reporting of data variability. Uncertainty in these factors generates large uncertainties in exposure and infection risk estimates.

Conclusion: Description of the mathematical model illuminates the exposure routes, and provides a foundation for subsequent presentations. Highly uncertain transmission factors that are determinant of exposure route and high infection risk should be prioritized for further research.

S-29A8-2

Dominant Modes of Influenza Transmission: An Epidemiologic Perspective

Ian Spicknall, James Koopman, Sheng Li, and Joseph Eisenberg *University of Michigan, Ann Arbor, MI.*

Background/Aims: Influenza can be transmitted through respirable (small airborne particles), inspirable (intermediate size), large droplet, and contact modes. How these modes are affected by features of the virus strain (infectivity, survivability, transferability, or shedding profiles), host population (behavior, susceptibility, or shedding profiles), and environment (host density, surface area to volume ratios, or host movement patterns) have only recently come under investigation. There is

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much disagreement in the literature with regard to what the dominant route of influenza transmission is.

Methods: A discrete-event, continuous-time, stochastic transmission model is constructed to analyze the environmental processes through which virus passes from one person to another via different transmission modes and explore which factors increase or decrease different modes of transmission. Using empirical estimates where possible, we vary 18 parameters that are relevant to the respiratory, inspiratory, droplet-spray, and contact-mediated transmission routes. These parameters are features of the agent, host, or environment.

Results: With the exception of the inspiratory route, each route on its own can cause high transmission in isolation of other modes depending on the specific context. Mode-specific transmission is highly sensitive to parameter values. For example, droplet and respirable transmission usually required high host density, while the contact route had no such requirement.

Conclusion: Depending on the specific context one or more modes may be sufficient to cause high transmission, while in other contexts no transmission may result. Because of this, when making intervention decisions which involve blocking environmental pathways, it is important to take into account the specific features of the system in question. Therefore, it should not be assumed a prior that interventions which target only one of these routes may be optimal in all settings.

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S-29A8-3

Influenza Virus Aerosols in Human Exhaled Breath: Particle Size, Culturability, and Effect of Surgical Masks

Patricia Fabian,[1] Donald Milton,[2] Matthew Angel,[2] Daniel Perez,[2] and James McDevitt[1] *[1]Harvard School of Public Health, Boston, MA; and [2]University of Maryland, College Park, MD.*

Background/Aims: The scientific literature on influenza transmission is lacking in data on the particle size, infectiousness, and quantity of viral particles released by infected persons. These data are necessary to understand the transmission pathways of influenza and are essential for assessing risk, providing interventions, and minimizing public fear.

Methods: We characterized exhaled breath and cough aerosols from influenza patients using molecular and viral culture methods during seasonal influenza in Hong Kong 2007, Massachusetts 2008, and 2009. Using filters or a novel impaction system to collect exhaled virus aerosols, we estimated virus generation rates during tidal breathing and coughing. We measured particle concentrations and size distributions with an optical particle counter. During the third season we measured the effect of surgical masks on virus concentrations in fine (0.05–<5 um) and coarse (≥5 um) particles as well as virus culturability from fine particles.

Results: We recruited 77 subjects with laboratory-confirmed influenza during the 3 seasons. We measured influenza RNA in 13%–33% of tidal breath samples and in 66% of cough samples. Over 87% of exhaled particles collected were less than 1 μm. Surgical masks reduced viral RNA copies in the coarse fraction from 1000 per 30 minutes to 2.6 per 30 minutes and in the fine-particle fraction from 5600 per 30 minutes to 1200 per 30 minutes. Overall, masks produced a 5.2-fold reduction in viral aerosol shedding. Samples from the 2 subjects with the highest influenza RNA copy numbers were culture positive.

Conclusion: Results from these studies show that influenza virus is present in fine particles generated during tidal breathing and coughing. These results and the presence of culturable virus in fine-particle aerosols support the hypothesis that the airborne route may play a role in influenza transmission. Data from 1 study suggest that surgical masks worn by patients can moderately reduce generation of virus containing aerosols and supports Center for Disease Control recommendations.

NOISE, EMERGING ENVIRONMENTAL PROBLEMS AND HEALTH

O-29A9-1

Road Traffic Noise and Stroke: A Prospective Cohort Study

Mette Sørensen,[1] Martin Hvidberg,[2] Zorana Andersen,[1] Rikke Nordsborg,[1] Kenneth Lillelund,[3] Jørgen Jakobsen,[4] Anne Tjønneland,[1] Kim Overvad,[5] and Ole Raaschou-Nielsen[1] *[1]Danish Cancer Society, Copenhagen, Denmark; [2]National Environmental Research Institute, Roskilde, Denmark; [3]Rambøll Danmark A/S, Århus, Denmark; [4]Danish Environmental Protection Agency, Copenhagen, Denmark; and [5]School of Public Health, Aarhus University, Århus, Denmark.*

Background/Aims: Approximately 40% of the population of the European Union is exposed to road traffic noise at levels exceeding the WHO guideline value for community noise. Epidemiological studies suggest that long-term exposure to road traffic noise increases the risk for cardiovascular disorders. The relationship between exposure to road traffic noise and risk for stroke has never been studied.

Methods: In a population-based cohort of 57,053 people, we identified 1881 cases of first stroke in a population-based nationwide hospital register between enrolment in 1993–1997 and 2006. Exposure to road traffic noise and air pollution at all addresses during the same period was estimated for all cohort members by validated prediction models. Input to the models included information on geographical coordinates, road lines, yearly average daily traffic, traffic composition, traffic speed, road type, and building polygons. Association between exposure to road traffic noise and stroke incidence was analysed in a Cox regression model with adjustment for air pollution and other potential confounders.

Results: We found an incidence rate ratio (IRR) for stroke of 1.15 (95% confidence interval [CI]: 1.05–1.26) per 10 dB higher level of road traffic noise. There was no noticeable increase in the risk for stroke at road traffic noise levels below 60 dB. At exposures higher than 60 dB, the risk for stroke increased in a dose-dependent manner. The association between road traffic noise and stroke was stronger for cases over 64.5 years (IRR = 1.23; 95% CI: 1.08–1.40) than for those under 64.5 years (IRR = 1.08; 95% CI: 0.94–1.23).

Conclusion: Exposure to residential road traffic noise was associated with a higher risk for stroke.

O-29A9-2

Road Traffic Noise Exposure and Risk of Hypertension in Taiwan

Ta-Yuan Chang, Su-Fei Li, Tzu-I Chen, and Yen-Ju Lin *Department of Occupational Safety and Health, College of Public Health, China Medical University, Taichung, Taiwan.*

Background/Aims: Epidemiological studies have demonstrated that road traffic noise exposure is associated with hypertension in Caucasian population, but the relationship in other population is unclear. This cross-sectional study investigated the association between road traffic noise exposure and the prevalence of hypertension in Taiwan.

Methods: We recruited 820 volunteers (321 male and 499 female) resided near 4 main roads in Taichung City. We simultaneously measured traffic noise exposure by using a sound-level meter and calculated the traffic density during 0900–1700 on week days. The prevalence of self-reported hypertension was collected by a standard questionnaire. Multivariate logistic regressions were applied to estimate the risk of hypertension by adjusting potential confounders.

Results: Each 1 vehicle/hour increase in the traffic density of motorcycles was significantly associated with the increasing mean level of 1.06 ± 1.09 A-weighted decibels (dBA) in the traffic noise exposure. The high-exposure group (82.2 ± 1.7 dBA, n = 358) had a significantly higher risk of hypertension (adjusted odds ratio = 2.15, 95% CI: 1.08–4.26) than the low-exposure group (77.2 ± 1.6 dBA, n = 462). For 8-hour road traffic

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noise, per 3-dBA increase in exposure was associated with an elevated risk of hypertension (adjusted odds ratio = 1.62, 95% CI: 1.11–2.36). The exposure-response relationship between the traffic noise exposure and the risk of hypertension was pronounced after adjusting for the traffic density.
Conclusion: Our findings suggest that exposure to road traffic noise may be associated with hypertension. Related regulations should be considered to reduce the noise levels in Taiwan.

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O-29A9-3

Do Long Distance Travels Trigger Acute Myocardial Infarctions?

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Background/Aims: Long distance travel by plane, car, or bus can be accompanied by long periods of sitting, lack of movement, and an oxygen undersupply which may precipitate an acute myocardial infarction (AMI). No epidemiological study so far has examined long distance travel as possible trigger of AMI.
Methods: We assessed the association of long-distance travel, defined as journeys by car, train, ship, or bus of at least 2 hours, or flights of any length, with the onset of non-fatal AMI using the case-crossover design. Cases of age 25–74 years were recruited from the KORA (Collaborative Health Research in the Region of Augsburg) Coronary Event Registry Germany, from February 1999 through December 2003. In personal interviews, detailed information was collected on activities and location for the 4 days preceding the onset of AMI. For each case, we compared exposure during the hazard period preceding the onset of AMI with the same subjects' exposure during 2 control periods 24 and 48 hours earlier in conditional logistic regression models.
Results: We included 1265 cases with confirmed AMI and complete activity data in the analyses. Of these, 125 mentioned at least 1 long distance travel in the diary. The patients reporting travelling were on average younger, more often male, employed, and rarely suffering from chronic diseases. In total, we identified 150 car travels, 12 flights, and 42 journeys with other means of transportation. The case-crossover analyses showed an association of travelling by plane with AMI within 24 hours (relative risk [RR[5.9, 95% confidence interval [CI[: 1.2–28.8). For long-distance car travelling, we estimated a RR of 1.3 (95% CI: 0.7–2.4) for the onset of AMI within 24 hours.
Conclusion: This study suggests that long distance travel especially by plane may be associated with a transiently increased risk of nonfatal AMI in susceptible populations.

O-29A9-4

Epidemiological Studies of the Incorporation of Naturally Occurring Radionuclides Via Drinking Water: A Review

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Background/Aims: Naturally occurring radionuclides are encountered at various levels in shallow or ground waters, which raises the question of possible health effects resulting from their incorporation. Epidemiological studies addressing this issue were reviewed.
Methods: Medline was searched using all possible 3-term combinations based on the following term categories: (1) "water," (2) "epidemiology," "cohort," or "case-control," (3) "radioactivity" or the names of all radionuclides naturally occurring in water.
Results: Studies of uranium (11), radium (14), and radon (10) were found. Uranium concentrations in drinking water were associated with tubular damages in 3 out of 5 studies assessing uranium nephrotoxicity and with glomerular damages in 1 study. No association was found with cancer from 5 studies, except for non-Hodgkin lymphoma in 1 case-control study. Radium concentrations were associated with: osteosarcoma in 1 case-control study out of 4, all bone cancers in 1 ecological study and orofacial cleft defects in 2 ecological studies. Two ecological studies, but not 1 case-control study, reported an association with leukaemia. Radon was associated with stomach cancer, that was the primary effect expected, in 1 ecological study out of 2 but not in 1 case-cohort study. No consistent pattern was observed for other cancers.
Conclusion: Despite modest epidemiological evidence toward uranium nephrotoxicity and radium effects on bone, available studies do not allow quantifying the health effects of radionuclides naturally occurring in drinking water. Methodological limitations (exposure assessment, control for potential confounders, sample size) affect most reviewed studies. Moreover, due to the modest magnitude of the risks expected from dosimetric estimates, it is questionable whether epidemiological studies of a manageable size could effectively quantify these. Therefore, to date, dosimetric calculation remains the most appropriate way to assess radiological risks related to radionuclides naturally occurring in water. Uranium chemical toxicity also must be addressed as part of risk assessments.

O-29A9-5

Case-control Study of Mobile Phone Base Stations and Early Childhood Cancers

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Background/Aims: There are public concerns and scientific uncertainties about possible health risks associated with living near mobile phone base stations. This study aims to investigate risk of early childhood cancers associated with macrocell mobile phone base station exposures during pregnancy.
Methods: This national case-control study across Great Britain, 1999–2001, included 1397 cancer cases ages 0–4 from the national cancer registry and 5588 birth controls from the national birth register, individually matched by sex and date of birth (4 controls per case). Three exposure metrics were estimated for the birth address of each case and control: (1) Distance (m) from the nearest mobile phone base station; (2) Total power output (kW) from summation across all base stations within 700 m; (3) Modeled power density (dBm) computed at each birth address for base stations within 1400 m, using a semi-Gaussian propagation model. The main outcome measures were brain and central nervous system cancers (International Classification of Disease C71–C72), leukemia and nonHodgkin lymphomas (C91–C95, C82–C85), and all cancers combined (C00–C96), adjusted for small-area measures of education level, socioeconomic deprivation, population density, and population mixing.
Results: Preliminary results indicated that mean distance of birth address from a macrocell base station based on a national database of 76,890 base station antennas, 1996–2001, was similar for cases (1107 [SE: 30] m) and controls (1073 [SE: 15] m, $P = 0.31$), as was total power output of base

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stations and modeled power density. Full results will be presented at the conference.

Conclusion: Preliminary results suggested no association between risk of early childhood cancers and estimated mobile phone base station exposure during pregnancy.

AIR POLLUTION - CARDIOVASCULAR HEALTH EFFECTS

O-29B2-1

Air Pollution From Bushfires and Out-of-hospital Cardiac Arrests in Melbourne, Australia

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Background/Aims: There is a gap in research relating to acute cardiac events that occur during extremely high air pollution episodes. The severity and extended duration of the 2006–2007 bushfires in Victoria, Australia, have provided unique data to better investigate associations between particulate air pollution and cardiac arrests.

Methods: We collected data for the study period (01 November, 2006–31 March, 2007) on out-of-hospital cardiac arrests (OHCAs) from the Victorian Ambulance Cardiac Arrest Registry, which captures all OHCAs attended by the Ambulance service. We restricted the analysis to those who were at least 35 years old and living in Melbourne (N = 807). Air pollution concentrations (PM_{10}, $PM_{2.5}$, NO_2, CO, O_3, SO_2) and meteorological data were measured during the study period. Case-crossover methodology was used to investigate the relationship between bushfire-related high air pollutant concentrations and OHCA. This design controls for confounding by day of week and monthly trends.

Results: During the study period, after adjusting for temperature and humidity, an interquartile range (IQR) increase of 6.0 $\mu g/m^3$ in $PM_{2.5}$ was significantly associated with an increased risk of an OHCA of 4.52% (95% CI: 0.48, 8.70), and an IQR increase in PM_{10} (11.7 $\mu g/m^3$) resulted in an increased OHCA risk of 6.57% (0.42, 13.11). For NO_2, SO_2, O_3, and CO, the associations between OHCA risk per IQR increase were nonsignificant: −0.11% (−11.12, 12.26), −11.87% (−22.85, 0.68), 16.05% (−0.72, 35.66), and 8.14% (−2.61, 20.07), respectively.

Conclusion: An increased risk of OHCA was associated with an increase in particulate matter during the 2006/2007 bushfire season in Melbourne, Australia.

O-29B2-2

Particulate Air Pollution Triggers Cardiac Arrest in Helsinki—Effect of Medical History and Two-pollutant Analysis

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Background/Aims: A study of air pollution as a trigger for out-of-hospital cardiac arrest (OHCA) was reanalyzed to investigate: (1) the effect of subjects' medical history on risk and (2) the confounding of one pollutant by another, using 2-pollutant models.

Methods: A case-crossover analysis was done on 629 OHCAs identified by Emergency Medical Services staff as due to myocardial infarction. Hourly measurements of $PM_{2.5}$, Coarse, Accumulation mode (Acc), and ultrafine particulate, NO, NO_2, O_3, SO_2, CO, were obtained from central monitoring sites. Disease status was assessed based on government-determined eligibility for drug reimbursement in specific disease categories. Hazard Ratios (HRs), for an interquartile exposure increment, were determined for hourly lagged exposure (Lag 0–Lag 7), and average exposure during 24-hour periods preceding the OHCA (Lag 0d–Lag 3d).

Results: Compared to the HR (Lag 0d) for all cases (1.21; 95% confidence interval [CI]: 1.07, 1.37), HRs were higher for diabetes (1.48; CI: 1.05 2.09), Heart Failure(2.05; CI: 1.28, 3.30), and no disease (1.31; 95% CI: 1.10, 1.57), and tended to be lower for subjects with coronary heart disease (1.12; 95% CI: 0.83, 1.51), hypertension (0.82; 95% CI: 0.61–1.10), and asthma/COPD (0.49; CI: 0.20, 1.17). Among all cases, in single-pollutant models, HRs were significantly above one ($P < 0.05$) only for $PM_{2.5}$ (Lag 0, Lag 1, Lag 2, Lag 0d = 1.16, 1.16, 1.14, 1.21, respectively), Acc (Lag 2, Lag 6, Lag 7, Lag 0d = 1.11, 1.10, 1.11, 1.17, respectively), and NO (Lag 0d = 1.06). For 2-pollutant models, including $PM_{2.5}$ and one other pollutant, HRs (Lag 0d) for $PM_{2.5}$ were generally increased and HRs for the other pollutant were generally decreased, compared to values in single-pollutant models. In 2-pollutant models, there were no significant HRs for pollutants other than $PM_{2.5}$ ($P > 0.05$).

Conclusion: Subjects with diabetes and heart failure may have a higher risk for particulate-triggered OHCA. There was little evidence that pollutants, other than $PM_{2.5}$, trigger OHCA.

O-29B2-3

Air Pollution and Atrial Arrhythmias in Patients With Implanted Cardioverter Defibrillators

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Background/Aims: Implanted cardioverter defibrillators (ICD) monitor and treat ventricular arrhythmias. These devices also provide electrocardiographic records of the dates and times of ventricular and atrial arrhythmias. We examined the effects of ambient air pollution on arrhythmias among a cohort of dual chamber ICD patients.

Methods: We prospectively collected data in ICD patients enrolled since November 2006. Dates and times of detected arrhythmias were downloaded during regular follow-up visits. Arrhythmias were categorized into ventricular and supra-ventricular (SVT) events (including atrial fibrillation [AF] and other atrial events) by review of electrograms. Fine particle data, gaseous pollutants and meteorological data were available on an hourly basis. We analyzed the association between air pollution and the onset of arrhythmias with a case-crossover approach, matching on month and day of the week. Six-hour, 12-hour, and 24-hour moving averages were considered. Analyses were adjusted for temperature and relative humidity, and reported as odds ratios (OR) for an interquartile range increase in exposure.

Results: A total of 110 patients with a mean follow-up time of 1.6 years had 2888 episodes of SVTs (1115 AFs). Increased risks of AF were associated with 6-hours mean $PM_{2.5}$ (OR = 1.19 for a 7.8 javascript: Add4('%CE%BC') g/m^3 increase, 95% CI: 0.99–1.41) and black carbon (OR = 1.26 for an 0.7 javascript: Add4('%CE%BC') g/m^3 increase, CI: 1.03–1.53), and were not associated with sulfate. The ORs for other atrial arrhythmias were 1.21 (1.04–1.41) for $PM_{2.5}$, 1.20 (1.09–1.33) for sulfate, and 1.05 (0.89–1.23) for black carbon. Results for the 12-h and 24-h exposure metrics were similar. We found no associations between ambient gases and SVTs.

Conclusion: These results suggest that particle exposure is associated with SVTs, with traffic particles primarily associated with AF and

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secondary particles with other atrial events. This increased risk of SVTs may account for a portion of the increased cardiovascular mortality observed with air pollution.

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O-29B2-4

Acute Effects of Fine Particulate Air Pollution on Cardiac Electrophysiological Parameters

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Background/Aims: We systematically examined the time-course and acute effects of fine particles (PM2.5) on following 5 major domains of cardiac electrophysiologic parameters: (1) heart rate variability (HRV) as measures of cardiac autonomic modulation (CAM), (2) heart-rate corrected QT intervals as measures of ventricular repolarization, (3) ST-segment height as measures of ventricular ischemia, (4) P-wave and PR durations as measures of atrial fibrillation vulnerability, and (5) frequency of ectopy.

Methods: We obtained 24-hour beat-to-beat ECGs using a 1000 Hz Holter ECG system. After visual identification and removal of artifacts and arrhythmic beats, we calculated the 5 major domains on each of the 30-minute segments. We used a personal PM2.5 monitor to measure 24-hour individual-level real-time PM2.5 exposures and calculated 30-minute time-specific average PM2.5 exposures. Distributed lag models were used to assess the autocorrelation corrected relationship between 30-minute PM2.5 and each of the 5 ECG domains. In these models, lag 0 indicates the spontaneous relationship between PM2.5 and the ECG outcomes, and lag 1 indicates 30 minutes between the PM2.5 and ECG outcomes, and so on.

Results: The mean (SD) of personal PM2.5 exposure was 14 (22) $\mu g/m^3$. We indentified 2 patterns of significant adverse effects of PM2.5 concentration on ECG parameters: (a) acute effects on decreasing CAM up to lag 7 and prolonging ventricular repolarization up to lag 8; and on increasing ST-height and atrial fibrillation vulnerability up to lag 4; and (b) ultra acute effects on increasing ectopy up to lag 1.

Conclusion: Higher PM2.5 is adversely associated with all 5 major ECG parameters we analyzed, with the adverse effects occurring acutely (within 2–4 hours of elevated PM2.5) or ultra acutely (within 0.5 hr of elevated PM2.5). These adverse effects on ECG parameters may trigger the onset of acute cardiac events and cumulatively over time, may result in increased risk of cardiac disease.

O-29B2-5

Source-oriented Analysis of Air Pollutants and Cardiorespiratory Emergency Department Visits in St. Louis, MO, Using Speciated Elemental PM, Nonpolar Organics, and Source-apportioned PM Data

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Background/Aims: Substantial evidence supports an association of particulate matter (PM) with cardiorespiratory illnesses, but less is known regarding characteristics of PM and/or sources that contribute to this association. Here, we present results from a time-series investigation of emergency department (ED) visits in St. Louis, MO.

Methods: Individual-level data were obtained from the Missouri Hospital Association for all ED visits to acute-care hospitals in the St. Louis Metropolitan area during 1 January 2001 to 30 June 2007. The data set included data for 36 hospitals and >5,600,000 ED visits. Daily ambient air monitoring data for the major urban pollutants were obtained from the USEPA Air Quality System for representative sites within the St. Louis study area. Daily speciated data (including $PM_{2.5}$ metals and non-polar organics) were obtained from the St. Louis—Midwest Supersite for a 2-year period, and were used in an 11-factor positive matrix factorization analysis to obtain daily source contribution estimates. We used Poisson generalized linear models, controlling for long-term temporal trends and meteorological variables, to examine associations between 0-1-2 day air quality measures and daily respiratory ED visits, and between same day air quality measures and cardiovascular ED visits.

Results: Over the study period, we observed mean ED visit counts of 282 per day for respiratory outcomes and 100 per day for cardiovascular outcomes. Analyses of the criteria pollutants indicated strong positive associations between ozone and ED visits for all respiratory outcomes, URI, and asthma, as well as between NO_2 and $PM_{2.5}$ and asthma. With cardiovascular ED visits, associations were observed with CO. Preliminary analyses of speciated pollutants have focused on selected $PM_{2.5}$ elemental species (including elemental [EC] and organic carbon [OC], sulfur, zinc, silicon, and potassium). Results to date indicate elevated associations between cardiovascular ED visits and traffic-related indicators (zinc, EC, OC). Further analyses of the $PM_{2.5}$ elements, as well as key indicators of sources using non-polar organics data (including chrysene, benzo(b+k)fluoranthene, benzo(a)pyrene, indeno(123-cd)pyrene, norhopane, hopane, n-Octacosane, n-Nonacosane) and source apportioned estimates.

Conclusion: Preliminary results indicate impacts of both primary (eg, CO, NO_2, EC) and secondary (eg, ozone, $PM_{2.5}$) pollutants on acute cardiorespiratory morbidity in St. Louis, and are comparable with results of previous similar studies in other cities. Future analyses will consider associations between these outcomes and nonpolar organics, and may help to further describe important emission sources for pollutant-related health effects.

O-29B2-6

Genetic Susceptibility to Acutely Decreased Ubiquitin Proteasome Pathway Activity Following Inhalation of Fresh Diesel Exhaust or Secondary Organic Aerosols

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Background/Aims: Epidemiologic studies have consistently documented that cardiovascular events occur rapidly following ambient air pollution increases; however, underlying mechanisms are not clearly established. The proteasome (UPP), a fundamental intracellular protein degradation pathway, plays a role in regulating several mechanisms that participate in acute air pollution responses, including inflammation, nitric oxide synthesis, and oxidative stress responses. Furthermore, the proteasome can be inhibited by oxidative stress, suggesting that air pollution may decrease proteasomal activity. We hypothesized that acute exposure to air pollution affects proteasomal activity, more prominently in those with genetic susceptibility to oxidant stress.

Methods: Thirty-eight healthy subjects volunteered for a 2-hour, double-blind, randomized cross-over protocol to breathe diluted diesel exhaust (DE), a secondary organic aerosol (SOA), or clean air (CA). Subjects were stratified based on a common polymorphism of their glutathione-S-transferase pi (GSTP1). Proteasome activity was examined in peripheral blood cells by measuring chymotryptic activity, 1 of 3 key peptidase activities of the proteasome. Results for WBC and RBC, using mixed linear models for the change from pre-exposure values to 3 hours postexposure onset, are presented separately for DE, for SOA, and for DE and SOA combined, and stratified by GSTP1 status.

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Results: Compared with CA, WBC showed decreased proteasomal activity for both DE, −1070.9 (95% CI: −2635.6 to 493.7); SOA, −1928.5 (95% CI: −3665.1 to −191.9); and for DE and SOA combined, −1418.1 (95% CI: −2811.3, −24.8). RBCs showed similar although nonsignificant effects. Change in proteasomal activity demonstrated a significant interaction between GSTP1 status and SOA exposure, −51,45.2 (95% CI: −8817.3, −1473.0) ($P < 0.006$).

Conclusion: In 2 peripheral blood cell types, 2 different air pollutants reduced the activity of a key regulatory enzyme system. Moreover, individuals homozygous for a variant allele (ILE/ILE) of an antioxidant gene showed a greater response, suggesting the importance of oxidative stress in acute responses to air pollution exposure.

CHEMICALS AND ENVIRONMENTAL HEALTH ISSUES: PERSISTENT ORGANIC CHEMICALS

O-29B4-1

Serum Dioxin Concentrations and Bone Mineral Density in the Seveso Women's Health Study

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Background/Aims: 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD), a widespread environmental contaminant, is a known endocrine disruptor. Bone metabolism is both estrogen- and androgen-dependent. In animal studies, exposure to TCDD and dioxin-like PCBs impairs bone metabolism and increases fragility. No studies have examined this association in humans. On 10 July 1976, as a result of a chemical explosion, residents of Seveso, Italy, experienced the highest levels of TCDD in a human population. In 1996, we initiated the Seveso Women's Health Study (SWHS), a retrospective cohort study of the reproductive health of the women. In 2008, we followed up the SWHS cohort and measured bone density in women who were ≤20 years in 1976.

Methods: TCDD concentrations were measured in serum collected near the time of the explosion by high-resolution mass spectrometry. In total, 833 women (86%) participated and those who were ≤20 years old in 1976 were eligible to have bone mass density (BMD) measured at the lumbar spine and femur (neck, trochanter, shaft, total hip) using dual-energy x-ray absorptiometry. We examined the relation of TCDD and BMD at each site using linear regression.

Results: In total, 3250 (82% of eligible) women underwent a bone density examination. The average age at explosion was 10.7 (±5.0) years and at follow-up was 43.3 (±5.0) years. The median serum TCDD level of the women was 74.3 ppt, lipid-adjusted, and mean BMD of the lumbar spine and total hip were 1.01 (±0.13) g/cm^2 and 0.89 (±0.12) g/cm^2, respectively. In unadjusted analysis, lumbar spine BMD (beta = 0.018, $P = 0.06$) but not total hip BMD (beta = 0.004, $P = 0.69$) was positively associated with a 10-fold increase in TCDD.

Conclusion: Multivariate results and effect modification by age at exposure will be presented and interpreted in light of study advantages and limitations.

O-29B4-2

Incidence of Thyroid Disease Following Exposure to Polybrominated Biphenyls and Polychlorinated Biphenyls, Michigan, 1974–2006

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Background/Aims: Although the thyroid gland plays a crucial metabolic role throughout life, the effects of persistent chemicals on the thyroid have received limited attention. Of particular interest are persistent organic pollutants, which are used in many consumer products and are increasing in environmental concentration. Our objective was to examine the relationship between serum polybrominated biphenyl (PBB) and polychlorinated biphenyl (PCB) concentrations and thyroid disease incidence.

Methods: We employed incidence density sampling to perform a nested case control analysis of the Michigan Long-term PBB Cohort. Cohort members (n = 3333) were exposed to PBBs following the unintentional 1973 contamination of cattle feed and to PCBs through diet and the environment. Serum PBB and PCB concentrations were measured at enrollment; cases were cohort members who answered "Yes" to "Has a healthcare provider ever told you that you had a thyroid problem?" during follow-up interviews. We calculated odds ratios (OR) with 95% confidence intervals (CI) and assessed body mass index (BMI), smoking, and prior pregnancy for confounding and effect modification.

Results: Total cumulative thyroid disease incidence after 33 years was 13.9% among females and 2.6% among males. After adjusting for BMI, there were no statistically significant differences in thyroid disease incidence by PBB or PCB exposure among females. There was a trend towards increased thyroid disease incidence among males exposed to PBBs or PCBs, but this was statistically insignificant. Compared to controls, women with a thyroid disease had increased odds of being overweight/obese (OR = 2.82; 95% CI: 1.94, 4.11) and having infertility (OR = 1.71; 95% CI: 1.08, 2.69), diabetes (OR = 1.61; 95% CI: 1.04, 2.51), or arthritis (OR = 1.71; 95% CI: 1.18, 2.50).

Conclusion: The Michigan Long-term PBB Cohort is and will continue to be valuable in assessing the public health impacts of PBB and PCB exposures. Additional research is warranted to further explore potential associations between PBBs/PCBs and adverse thyroid disease in males.

O-29B4-3

Internal Doses of PCB153 Estimated for Different Exposure Windows During Women's Lifetime are Inversely Associated With the Incidence of Breast Cancer

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Background/Aims: Endocrine disrupting chemicals such as polychlorinated biphenyls (PCBs) have been suspected to play a role in breast cancer etiology, but epidemiologic studies have generally failed to detect an association between biological levels of PCBs and breast cancer. Measuring PCBs close to the time of cancer diagnosis and not assessing exposure during key periods of mammary gland development, eg, during childhood and adolescence, constitute major limitations, and may hinder the possibility of detecting an association between exposure and disease. We studied the relation between breast cancer risk and biological levels of

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PCB153 estimated during different exposure windows in the women's lifetime.

Methods: We conducted a case-control study including 1079 incident cases of breast cancer and 1055 population controls, who elicited a detailed questionnaire and gave a blood specimen during interview. Based on serum levels, the individual lifetime profiles for PCB153 internal doses were simulated using a physiologically-based pharmacokinetic framework that integrates information on age, height, weight changes over lifetime, pregnancies, and breastfeeding history. Logistic regression models were used to calculate odds ratios for breast cancer associated with PCB153 levels estimated during the first to the fifth decade of life, obtained from the pharmacokinetic profiles, and adjusting for age and reproductive risk factors.

Results: The odds ratio of breast cancer for women in the highest exposure quartile of PCB153 measured at recruitment in the study was 0.73 (0.54–0.99), as compared to women in the lowest exposure quartile. Using physiologically-based pharmacokinetic models had only weak influence on the findings, as the odds ratios were also below unity when women were classified according to simulated levels of PCB153 in different decades of life.

Conclusion: The inverse association with breast cancer confirms previous findings, possibly reflecting the effect of unmeasured environmental factors that correlate with PCB153, or a possible protective role resulting from AhR stimulation by PCBs.

O-29B4-5

Chronic Effects of Taiwanese People Highly Exposed to Polychlorinated Biphenyls and Dibenzofurans (PCBs/PCDFs)—A Mortality Analysis of Yucheng Subjects

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Background/Aims: In 1979, approximately 2000 victims in central Taiwan accidentally ingested rice oil, which was contaminated with polychlorinated biphenyls/dibenzofurans (PCBs/PCDFs). Mortality in the exposed people in the first 8 years (1980–1987) had been documented, and that caused by chronic liver diseases and cirrhosis was elevated. In this study, we compared mortality between the exposed subjects and their neighborhood referents in 1988–2007 to examine the chronic effects of PCB/PCDF exposure to mortality.

Methods: We obtained age- and gender-matched referents from the 1979 neighborhood of the exposed people. Cause-specific mortality (classified by ICD-9 codes) was compared between exposed subjects (N = 1850) and their neighborhood referents (N = 5247). Age-modified indirect standardized mortality ratios (indirect-SMR) were calculated utilizing the Yucheng subjects' neighborhood referents as reference group. Total person-year of Yucheng subjects and neighborhood referents was 35,020 and 99,411, respectively.

Results: Mortality of "other forms of heart disease" (ICD = 420–429) was increased in exposed subjects (SMR = 2.1; 95% confidence interval [CI] = 1.2–3.4). For females, systemic lupus erythematosus (SLE) was highly increased (5 in Yucheng subjects, 0 in neighborhood referents). For males, mortality of "disease of digestive system" (ICD = 520–579) (SMR = 2.2; 95% CI = 1.3–3.5), and "disease of genitourinary system" (ICD = 580–629) (SMR = 3.0; 95% CI = 1.1–6.5) were increased. In the "disease of genitourinary system," "nephritis, nephrotic syndrome, and nephrosis" (ICD = 580–589) (SMR = 3.6; 95% CI = 1.2–8.3) was increased. Despite that "neoplasms" was not increased, "malignant neoplasm of lymphatic and hematopoietic tissue" (ICD = 200–208) (SMR = 3.6; 95% CI = 1.2–8.3) were increased.

Conclusion: This study found increased mortality due to heart diseases in PCB/PCDF-exposed people. Among women, mortality due to SLE was increased. Among men, mortalities of digestive system, genitourinary system, and malignant neoplasm of lymphatic and hematopoietic tissue were increased.

CHEMICAL EXPOSURES DURING PREGNANCY AND DEVELOPMENT AND DISEASE IN INFANTS

S-29B5-1

The Association Between Perfluoroalkyl Chemical Levels in Umbilical Cord Blood and Neurodevelopment at 2 Years of Age

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Background/Aims: The perfluoroalkyl chemicals (PFCs) are persistent organic pollutants with global distribution. In animal studies with high dose exposure, adverse neurodevelopment had been reported. Yet, human epidemiological study is limited. The objective of this study was to explore the association between children's neurodevelopment at the 2 years of age and the concentration of PFCs in umbilical cord blood plasma.

Methods: Total 455 mother-infant pairs were recruited between April 2004 and January 2005 in northern Taiwan. We interviewed them by a structured questionnaire after delivery and collected cord blood at birth. The concentration of PFCs in cord blood was analyzed by UPLC-MS/MS. At children's age of 2, physical therapist evaluated their neurodevelopment using The Comprehensive Developmental Inventory for Infants and Toddlers. The scores of subtests including cognitive, language, motor, social and self-help were then transformed to developmental quotients (DQs) to correct the age of test. We examined the association between DQs and log10 transformed PFCs levels by linear regression models.

Results: Perfluorooctanoate, perfluorooctane sulfonate (PFOS), and PFNA levels in cord blood plasma were on average 1.15, 1.90, and 2.41 ng/mL, respectively. PFOS was negatively associated with gross motor (per log10 unit: $\beta = -6.65$ DQs; 95% confidence interval [CI]: -12.71 to -0.59 DQs) and fine motor (per log10 unit: $\beta = -7.16$ DQs; 95% CI: -12.78 to -1.53 DQs) of the Comprehensive Developmental Inventory for Infants and Toddlers. After adjusting for potential confounders, only the influence on gross motor remain statistically significant (per log10 unit: $\beta = -7.85$ DQs, 95% CI: -14.05 to -1.65 DQs).

Conclusion: Our data suggest inverse associations between PFOS levels in umbilical cord blood plasma and children's motor development. Further follow-up for these children is warranted.

S-29B5-2

Levels of Polycyclic Aromatic Hydrocarbons and Phthalates in Placentas of Women Who Delivered a Baby With a Neural Tube Defect and Women Who Delivered a Healthy Baby

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Background/Aims: Neural tube defects (NTDs) are a group of disorders that arise early in fetal development and can cause perinatal death or life-long complications. In some areas of China, the prevalence of NTDs is as high as 13.9 per thousand births. To explore the possible role of environmental pollutants in the development of NTDs, we assessed the concentrations of 15 polycyclic aromatic hydrocarbons (PAHs) and 6 phthalates in the placentas of women who had an NTD-complicated pregnancy and women who gave birth to a healthy baby.

Methods: Cases were 82 women who had an NTD-complicated pregnancy and controls were 50 women who gave birth to a healthy baby. Placentas were obtained upon delivery, placed in a polyethylene bag, and frozen at −20°C until preparation for analysis. A piece (about 10 g) of the thawed placentas was cut with stainless knife and washed 3 times with deionized water to remove blood. PAHs and phthalates were analyzed with gas chromatography-mass spectrometry.

Results: Preliminary data on 11 samples from case placentas and 10 samples from control placentas showed that mean levels of 13 PAHs were higher in the case group than in the control group, but none reached statistical significance. Anthracene levels were equal between the 2 groups. Acenaphthene and fluorenone levels were lower in the case group than in the control group ($P = 0.05$ and $P = 0.04$, respectively). As for phthalates, dicthyl ortho-phthalate levels were lower in the case group than in the control group, whereas levels of di-n-butyl ortho-phthalate and bis(2-ethylhexyl)ortho-phthalate were higher in the case group. However, none of these differences were statistically significant. Dimethyl ortho-phthalate and di-n-octyl ortho-phthalate were detectable only in some samples.

Conclusion: The preliminary results do not provide sufficient data to draw a conclusion. The laboratory assessment on the remaining samples is on-going and the full results will be presented.

S-29B5-3

Prenatal Exposure to Polycyclic Aromatic Hydrocarbons, Bisphenol A, and Phthalates and Growth and Neurodevelopment in Infants and Children

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Background/Aims: To examine the potential health effects of growth and neurodevelopment in infants and children associated with prenatal exposure to polycyclic aromatic hydrocarbons (PAHs), bisphenol A (BPA), and phthalates.

Methods: Study subjects were mothers and children (n = 200–600 pairs) who were enrolled in the mothers and children's environmental health (MOCEH) study, a multicenter cohort of pregnant women. We measured maternal urinary levels of 1-hydroxypyrene and 2-naphthol (2-NA) as metabolites of PAHs, BPA, and 3 phthalates as environmental endocrine disruptors during early pregnancy and at delivery. Fetal growth was assessed by ultrasonogram measuring biparietal diameter, abdomen circumference, and femur length. Birth weight and the Ponderal index were measured at delivery. At 6 and 12 months of children, neurodevelopment was assessed using Bayley test. We analyzed the association between prenatal urinary levels of these chemicals in mothers and fetal growth, birth weight, and neurodevelopment in children using multiple regression, logistic regression, and mixed model adjusted for possible confounding factors.

Results: The fetal abdominal circumference showed a positive association with urinary phthalate level (MBP) at early pregnancy ($P = 0.02$), while any indices of fetal growth having no association with the other chemicals. The birth weight increased significantly according to increasing maternal BPA level at delivery (P trend $= 0.04$), but it decreased according to increasing 1-hydroxypyrene ($P = 0.06$) and 2-NA ($P = 0.07$). The psychomotor developmental score assessed by Bayley test at 6 months of infant was significantly decreased according to increasing maternal urinary BPA level at delivery ($P = 0.04$). The mental developmental score at 12 months of infants was significantly decreased by increasing 2-NA level at delivery (P trend $= 0.01$).

Conclusion: The prenatal PAHs exposure seems to decrease birthweight and mental development of infant, while prenatal exposure to endocrine disruptors increase fetal growth and birth weight, but decrease the psychomotor development of infant.

S-29B5-4

Sex Difference of Prenatal Effects to Dioxins Exposure on Birth Weight, Development, and Infectious Diseases in Offsprings: The Hokkaido Study on Environment and Children's Health in Japan

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Background/Aims: Animal studies suggested that sex-specific difference was related to different affinity by sex with AhR, and sex different effect might be related to the demonstrated cross-talk between the AhR and ER signaling pathways. Several birth cohorts have been established worldwide to investigate effects of environmental chemicals; however, few reports have been published on the relationship between low-level exposures and adverse outcomes and health effects to the offspring, especially focused on gender differences. We investigate effects of PCDDs/PCDFs and dioxin-like PCBs exposure on birth weight, neurodevelopment, and immune systems to confirm that adverse effects may exert in males but not or less prominent in female offspring.

Methods: The Hokkaido Study on Environment and Children's Health; Malformation, Development, and Allergy is the largest cohort (n = 20,000) in Japan, which began in 2001. The study consists of 2 cohorts. Using a HRGC/HRMS, we measured 29 congener levels of PCDDs/PCDFs and dioxin-like PCBs in maternal blood to examine an association between these concentrations and infant birth weight, child development, Cord serum Ig E, and infectious diseases. BSID-II was used to at 6–7 and 18 months of age.

Results: The mean total toxic equivalents (TEQ) level was 17.5 TEQ pg/g lipid in maternal blood. Among male infants, significant adverse associations with birth weight were found for total PCDDs TEQ level, total PCDDs/PCDFs TEQ level, and total TEQ level; Total PCDDs, total PCDDs/ PCDFs, and 1,2,3,4,6,7,8-HpCDD were significantly negatively associated with developments and IgE especially in males. We also observed association between dioxins levels and otitis media among male infants. However, these significant associations were not found among female infants.

Conclusion: Regard similar to animal data findings, our results indicate that male offspring might be more susceptible to dioxin than female offspring ie, birth weight, neurobehavioral development, Ig E level, and infection, which confirm that adverse effects may exert in males but not or less prominent in female offspring.

S-01A3-4

Trihalomethane Exposure at Pregnancy, Birth Weight, and Duration of Gestation: Results From a Cohort Study in Spain

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Background/Aims: Exposure to disinfection byproducts during pregnancy has been associated with reduced birth weight and altered duration of gestation but evidence remains inconclusive. We assessed exposure to trihalomethanes (THMs) during pregnancy through ingestion, showering, bathing, and swimming in pools and evaluated the association with birth weight, small for gestational age (SGA), low birth weight (LBW), and duration of gestation.

Methods: A mother-child cohort study was set up in Asturias, Gipúzkoa, Sabadell, Valencia, and Granada (INMA project). Study population was recruited at week 12 of gestation and followed up to delivery. A personal interview at week 32 requested water use: source of drinking water, showering, bathing, and swimming in pools. Trihalomethane level was ascertained through sampling campaigns (834 measurements) and regulatory data (264 measurements) during the pregnancy period. Chloroform, bromodichloromethane, dibromochloromethane, bromoform, and total THM were modeled for each region, predicting monthly level over pregnancy. Modeled residential THM was combined with personal water use and uptake factors to estimate THM uptakes. Outcomes were defined following standard definitions. Linear and logistic regressions adjusting for potential confounders were applied stratifying by area and all areas combined.

Results: Total THM ranged from a median of 5.9 μg/L (Valencia) to 114.7 μg/L (Sabadell). A total of 2091 newborns were included, with 52% male, mean birthweight of 3267 g, 10.5% SGA, 5.1% LBW, and 3.8% preterm. All area combined estimated change of birth weight for a 10% increase in uptake was −0.46 g (−1.36, 0.45) for chloroform and 0.18 g (−1.36, 1.71) for brominated THMs. A meta-analysis showed no heterogeneity of effects among areas. Chloroform uptake was not associated with SGA, slightly increased LBW risk, and moderately reduced the risk of preterm delivery.

Conclusion: Despite the high THM levels in some areas, THM exposure was not associated with birthweight or SGA and was only slightly associated with LBW and preterm birth.

WHO-ISS SYMPOSIUM: HEALTH IN CONTAMINATED SITES: EXPERIENCES, NEEDS, PRIORITIES

S-29B6-1

Health in Industrially Contaminated Sites. Challenges and Opportunities

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Background/Aims: High concentration of industrial activities, especially large scale petrochemical, power generation, heavy industry, extractive etc, involves strong environmental pressures, with health implications for local communities through occupational and residential exposures to a variety of agents, typically in complex mixes.

Methods: Assessing the occurrence and the extent of the associated health impacts is normally very difficult, for several reasons, for example, poor exposure assessment, unreliable emission and contamination data, presence of multiple substances, and mixes of exposures, need to consider multiple health end points.

Results: Such difficulties may explain the relative lack of data about the possible health impacts of industrially contaminated sites, although many.

Conclusion: Experiences exist where methodology was developed and applied to try and deal with the complexities and the uncertainty always present in these assessments, but the question of the overall health impact of these facilities remain essentially unanswered. Information and data are also needed on to what extent these impacts pose additional health burdens on subpopulations already suffering from other pressures, for example, from a socially deteriorated environment. Such dimension of environmental justice, a crucial policy driver, needs careful and urgent clarification, if meaningful remediation policies are to be identified and implemented.

S-29B6-2

Monitoring the Health of Populations With Polluted Drinking Water. The Example of Perfluorinated Compounds

Tony Fletcher *London School of Hygiene and Tropical Medicine, London, United Kingdom.*

Background/Aims: Perfluorinated compounds are highly persistent and widely distributed. They do not exist in nature, are associated with a wide variety of toxicological end points including carcinogenicity, and have been used increasingly since the 1950s. One of the 2 most widely distributed compounds perfluorooctane sulfonate has been declared a POP; the other, Perfluorooctanoic acid (PFOA), is being phased out of some its main uses. In the mid-Ohio valley in the United States, drinking water in 6 water districts has been contaminated for approximately 50 years with PFOA (also known as C8), which was released by a nearby Teflon manufacturing facility. The exposure of a community to this compound led to litigation against the polluting company. Part of the settlement was a comprehensive epidemiological programme assessing potential health effects in the exposed population, designed to give a clear indication of what health effects are probably linked to exposure.

Methods: The C8 Science Panel (www.c8sciencepanel.org) including this author, is currently conducting several complementary epidemiological studies of PFOA in this community. This work includes the analysis of a baseline survey of 69,030 community residents conducted in 2005/2006 in which PFOA was measured in the blood.

Results: The mean serum PFOA in this population was 83 ng/mL (median 28 ng/mL), compared to an average of about 4 ng/mL in the general US population. Outcomes of monitoring health and exposure to these compounds for which we have completed reports include cholesterol, immune and inflammatory markers, uric acid, and reproductive outcome. Others are underway.

Conclusion: This legal conflict led to a novel way of combining a health study and evaluation to monitor health in a non-conflictual research framework. Although it is a means of providing resources for research, litigation in general is limited in determining priorities for selecting exposures to study.

S-29B6-3

Multicentre Mortality Study of Contaminated Sites of National Concern in Italy

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Background/Aims: Soil contamination requiring clean-up occurs in approximately 250,000 sites in the European Environment Agency-EEA member countries; several thousand sites qualify for remediation in Italy, 57 of them are defined as "of national concern" for the entity of the documented contamination. SENTIERI project, funded by the Italian Ministry of Health, aims at describing sources of environmental pollution in Italian contaminated sites and health status of resident populations using mortality data.

Methods: In all, 44 sites were selected for analyses (298 municipalities, 5.5 million inhabitants, about 10% of Italian population at 2001 census). These sites were classified based on the presence of environmental exposure/s as documented in the Ministerial Decrees, namely presence of chemical/petrochemical plants, refineries, asbestos/other mineral fibers, steel plants, thermoelectric-power factories, mines/quarries, landfills/incinerators. Standardized mortality ratios, crude, and adjusted for deprivation (taking into account unemployment, education, house ownership, and overcrowding) were computed for 54 groups of causes of death (reference: regional populations, 1995–2002). Besides analyses of the health status, biomonitoring programs are in progress to improve exposure assessment and surveillance.

Results: As an example, Taranto area, affected by a large industrial facility, including one of the largest European steel factories, showed significantly increased mortality for all causes, all cancers (namely esophagus, liver, pancreas, larynx, lung, and pleura), circulatory and respiratory diseases, and liver cirrhosis. Where applicable, cancer registry data are used to evaluate departures of observed incidence rates from expectation; thus, improving accuracy of outcome indicators and avoiding bias from differential survival by geographic area. In Taranto, an exploratory study on the body burden of dioxins and metals in a sample of residents is also ongoing.

Conclusion: SENTIERI is the first project describing the health impact of residence in polluted sites at national level, it aims at identifying priorities in planning environmental remediation. International cooperation is desirable both for improving methodological approaches and for evaluating replicability of findings.

S-29B6-4

Studies on the Effects of Municipal Waste Incinerators

Manolis Kogevinas *CREAL, Barcelona, Spain.*

Background/Aims: An association between proximity to municipal solid waste incinerators (MSWIs) and congenital anomalies, lymphomas, or other neoplasms has been found in studies in France and Italy. Although the evidence is inconclusive, findings raise concern due to the widespread use of this technology. The attitude of public health authorities has been sceptical concerning potential health effects, particularly regarding modern incinerators with improved emission control. The paper will present studies evaluating potential effects of municipal waste incinerators, including a biomarker study in Barcelona, and will focus on the difficulties in evaluating relatively low-level complex exposures.

Methods: We conducted a study north of Barcelona, Spain comparing blood levels of dioxins and polychlorinated biphenyls when a modern MSWI started functioning and in 2 follow-up periods spaced 2 years each. Participants in the study were a random sample of 104 residents living within 1.5 km from the plant, an equal number living at about 4 km north and another sample living about 20 km north. A World Health Organization accredited laboratory (ERGO, Hamburg, Germany) performed all dioxin analyses.

Results: At baseline, the blood levels were slightly below 15 pg international dioxin toxic equivalents/g fat. We found a continuous increase in dioxin blood levels over the 4 years of the study, which was similar in people living near and far from the incinerator, affecting both sexes and all groups of age.

Conclusion: The increasing level of dioxins in this population is surprising, since it contrasts to the general tendency in industrialized countries. The geographical comparison between study areas indicates that this increase cannot be attributed to this incinerator. Several aspects should be considered in the discussion of potential short- and long-term effects of MSWI. Perhaps the most important is that massive investment on MSWI seriously compromises efforts for an ecological handling of residues.

IS IT POSSIBLE TO CONTROL AEROSOL TRANSMISSION AND CAN WE RESOLVE UNCERTAINTIES? (ISIAQ SYMPOSIUM)

S-29B8-1

Expiratory Aerosol Transport and Deposition in Different Indoor Environments: Exposure and Risk Assessment Related to Influenza Transmission

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Background/Aims: The transport and deposition of expiratory aerosols in indoor environments are closely related to the transmission of respiratory infectious diseases. Respiratory pathogens can be aerosolized during expiratory actions such as coughing or sneezing. Disease transmission by pathogen-laden expiratory aerosols can be classified into different modes. Understanding of the complicated mechanisms behind infection and disease transmission requires multidisciplinary knowledge. Their transport in air and their deposition on surfaces involve multiphase fluid dynamics while the pathogen survival is related to their microbiological properties.

Methods: The dispersion and deposition of expiratory aerosols in a hospital ward, an aircraft cabin, and an office environment were investigated both experimentally and numerically. Based on these data, exposure and infection risk assessment on influenza using dose-response model were conducted. Spatial exposure levels to these infectious particles were obtained. Microbiological properties of the pathogens were integrated to obtain the pathogen exposure level of each susceptible person.

Results: Expiratory aerosols with initial sizes smaller than 28 micron in size can remain airborne for substantially long time to be the major contributors to airborne mode disease transmission. The transport and deposition of aerosols with initial sizes larger than 28 micron in size are dominated by inertial and gravitational effects. These large aerosols are the major contributors to disease transmissions via the contact mode.

Conclusion: Airflow patterns in the premises were able to affect the infection risk of the occupants significantly in all pathways. Size of the aerosols also plays an important role on the transmission of respiratory infectious diseases. Use of benign bacterial virus as "tracer virus" to study the transport of aerosolized viruses in indoor environment can be a very useful method for exposure and risk assessment on respiratory infectious diseases such as influenza.

S-29B8-2

Engineering Approaches to Characterize the Effectiveness of Upper-room UVC Lights for Controlling Aerosol Transmission of Influenza

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Background/Aims: The inactivating effect of UVC (200–280 nm) light on influenza virus, to be reviewed, provides an opportunity for engineering controls to prevent airborne influenza transmission. In this presentation, some engineering approaches to predict the effectiveness of upper-room UVC systems by characterizing the air movement in buildings and accounting for susceptibility of influenza would be introduced.

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Methods: Numerical methods were used for simulating the air movement considered to convey the aerosolized influenza virus and they referred to the experimental data demonstrating susceptibility of aerosolized influenza virus to UVC light and UVC intensity distribution data in upper area of rooms. A simplified ward including a source point was modeled and the inactivation performance of upper-room UVC light were predicted in several cases changing the position of UVC light and ventilation openings, which might eventually change the airflow distribution in the ward.

Results: The experimental results indicated reasonable susceptibility of the aerosolized influenza virus to UVC light. In many simulated cases with the data, the position of UVC light and some factors affecting air movement in the ward such as the position of ventilation openings affected the entire inactivation efficiency of upper-room UVC systems. Specifically speaking, the residence time of air containing influenza virus at high UVC intensity area needs to be increased for better performance of the systems.

Conclusion: Considering the possibility of aerosol transmission of influenza, air movement is a critical factor not only for the dispersion of influenza virus but also for the inactivating effect of upper-room UVC systems.

S-29B8-3

Do We Know Enough and Do We Agree Enough to Implement Effective Non-pPharmaceutical Interventions? Research Directions

Donald K. Milton *University of Maryland, College Park, MD.*

Background/Aims: The US-Center for Disease Control assumes that the primary route of transmission of seasonal influenza is via large droplet spray generated from coughs and sneezes with direct hits on the mouth or nose of susceptible people nearby. Recommendations for non-pharmaceutical interventions in seasonal and pandemic influenza do not emphasize control of aerosol transmission, except for aerosol generating procedures. However, the US National Academy of Sciences recommended use of N-95 or better respirators to protect healthcare workers against pandemic influenza because of the potential for an important role of transmission via fine particle aerosols. In the United States, OSHA made these recommendations enforceable. How can we resolve this controversy?

Methods: We review Langmuir criteria for definitive studies of respiratory infection transmission, review the implications of the standard hierarchy of workplace environmental controls in the setting of infectious diseases, and engage the audience in a discussion of how environmental epidemiology and exposure science can contribute to future studies capable of resolving the scientific and policy questions posed by the problem of influenza control.

SOLVENT EXPOSURE IN PETROCHEMICAL INDUSTRY

O-29B9-1

Follow-up Study on Occupational Exposure to Organic Solvents and Neurobehavioral Performances of Automotive Painters

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Background/Aims: This study assessed occupational exposure to organic solvents and neurobehavioral performance of exposed automotive painters. The mean personal air toluene concentration (PATC), urinary hippuric acid concentration, and standard score (SS) of the modified WHO Neurobehavioral Core Test Battery (NCTB) of exposed workers in 2008 were compared with those obtained in 2004.

Methods: The study subjects consisted of 48 automotive painters who had participated in the 2004 study. They were re-examined in 2008 using PATC, urinary hippuric acid concentration, and 7 test items of the NCTB. A questionnaire was used to obtain sociodemographic information.

Results: The mean PATC in 2008 was 0.403 ppm, which was significantly lower ($P < 0.001$). The mean SS for the Digit Span Test, Benton Visual Retention Test, Pursuit Aiming Test, and Total NCTB were significantly higher in 2008 compared to those in 2004 with the exception of the Santa Ana Manual Dexterity Test that showed significantly lower mean SS in 2008 compared to those in 2004.

Conclusion: The lower concentration of solvents in the workplace and a shorter duration of exposure have contributed toward an improvement in the neurobehavioral performance of automotive painters in 2008 as compared to those in 2004 with the exception of manual dexterity.

O-29B9-2

The Risk of Multiple Sclerosis Among Petroleum Workers Exposed to Crude Oil and Other Hydrocarbons

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Background/Aims: Environmental factors are likely to play an important role in the development of multiple sclerosis (MS). Offshore workers in the Norwegian petroleum industry are exposed to a number of chemical factors, such as organic solvents, mineral oils, and other hydrocarbons, suggested to contribute to an increased risk. Further, recently there has been a concern in the society about a perceived excess of MS in this industry. We therefore estimated the risk of MS in this population compared with the general working population in Norway.

Methods: Using the Norwegian Registry of Employers and Employees, we included all 27,919 offshore workers registered from 1981 to 2003 and 366,114 referents from the general working population matched by gender, age, and community of residence. Based on the workers industrial classification codes for their first registered engagement in the offshore-related petroleum industry, we categorized the workers into 4 job categories. A diagnosis of MS among these workers was ascertained by linkage to the Norwegian MS-registry and discharge files from neurological departments covering the counties where the workers resided; resulting in a total of 733 patients with onset of disease after start of their working engagement. The risk of MS according type of occupation was estimated prospectively using Cox proportional hazard regression model including age, gender, level of education, and year of employment as covariates.

Results: There was no excess risk of MS among the offshore workers compared with the general working population. The workers in the 2 job categories assumed to have the most extensive contact to hydrocarbons (production and drilling) had a nonsignificantly decreased risk (RR = 0.54, 95% CI: 0.24.1–1.21 and RR = 0.92, 95% CI: 0.46–1.86).

Conclusion: These findings do not support a major etiological role of crude oil, organic solvents, or other petroleum-based oil products in the development of MS.

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O-29B9-5

Exposure to Benzene During Turnaround in Aromatic Hydrocarbon Manufacturing Plant

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Background/Aims: This study assessed benzene exposure during turnaround (TA) in an aromatic hydrocarbon manufacturing plant.
Methods: Exposure assessment was conducted by full shift-based long term personal sampling (TWA-P) with passive samplers (OVM 3520) and task-based short term personal sampling (STEL-P) with charcoal tube during all phases of the TA. In addition, area sampling (TWA-A) was carried out to evaluate variation of concentration by steps of the TA.
Results: A total of 697 samples were collected from an aromatic hydrocarbon manufacturing plant in Korea. The average benzene concentrations of TWA-P, STEL-P, and TWA-A were 1.1, 15.9, and 2.3 ppm, respectively. A 20% of TWA-P samples exceeded the occupational exposure limit, 1 ppm. The tasks with the highest benzene exposure level were open draining (maximum, 220.4 ppm), steam out (maximum, 170 ppm), drain hose line-up (maximum, 81.3 ppm), and blind swing (maximum, 50.1 ppm). The average benzene exposure levels were significantly different by the steps of TA ($P < 0.01$). The most risky step was the phase of oil out and steam out with the average TWA-P benzene concentration, 1.45 ppm.
Conclusion: In conclusion, the possibility of high exposure to benzene during TA should be considered in terms of the epidemiological study for petrochemical workers related to benzene.

MATERNAL EXPOSURE TO PERSISTENT TOXIC SUBSTANCES AND PREGNANCY OUTCOMES IN THE ASIA-PACIFIC REGION

S-29C1-1

Maternal Exposure to Persistent Toxic Substances and Pregnancy Outcomes in the Asia-Pacific Region. The North-South Dimension. Introductory to the Symposium

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Background/Aims: Globally, a number of persistent toxic substances (PTS), including metals, are recognized as being responsible for adverse neurological development and other health effects in children. The growing fetus and newborn child are especially sensitive to the toxic effects of many persistent organic pollutants and heavy metals found in the environment. The levels of these contaminants in maternal blood during pregnancy give an indication of the potential risk to the developing fetus. Considerable efforts have been made over the last 30 years to characterize PTS concentrations in the environment in the Northern Hemisphere. Most of the research has focused on the DDT group, the PCB-group, industrial chemicals, and by-products such as dioxins and furans. Heavy metals such as mercury and lead have also been monitored in the environment and in a range of biota. More recently, the brominated flame retardants have been found in increasing concentrations in the environment and are considered the "new" or emerging PTS.
Methods: There is so far very limited information relating to the Asia-Pacific Region. The Arctic Monitoring and Assessment Programme (AMAP) initiated collaborative research programmes in a range of developed and developing countries in the Southern and Northern Hemisphere. The protocols for these studies are developed through the AMAP network, including the quality assurance/quality control of the laboratory performance in all study bases. This cooperation allows a direct comparison of results and assessments. Attention is now being given to the Asia-Pacific Region including Australia.
Results: The aim of this symposium is to share current results of studies of maternal exposure and pregnancy outcomes from AMAP participants including Australia, Vietnam, and Russia.
Conclusion: The introductory presentation will outline the frame and context for the results presented in the symposium, including an overview of new Arctic cohorts.

S-29C1-2

Metals Exposure in Pregnant Women in South West Western Australia—Preliminary Results

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Background/Aims: Globally, a number of persistent toxic substances, including metals, have been recognized as priority environmental pollutants due to their ubiquitous nature. Metals, specifically lead, cadmium, mercury, and arsenic, have given rise to adverse health effects at low concentrations. Past investigations have highlighted infants, young children, and pregnant women as the most vulnerable groups. In Australia, there is little information about the pattern and levels of metals exposure in the general community and no systematic assessment of exposure in pregnant women and children. Our study aimed to determine the concentration of metals exposure in nonoccupationally exposed pregnant women living in the South West of Western Australia.
Methods: A preliminary investigation of exposure was undertaken using biological and environmental sampling in combination with diet diaries and questionnaire information. Samples of blood, urine, and drinking water were collected from 22 participants aged between 26 and 42 years and analyzed for metals by inductively coupled plasma-mass spectrometry.
Results: The concentrations in blood for most metals were in the typical ranges; however, there was some evidence of elevated nickel (mean: 58.7 μg/L, range: $<6-879.7$ μg/L). Nickel, copper, and cadmium concentrations in urine were elevated for 45%, 36%, and 59% of participants with median concentrations 2.6 μg/L, 9.4 μg/L, and 0.8 μg/L, respectively. The observed median metals concentrations in drinking water were all below the Australian Drinking Water Guidelines. Additional blood, urine, drinking water as well as soil, dust, and dietary information are currently being analyzed.
Conclusion: These results reveal for most participants concentrations are low; however, there are some elevated exposures, which require additional investigation to identify the source.

ISEE-0891

A Systematic Review of PBDEs in Dust Comparing Concentrations Across Home, Office and Vehicle Environments and Country

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Background/Aims: Production, demand, and consumption of Brominated Flame Retardants (BFRs) have increased rapidly over the past 20 years as has the potential for human exposure. BFRs are included in textiles, plastics, foams, electronics, and building materials to prevent fires. They are known to be persistent, lipophilic, bioaccumulate through the food web and spread easily to soil, water, and air. Humans are exposed through consumption of contaminated foods, inhalation/ingestion of contaminated dust, and occupational exposure. Polybrominated diphenyl ethers (PBDE) are the most common BFR and spread to the environment during production, leakage from a product or during the breakdown of the

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product containing PBDE. All sources of PBDEs and pathways of exposure are yet to be identified. However, research indicates indoor exposure (air/dust) may be of higher importance than diet. The aim of this systematic review was to determine the concentration of exposure to PBDE through dust and where most exposure occurs.

Methods: Database searches of MEDLINE, the Cochrane Library, ScienceDirect, and Web of Science until 2010, in the English language. Key words used: brominated flame retardan*, flame retardan*, PBDE*, polybrominated diphenyl ether*, dust.

Results: Median levels of BDE-209 in homes ranged 63–10,000 ng g^{-1}. In a study of 20 vehicles concentrations ranged from 12,000 to 2,600,000 ng g^{-1}, median 100,000 ng g^{-1}. Highest levels of PBDEs are found in offices and recently built homes with carpet and air-conditioning; lowest levels have been found in older homes without air-conditioning. Higher levels of PBDE are found in vehicles than in homes, PBDEs are abundant in the internal structure of vehicles. BDE-209 is the most dominant congener detected in dust samples, found in highest concentrations in the United Kingdom. In the main reported levels in United States are significantly higher than anywhere in the world.

Conclusion: PBDEs are commonly detected in home/vehicle/office environments. However, little is known about the health risks of exposure.

S-29C1-4

Maternal Levels of Organochlorines in 2 Communities in Southern Vietnam

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Background/Aims: Some chlorinated pesticides and polychlorinated biphenyls (PCBs) continue to be reported as environmental problems in some areas of Vietnam. The aims of the study were to determine levels of these contaminants in delivering women's plasma samples, and to identify exposure risk factors.

Methods: The research took place in 2005 in 2 communities in south-central Vietnam (Khanh Hoa Province), namely the coastal city of Nha Trang and the rural district of Dien Khanh located about 10 km inland. The design of the study was cross-sectional. In all, 189 delivering women's blood samples were collected and they were interviewed at home about related information within 4 months after delivery. The OC concentrations were quantified on GC/MS with a method as described by Sandanger et al. The GC/MS Shimadzu QP-5050A and Fishon MD-800 were used in Viet Nam and in Norway, respectively.

Results: The main findings in plasma (n = 189) were relatively high mean concentrations of p,p′-DDE (12.2 μg/L in Nha Trang and 11.4 μg/L in Dien Khanh) and p,p′-DDT (1.2 μg/L in Nha Trang and 1.1 μg/L in Dien Khanh) with no significant community differences. The ratio of p,p′-DDE/p,p′-DDT were 11.5 in Nha Trang and 12.7 in Dien Khanh. Mean concentrations of PCB 153 (0.15 μg/L in Nha Trang and 0.10 μg/L in Dien Khanh) and other congeners were low in both communities. Age and parity (all compounds), as well as community of residence for PCB 153, were the most important predictors of plasma organochlorine concentrations.

Conclusion: The results suggest, as in other Vietnamese OCs studies, recent use of p,p′-DDT in this area of Vietnam despite its ban. The relatively high levels of p,p′-DDE and p,p′-DDT and PCB 153 in delivering women blood give reason for concern about the long-term effect on children's health. Because the breast-feeding should remain a priority, the education on the hazards of OCs use and the dietary advice for women is important to circumvent high body burdens.

S-29C1-5

The North Pacific Russian Experience: Chukotka and Commander Islands Indigenous Population Exposure to PTS and Pregnancy Outcomes

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Background/Aims: Indigenous communities in the Arctic are at high risk of exposure to persistent organic pollutants (POPs) and metals, which increases the risk of adverse reproductive health effects (AMAP 2009). The objective of the study was assessment of the PTS blood levels in the coastal and inland Chukotka and in Commander Islands, and evaluation of the pregnancy outcomes in connection with maternal exposure in Chukotka.

Methods: In all, 126 maternal blood samples from coastal and inland Chukotka, 92 blood samples from population of both genders from Chukotka and 89 blood samples from population of Commander Islands (all collected in 2001–2003) were analyzed for PCBs, DDTs, HCHs, HCB, oxychlordane, t-nonachlor, mirex, toxaphenes, mercury, lead, and cadmium. Data on maternal and child health were collected from the mothers' medical files, newborns' delivery records, and questionnaires of the mothers.

Results: Geographically, the highest blood levels of the majority of pollutants were detected in coastal Chukotka obviously due to traditional marine mammal consumption and additional contamination of foodstuffs during storing. Concentrations of PCBs in about 70% of blood samples from pregnant women and women of reproductive age from coastal Chukotka were found exceeding the internationally recommended levels of concern and, in some cases (up to 20%), action levels. Concentrations of mercury in about 60% of blood samples from women of reproductive age from coastal Chukotka were found exceeding the level of concern. Concentrations of lead in about 35% of blood samples from women and 75% from men from coastal Chukotka, and about 60% from men from inland Chukotka were found exceeding action level. Some associations between the maternal serum concentration of selected POPs and a number of adverse reproductive effects such as premature births, low birth weight, developmental defects have been shown, in some cases statistically significant. No reliable differences of average blood levels of metals were identified between pregnancy failure women and the control group. Analysis of menstrual status anamnesis of Chukotka mothers has shown certain associations between the maternal serum concentrations of specific POPs and such parameters as age of first menses, cycle length, and bleeding duration.

Conclusion: The results of the study demonstrate high levels of PTS exposure of indigenous people in Chukotka and Commander Islands, increased risk of adverse pregnancy outcomes, and the necessity of risk reduction measures substantially in coastal Chukotka.

EXPOSURE TO AND HEALTH EFFECTS OF TRAFFIC-RELATED POLLUTION

S-29C2-2

Black Carbon Measurement Is Effective in Detecting the Benefits of Traffic Restriction Policy on Outdoor Air Quality—The Field Study of Ecopass Area in Milan, Italy

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Background/Aims: The impact on air pollution of the traffic restriction scheme in Milan "Ecopass" is questionable. Ecopass, allowing only low-

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emission cars enter the city center without paying a charge, was implemented in 2008 with expectations of a 30% decrease in particulate matter (PM_{10}) levels. However, a field study conducted in 2009 showed no PM reductions in the city center, in spite of an objective decrease in vehicular traffic. Aerosolized black carbon (BC, also called elemental carbon) is a primary product of incomplete combustion and could be a better indicator of local air quality improvement than PM_{10}, which is more representative of background pollution. The aim is to study BC in assessing Ecopass impact on air quality compared to PM.

Methods: We measured BC and PM levels on the sidewalks of a radial metropolitan road characterized by 3 different traffic schemes: an outer segment without traffic restrictions, an intermediate one subject to Ecopass, and an inner pedestrian zone. BC was measured with a handheld analyzer (microAeth Aethalometer AE51, Magee Scientific, Berkeley, CA), while PM was measured with a laser-operated particle analyzer (Aerocet 531, Met One, Grants Pass, OR).

Results: PM levels were quite stable, with a mean ± standard deviation of 20.6 ± 3.2, 19.6 ± 2.2, and 21.2 ± 2.4 $\mu g/m^3$ for PM_1; of 26.5 ± 4.6, 24.2 ± 2.7, and 25.4 ± 2.7 $\mu g/m^3$ for $PM_{2.5}$; and of 69.0 ± 18.8, 54.5 ± 6.9, and 52.0 ± 7.1 $\mu g/m^3$ for PM_{10}, respectively for no-restriction, Ecopass, and pedestrian zone (significant only no-restriction/pedestrian zone for PM_{10}). On the contrary, for BC levels a progressive reduction was found moving toward the least polluted area, with 12.2 ± 4.6, 6.9 ± 1.5, and 3.0 ± 0.6 $\mu g/m^3$ for no-restriction, Ecopass, and pedestrian zone, respectively ($P < 0.0001$ for each comparison). $BC/PM_{2.5}$ ratios were also distinctive for each area, being 46.2 ± 5.2, 28.4 ± 2.1, and 11.7 ± 1.2, respectively ($P < 0.001$).

Conclusion: BC is more suitable than PM in detecting the impact of traffic restrictions on air quality.

S-29C2-1

The Effect of Traffic-related Air Pollution on Infantile Bronchiolitis and Susceptibility to Childhood Asthma

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Background/Aims: The present study was performed to evaluate the effect of pre- and postnatal traffic-related air pollution (PPTAP) on infantile bronchiolitis and childhood asthma through the life course approach. The relationship between PPTAP and bronchiolitis was investigated; then, the effect of the exposure to air pollution on the susceptibility to childhood asthma was analyzed, including interaction with the experience of bronchiolitis.

Methods: The present investigation involved 2754 children who participated in the study. Individual exposure to the environmental air pollution concentration was analyzed using geostatistical analysis and spatial statistical analyses. Individual exposure to traffic-related air pollution was calculated by the total length of nearby roads and the distance between the residence and nearby roads. A multiplicative model, which considered the interaction terms of multiple logistic regressions, was used to analyze the complex effects of various factors of PPTAP and the measured air pollution.

Results: The experience of bronchiolitis after birth was affected by the exposure to air pollution through particulate matter (PM_{10}) and CO, the early periods after birth with statistical significance. An incremental tendency toward bronchiolitis with the increasing total length of roads within 200 m from the residence was found. As for bronchiolitis according to the length of roads, within 200 m of the home and parental history of allergy, those with 200 m or more road length and parental history had more bronchiolitis (odds ratio [OR], 3.10; 95% CI, 1.62–5.92) than those without. Those whose parents were less educated and had prior experience of bronchiolitis showed higher OR when exposed to PM_{10} and CO above the upper limit, and increased length of roads. Moreover, the OR for bronchiolitis was the highest, when children were highly exposed to passive smoking and PM_{10}, born prematurely, and experienced longer nearby roads. The OR of asthma was calculated in relation to the experience of bronchiolitis and recent exposure to PM_{10}. Those with a history of bronchiolitis and with annual mean level of 50 $\mu g/m^3$ more exposure to PM_{10} showed the highest OR (9.39; 95% CI, 4.85–18.15) compared with those without these 2 risk factors. The OR of asthma was also calculated in relation to the experience of bronchiolitis and the total road length within 200 m of the home.

Conclusion: There are individuals who are especially susceptible to air pollution, and they have distinct characteristics compared healthy children. Children who suffered from bronchiolitis before the age of 2 years are at risk of asthma. Premature birth, passive smoking, air pollution, as well as allergy history of the parents, affect the risk of bronchiolitis before the age of 2 years, and are risk factors of the incidence of asthma thereafter. The reduction of PPTAP and passive smoking, therefore, are very important for the prevention of childhood asthma.

S-29C2-3

Traffic-related Air Pollution Is Associated With Aortic Distensibility in the Multi-ethnic Study of Atherosclerosis and Air Pollution

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Background/Aims: Long-term exposure to ambient and traffic-related air pollution is associated with cardiovascular disease, but the mechanisms remain uncertain. Research has demonstrated that measures of aortic distensibility and its reciprocal, aortic wall stiffness provide prognostic information independent of traditional risk factors for atherosclerosis. We hypothesized that exposure to traffic-related air pollution was associated with impaired aortic distensibility on magnetic resonance imaging (MRI).

Methods: We measured proximal aortic distensibility in baseline cardiac MRI examinations of the Multi-Ethnic Study of Atherosclerosis, among 3677 adults without clinical cardiovascular disease, aged 45–84 years. Distensibility is aortic strain divided by the product of minimal aortic lumen area and central pulse pressure. Of total, 83% (n = 3045) of participants with MRI had accurate address information for exposure assignment. Participants were considered exposed to traffic-related air pollution if their home was located within 100 meters (m) of a major highway, or within 50 m of a major arterial road at the baseline examination. We tested the association between distensibility and road proximity using ordinary least squares regression, adjusting for age, sex, race/ethnicity, education, smoking, environmental tobacco smoke, alcohol consumption, family history, waist-to-hip ratio, BMI, diabetes, physical activity, systolic blood pressure, cholesterol, C-reactive protein, homocysteine, and fasting glucose.

Results: Mean distensibility for the study population was 1.89 kPA-1·10–3 (standard deviation [SD]: 1.35). Approximately 30% of participants (n = 920) were classified as exposed to traffic-related air pollution. Regression results from the full model indicates that residential proximity to roadways was associated with a 0.116 unit decrease in aortic distensibility ($P = 0.02$). Results were attenuated when further adjusted for study site ($\beta = -0.103$, $P = 0.06$).

Conclusion: Increased aortic stiffness was associated with living very near a major roadway, but not with preliminary predictions of $PM_{2.5}$ concentrations, which are dominated by larger scale geographic variations in air pollution.

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S-29C2-4

Childhood Leukemia and Traffic Air Pollution in Taiwan: Petrol Station Density as an Indicator

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Background/Aims: To investigate the relationship between traffic air pollution exposure and development of childhood leukemia (14 years of age or younger), a matched case-control study was conducted using childhood deaths that occurred in Taiwan from 1996 through 2006.

Methods: Data on all eligible childhood leukemia deaths were obtained from the Bureau of Vital Statistics of the Taiwan Provincial Department of Health. The control group consisted of children who died from causes other than neoplasms or diseases, which were not associated with respiratory complications. The controls were pair matched to the cancer cases by gender, year-of-birth, and year-of-death. Each matched control was selected randomly from the set of possible controls for each case. Data on the number of petrol stations in study municipalities were collected from the 2 major petroleum supply companies, Chinese Petroleum Corporation and Formosa Petrochemical Corporation. The petrol station density (per square km) (PSD) for study municipalities was used as an indicator of a subject's exposure to benzene and other hydrocarbons present in evaporative losses of petrol or to air emissions from motor vehicles. The subjects were divided into tertiles according to PSD in their residential municipality.

Results: The results showed that there was a significant exposure-response relationship between PSD and the risk of leukemia development in young children after controlling for possible confounders.

Conclusion: The findings of this study warrant further investigation of the role of traffic air pollution exposure in the etiology of childhood leukemia.

S-29C2-5

Traffic Exposure and Asthma Exacerbation Among a Nationally Representative Sample of the US Population

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Background/Aims: Over 23 million Americans who are currently living with asthma, requiring $15 billion dollars in direct health care costs. The majority of this population is exposed to traffic exhaust on a daily basis. Using distance-based (residential proximity to roadways) and density-based (average annual daily traffic or vehicle miles traveled) approaches, epidemiological studies have linked traffic exposure with exacerbation of asthma. However, these studies have been conducted in relatively small geographical areas so their findings may not be generalizable to the continental US where competing factors may be at play.

Methods: We linked a large nationally representative sample of the US population (National Health and Nutrition Examination Survey respondents) with traffic data from the National Highway Planning Network using a Geographical Information System. Individual level measure of traffic exposure was calculated for each survey respondents based on (1) distance to the nearest roads, (2) average annual daily traffic within 100, 300, or 500 m radii of residence. Using logistic regression that accounted for the complex sample design, we modeled the risk of having asthma attack in the past year by comparing respondents in the low quartiles of distance (high exposure groups) to those in the highest quartile (lowest exposure group), adjusting for confounders.

Results: Among US adult asthmatics, the risk of having asthma attack in the past year increased by 38% (odds ratios: 1.38, 95% confidence interval: 1.05–1.81) for those living closest to roadways compared to those who lived farthest away.

Conclusion: Our findings from a large representative sample of adult US asthmatics show that living in close proximity to roadways increases the risk of asthma attacks. This is the first study to provide a national scale assessment of this relationship, and has implications for future land use and transportation policies.

OUTDOOR AIR POLLUTION AND HEALTH IN THE DEVELOPING COUNTRIES OF ASIA: A CRITICAL REVIEW

S-29C3-1

Development, Air Pollution, and Population Health: An Overview of Status and Trends in Developing Asia

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Background/Aims: World Health Organization estimated that developing Asia accounted for nearly two-thirds of the estimated 800,000 deaths and 6.4 million Disability Adjusted Life Years attributed annually worldwide to urban outdoor air pollution in 2000. As countries in Asia prioritize public health strategies, it is necessary to identify likely future trends in air pollution and related diseases. Asia's rapid development, combined with urbanization, is linked to urban air pollution and to transformation of the demographic and epidemiologic characteristics of the population, which affects their vulnerability to air pollution-related health effects. Underlying these broad trends within Asia is considerable between and within country variation in the factors that determine exposure to air pollution and its health impacts.

Methods: In HEI's review, Urban Outdoor Air Pollution and Health in the Developing Countries of Asia: a Second Critical Review and Research Needs Assessment, we assess these trends and their implications for air pollution health impacts in Asia.

Conclusion: Several conclusions emerge: (1) Increased longevity, obesity, tobacco smoking, and changes in diet increase the burden of disease from cardiovascular disease, COPD, and cancer. Given air pollution's contribution to the incidence and progression of these diseases, it is likely that the burden of disease related to air pollution in Asia will increase, even as air quality improves. (2) Urban air pollutant concentrations are decreasing or stabilized in Asia. These reductions have occurred in spite of dramatic increases in source activity. However, air pollution in Asia is highly complex and variable both spatially and temporally and depending on the local situation these trends are not universally evident. (3) New air quality issues are emerging for Asia, in particular, an overall degradation of regional air quality and increased transboundary air pollution.

S-29C3-2

Particulate Matter Source Apportionment: An Overview and Summary of Current Asian Studies

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Background/Aims: An extensive literature review was conducted to evaluate the sources, composition, and ratios of particulate matter (PM) air pollution in Asian cities as part of a broader review of the literature on the health effects of air pollution in developing Asia.

Methods: The reviewed air quality studies were published between 1995 and 2009 and were conducted in 16 Asian cities representing major urban conglomerates and background sites. Each reviewed study used receptor-based methods that include the following: Chemical Mass Balance Analysis, Principal Component Analysis, Positive Matrix Factorization, or other accepted chemical speciation methods.

Results: The results obtained from these studies were regrouped into 6 different categories of sources that include: mobile, stationary, biomass, fugitive, secondary, and other. The highest fine PM concentrations were observed in Beijing, Hanoi, Delhi, and Kolkata reaching over 100-$\mu g/m^3$ (annual average). There was great variation of source contribution by city suggesting the differences among the cities' PM problem. For some major cities, the ratios of $PM_{2.5}$ to PM_{10} were calculated. South Asian cities seemed to have a higher coarse fraction in their PM compared to East Asian cities. In the South Asian cities of Dhaka, Rajshahi, Chennai, Islamabad, and Chak Shahzad, the ratios of $PM_{2.5}$–PM_{10} were in the range of 0.22 and 0.35 illustrating that the coarse fraction dominated because of resuspended road dust, soil dust, and uncontrolled construction particles. With progressive development in recent years, this ratio is probably shifting to equal portion of both fine and coarse fractions as seen in many East Asian cities. In Bangkok, Beijing, Taiwan, and Bandung, the fine fraction slightly dominated the coarse fraction as vehicle emissions and industrial activity have progressively increased in the last decade. In more developed countries such as South Korea and Japan, this ratio was as high as 0.77.

Conclusion: Together, the fine to coarse fraction PM ratio, the source contributions of PM, and the amount of fossil fuel burning and/or associated stage of development, provide a foundation for understanding the potential health risk and air quality status for some of these Asian cities. This work was funded by the Health Effects Institute.

S-29C3-4

Research Needs: Setting Priorities for Future Directions

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Abstract: Building from the materials presented in the symposium, this talk will discuss how key research gaps and health impact assessment needs are currently/can be further used to set priorities for future directions. The effects of short-term exposure in Asian cities are on a par with those observed in hundreds of studies worldwide; results from coordinated multi-city time-series studies, the meta-analytic estimates appear consistent in both direction and magnitude with those from other regions. Although more limited, the results of the chronic effects studies also appear broadly consistent with those of studies in other regions, suggesting that long-term exposure to air pollution is causing chronic pulmonary disease and other adverse effects that result in reduced life-expectancy. The extent to which exposures to air pollution may affect the health of infants and young children remains an important gap in the epidemiologic literature on the health effects of air pollution. This is an area of increasing policy concern worldwide, especially in Asia, where the largest burden of disease from adverse pregnancy outcomes and acute lower respiratory infection occurs. In addition, studies of acute effects cannot currently be used to estimate reductions in life expectancy due to long-term exposure. Studies of cohorts or dynamic populations in which large numbers of individuals exposed to different levels of air pollution are observed for years and their mortality rates compared are needed in Asian populations to estimate effects of long-term exposure on cardiovascular disease, lung cancer, chronic respiratory disease (including tuberculosis), annual average mortality, and life-expectancy. Asia-specific challenges to conducting long-term studies will be addressed, including the need to control for potential confounders such as tobacco smoking, indoor air pollution from the burning of solid fuels, and factors related to socioeconomic status, such as diet.

AIR POLLUTION - EFFECTS ON FETAL GROWTH AND CHILDREN'S HEALTH

O-29C4-1

In Utero Exposure to Air Pollution and Ultrasound Measures of Fetal Growth in Los Angeles, California

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Background/Aims: Some evidence suggests prenatal air pollution exposure impairs fetal growth. To date, only a few studies have investigated effects longitudinally because most studies so far have relied on anthropometric measures of fetal growth at birth from birth certificates.

We hypothesized that maternal exposure during pregnancy, especially to traffic-related air pollutants, impairs fetal growth, and that certain gestational time periods may be particularly susceptible.

Methods: Pregnancy-period specific exposures to traffic were estimated by CALINE4 NOx air dispersion modelling, and to regionally distributed pollutants (O_2, PM10, NO_2, CO), by using measurements from government air monitoring stations linked to women's residential locations during pregnancy. From the Los Angeles Cedars-Sinai Medical Center, 'Behavior In Pregnancy Study' data (n = 588), we used ultrasound measures (US) at 18–20, 28–30, and 35–36 weeks gestation and potential confounders. Change in fetal weight and in fetal size measures between pairs of consecutive US, and from the estimated time of conception to each US time point was first assessed in linear regression models; multilevel mixed models are being developed to explore impacts on growth patterns.

Results: Ranges in average exposure to pollutants during the time periods corresponding to fetal US were: 9 ppb to 78 ppb NO_2, 14 μg/mł to 112 μg/mł PM10, and 6 ppb to 98 ppb average 8-hr daily maximum ozone. Preliminary findings based on the ambient monitoring-based averages suggest that PM10 exposure in the period 2nd to 3rd US may be related to decelerated growth of femur length in that period in both genders combined (unadjusted): 0.0091 mm (STD: 0.0029 mm) deceleration/day per IQR PM10 increase ($p = 0.002$).

Conclusion: Our preliminary findings support the notion that air pollution concentrations as experienced in many countries contribute to fetal growth impairments.

O-29C4-2

Ambient Air Pollution and Low Birth Weight in Texas, 1998–2004

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Background/Aims: Existing literature supports a causal link between maternal air pollution exposure and adverse birth outcomes such as infant low birth weight, although results across studies are not consistent. Additional research is needed to confirm the effect, investigate the exposure window of importance, and distinguish which pollutants cause

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harm. We investigated relationships between birth weight and maternal exposure during pregnancy to particulate matter with aerodynamic diameter <10, <2.5 μm (PM_{10}, $PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and ozone (O_3) for 1,548,904 births in Texas from 1998 to 2004.

Methods: Analysis included linear models with birth weight as a continuous variable, and logistic models for low birth weight (<2500 g). Exposure was assigned as the average county-level concentration over gestation and each trimester based on mother's residence. We adjusted for gestational length, prenatal care, type of delivery, child's sex, birth order, weather, year, and mother's race, education, marital status, age, and tobacco use.

Results: An interquartile increase in gestational exposure to SO_2 and O_3 was associated with a 4.99 g (95% confidence interval [CI]: 1.87–8.11) and 2.72 g (95% CI: 1.11–4.33) lower birth weight, respectively. A positive association was found for exposure to $PM_{2.5}$. Effect estimates for SO_2 were higher for infants of Hispanic mothers compared to those of black and white mothers, whereas effects estimates for O_3 were higher for black mothers compared with Hispanic and white mothers.

Conclusion: Current ambient air pollution levels may be increasing the risk of infant low birth weight, and these risks may also increase for certain portions of the population. Additional research is needed to investigate these findings.

O-29C4-3

Effect of Prenatal Exposure to Wildfire-generated $PM_{2.5}$ on Birth Weight

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Background/Aims: Prenatal exposure to air pollution is associated with adverse birth outcomes such as low birth weight. We sought to investigate whether prenatal exposure to high levels of particulate matter ($PM_{2.5}$) from large wildfires were also negatively associated with birth outcomes, independent of background air pollution levels.

Methods: In 2003, several large wildfires occurred across 6 counties in Southern California, burning more than 750,000 acres over several days. We investigated the effect of wildfire-generated $PM_{2.5}$ on birth outcomes, using California vital statistics records for 2003–2004 and exposure estimates created at the zip-code level for the week of the wildfires in 8 counties in southern California, including 2 counties with no wildfire exposure. Exposure estimates were derived in a GIS framework using a combination of existing data from an extensive monitoring network, light extinction data, meteorological conditions, and smoke information extracted from MODIS satellite images. Exact addresses from records were geocoded and assigned an exposure estimate for wildfire $PM_{2.5}$ and for background ambient $PM_{2.5}$. Logistic and linear regression models were used to determine whether an association existed between wildfire $PM_{2.5}$ exposure and birth weight, small-for-gestational age, and preterm birth, after adjustment for background ambient $PM_{2.5}$ and other covariates.

Results: Overall, pregnant women living in 1 of the 6 counties at the time the wildfires occurred delivered babies who weighed on average 18 g less ($P = 0.01$) than the babies of mothers living in 2 counties with no wildfires. Significant effects were observed by trimester, with a stronger association in the third trimester. When level of wildfire $PM_{2.5}$ exposure was categorized into low, medium, or high, no strong dose-response was observed. However, the effects were also strongest in the third trimester. No effects were observed for small-for-gestational age or preterm birth.

Conclusion: Exposure to wildfire-generated pollution may have an adverse effect on birthweight independent of background pollution.

O-29C4-4

Impact of Ambient Air Pollution on the Respiratory Health of Children With Sickle Cell Anemia in Atlanta, Georgia

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Background/Aims: Children with sickle cell disease (SCD) comprise a potentially susceptible, yet largely unstudied, sub-group. SCD is an inherited, autosomal recessive blood disorder and is one of the most prevalent genetic disorders in the United States. The aim of the pilot study is to determine if elevated concentrations of personal exposures to air pollutants are associated with adverse respiratory health effects in children with SCD. To our knowledge, this is the first panel study in the United States, examining these potential associations in this population.

Methods: We conducted a panel study of 7 homozygous children with SCD in Atlanta, GA from 2008–2009. Repeated measurements of 24-hour integrated personal exposures to fine particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO_2) were collected for 2 seasons, with 12 samples per season. Before and after each sampling period, children underwent an assessment of their pulmonary inflammatory response, airway resistance, and respiratory symptoms. Lung function data were also collected at the beginning and end of each week.

Results: The mean age of the participants was 9 years (range: 7–12 years). Preliminary 24- hour mean personal $PM_{2.5}$ and NO_2 exposure concentrations were 15.0 ± 25.5 $\mu g/m^3$ and 0.23 ± 0.14 ppm, respectively. Exhaled nitric oxide measurements for all participants ranged from <5 to 57.5 ppb. Overall, daily NO_2 concentrations were strong ($r = 0.77$) and positively correlated with exhaled nitric oxide measurements made after the sampling period. Exhaled nitric oxide was negatively correlated with $PM_{2.5}$. When examined by child, correlations were moderate-to-strong ($r < 0.80$) but varied by pollutant.

Conclusion: The initial findings suggest that associations exist between children's exhaled nitric oxide levels and exposures to $PM_{2.5}$ and NO_2. Complete analysis, including lung function and other markers of airway inflammation and resistance will also be presented to help elucidate the variability and the strength of this association among the children.

ENVIRONMENTAL TOXICOLOGY, NANOTECHNOLOGY AND HEALTH

O-29C5-1

An Approach to Characterizing Combined Toxicity Based on Epidemiological Data

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Background/Aims: When a population is exposed to 2 or more environmental hazards that have coinciding health outcomes, the respective risks are usually summed up, although it is well known that combined toxicity (CT) can be both higher and lower than additive one (synergism and antagonism, respectively). Although theory and methodology of assessing the dominating type of CT in experimental toxicology are complicated and still under discussion, there have been very few attempts to extrapolate this theory to environmental epidemiology and to develop adequate mathematical models of the CT based on epidemiologically established dose-response relationships.

Methods: We analyzed data obtained for 260 children, aged 3–7 years, dwelling in 4 townships in the Middle Urals (Russia), each child being

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described with morning urine levels of lead, cadmium, and beta-2-microglobulin (B2u). We plotted the probability of having B2u > median against one metal level at 3 different levels of another metal and considered both geometrical and analytical interpretation of these relationships. We also constructed an isobole based on multiple regression of the same probability on 2 metals levels. We consider the first approach as based on the paradigm of effect additivity and the second approach as based on the paradigm of dose additivity (which in the CT theory are also called Bliss independence and Loewe additivity).

Results: Both approaches provided evidence that on the levels observed, the renal CT of cadmium and lead (as judged by increase in B2u level) is of subadditive type.

Conclusion: For this particular combination of hazards, a simple summation of assessed risks would be conservative enough as it ignores toxicological antagonism revealed by us. The methodology we developed can be recommended for further testing on other combinations.

O-29C5-2

Preliminary Study on The toxicity of Some Anions Using Vibrio Fischeri as a Biological Target

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Background/Aims: Aim of the study is to establish dose-response curves for: nitrates (NO_3), nitrites (NO_2), sulphates (SO_4), and fluorides (F-) in aqueous solutions. It appears that the Microtox test is sensitive enough to detect toxicity of some anions with respect to European Union (EU) official regulations dealing with pollution control.

Methods: Microtox analysis was conducted as planned in ISO 11348–3:2007 for waste water analysis using anion standards Merck and Diluent SDI reagent. The anion solutions were prepared according to the limit of concentrations allowed in industrial waste water of the EU official regulations: NO_3 20 mg/L, NO_2 0.6 mg/L, SO_4 1000 mg/L, and F- 6 mg/L; from this solution 3 dilutions were made: 3/4, 1/2, 1/4. Practically, the EC50 values were calculated by regression analysis of the linear relationship between the logarithm of the anions concentration against the logarithm of the lost/remaining light intensity ratio.

Results: All anions investigated result with toxicity <50% both at 5 to 15 minutes. As expected, NO_3 and SO_4 have a nourishing effect on Vibrio fischeri; NO_2, and F instead have a constant effect in all dilutions. When the mix of all anions indagated was tested, at the same dilution, the toxicity resulting is less than the individual anion. This could be caused by many factors, such as the nutrient effect and to not mention physical factors.

Conclusion: Our study underscores the difficulty to predict the resulting toxicity of a chemical mixture. Regarding adequate environmental safeguards, the single low limits of waste water cannot take account of the synergy effects caused by the different possible combination of the effluents composition. However, any possible synergistic enhancements in toxicity cannot be ignored.

O-29C5-3

Effect of Carbon Nanotubes on Human Bronchial Epithelial Cell

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Background/Aims: The aim of this study was to investigate the in vitro responses of human bronchial epithelial cells (BEAS-2B) after exposure to 2 types of commercial carbon nanotubes (MWCNT: D 10–40 nm, L 5–30 nm; SWCNT: D 1–2 nm, L 5–30 nm).

Methods: We focused on their effects on cell viability, production of ROS such as the Glutathione peroxidase-1 (GPx-1), and the expression of the cleaved caspase-3.

Results: The measurement of the viability by the CCK-8 assay after CNTs exposure for 24 hours implicated an obvious dose- and diameter size-dependent decrease of data. The cell viability by the SWCNT was about 3-fold (25 μg/mL) lower than the MWCNT. SWCNT also enhances the apoptosis of the cell. We confirmed it check through the cleaved caspase-3. The induction of cleaved caspase-3 induced by SWCNT was dose-dependent (12.5, 25, 50, 100 μg/mL). Last, CNTs treatment resulted in a significant increase in GPx-1 protein expression. We found that SWCNT results was higher expression and correlated with treatment concentration and time.

Conclusion: In conclusion, we have found that the CNTs lead to cellular toxicity such as cell death, apoptosis, and oxidative stress in BEAS-2B. Also, we confirmed that effect of CNTs on human can change, depending on their diameter size.

This work was supported by NRF through National Core Research Center for Nanomedical Technology (2009-009-1500).

O-29C5-4

Public Perceptions of Nanotechnology in Taiwan

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Background/Aims: We explore the public perceptions of nanotechnology in Taiwanese general population, analyze the correlations of familiarity, risk, benefit, and trust, and identify factors in determining risk perceptions.

Methods: A cross-sectional telephone survey was conducted by the Center for Survey Research, Academia Sinica in October, 2008, with a randomized sample of 2035 adults aged 18 years and older.

Results: There were 87.9% of participants who had heard of nanotechnology, where there were higher percentages in women, younger, and higher education groups. Among those who had heard of nanotechnology, their familiarity, benefit, risk, and trust of nanotechnology were significantly different in gender, age, education, and marital status. Familiarity, benefit, risk, and trust were all correlated. General linear model analysis indicated that gender, age, education, benefit, trust, and optimism were the factors in determining risk perception.

Conclusion: There was very high percentage of Taiwanese general population who had heard of nanotechnology. Other than gender, age, and education, trust and optimism of the technology play important roles in deciding risk perception of nanotechnology.

ADVERSE REPRODUCTIVE OUTCOMES AND DISINFECTION BYPRODUCT EXPOSURE

S-29C6-1

Disinfection Byproducts, Polymorphisms, and Susceptibility to Adverse Pregnancy Outcomes

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Background/Aims: The HiWate project is an international European project evaluating several health effects including reproductive outcomes associated with exposure to disinfection by-products (DBPs) in drinking water. Previous evidence including a recent meta-analysis indicates that if there is any effect of exposure to DBPs during pregnancy, this should be small. However, several studies had serious limitations particularly in exposure assessment. We examined exposure to DBPs in 5 mother-child cohorts in the United Kingdom, Spain, Greece, France, and Lithuania in relation to reproductive outcomes, taking into account genetic susceptibility.

Methods: The study population includes 14,000 mother-child pairs with extensive information on exposure to DBPs through multiple exposure routes. We examined 144 SNPs in genes in metabolizing, folate, and inflammation pathways. We evaluated gestational duration, preterm delivery, low birth weight and term LBW, small for Gestational Age and Fetal Growth Restriction (relative to growth potential). Mean GA varied from a low of 38.2 weeks in the RHEA cohort, Crete to 39.6, INMA cohort, Spain. There were differences between cohorts in other outcomes, and differences in total and specific trihalomethanes (THM) exposure levels.

Results: Overall, there was no association with birth weight, except for an inverse, not statistically significant association in high levels of THM (>120 μg/L). For all other outcomes, effects were minimal, although some were statistically significant due to the large sample. Differences by route of exposure were observed particularly when taking into account cumulative exposure from drinking, showering, swimming, and dishwashing and other less important sources of exposure, as compared to simple models based on residential levels of THMs. Extensive adjustment for confounding did not modify results. Results on gene-environment interactions will be presented.

Conclusion: Overall, this large population with extensive evaluation of exposure and of confounders did not find major effects on reproductive outcomes associated with exposure to DBPS during pregnancy.

S-29C6-2

The Effect of Disinfection By-products, Water Source, and Type of Disinfection Treatment on Adverse Birth Outcomes in Massachusetts

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Background/Aims: Several studies suggest that women exposed to high levels of disinfection by-products (DBPs) may have an increased risk of adverse pregnancy outcomes.

Methods: We used birth certificate data on 672,220 infants to examine third-trimester exposures to DBPs, water source, and disinfection treatment type on birthweight and small for gestational age (SGA). DBP data (based on quarterly sampling) on total trihalomethane (TTHM), chloroform (CHL), and bromodichloromethane concentrations were collected from 210 towns in Massachusetts from 1995 to 2004. We used linear and log-binomial regression for the term birthweight and SGA analyses, respectively.

Results: Based on our preliminary results, we observed a lower mean infant birthweight (−17 g) among participants in both the middle and upper TTHM and CHL tertiles compared to the lowest tertile. Relative to ≤20 μg/L, an increased risk for SGA was also observed for TTHM categories of 41–60, 61–80, and >80 μg/L (range: 1.05–1.07) and CHL >21–40 μg/L (range, 1.06–1.12). Subjects using public ground water sources had infants with a higher mean birthweight than subjects using public surface water (24 g; 95% CI: 20, 28). Subjects using chlorinated public drinking water had infants with a lower mean birthweight (range, −10 to −18 g) relative to those in public systems using other disinfection treatments (chloramination, O_3, ClO_2, ultraviolet light). A reduced relative risk (0.86; 95% CI: 0.84, 0.88) of SGA was detected for participants using ground water relative to surface water.

Conclusion: Our findings of small increased risks of SGA and birthweight deficits associated with TTHMs exposures are consistent with previous studies. Although we found limited evidence of an association between adverse fetal outcomes and specific types of disinfection, more research may be warranted since different disinfectants can result in disparate exposure mixture scenarios. Ongoing analyses will include additional adverse pregnancy outcomes and further examine potential confounding factors.

S-29C6-3

Risk of Stillbirth in Relation to Disinfection By-products in Taiwan

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Background/Aims: Recent findings suggest that exposure to disinfection by-products may increase the risk of stillbirth. The results of these studies are inconsistent, but warrant further attention.

Methods: To assess the effect of water chlorination by-products on stillbirth, we conducted a population-based case-control study of 3289 cases of stillbirth and a random sample of 32,890 control subjects from 396,049 Taiwanese newborns in 2001–2003 using information from the Birth Registry and Waterworks Registry in Taiwan. We compared the risk of stillbirth in 4 disinfection by-product exposure categories based on the levels of total trihalomethanes (TTHMs) representing high (TTHMs 20+ μg/L), medium (TTHMs 10–19 μg/L), low exposures (TTHMs 5–9 μg/L), and 0–4 μg/L as the reference category.

Results: In logistic regression analysis adjusting for gender, maternal age, plurality, conception of season, and population density of the municipality where the mother lived during pregnancy, the odds ratio for stillbirth was 1.10 (95% CI: 1.00–1.21) for medium exposure and 1.06 (95% CI: 0.96–1.17) for high exposure compared to reference category.

Conclusion: The risk of stillbirth may associate with women exposure to disinfection by-products in Taiwanese drinking water.

S-29C6-5

Trihalomethane Levels in Relation to Rates of Stillbirth and Low Birth Weight: An Intervention Study

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Background/Aims: In North West England, drinking water is supplied to 7 million people by the water company United Utilities. The company introduced enhanced coagulation for some of their treatment works during 2003 and 2004. Compared to conventional coagulation, enhanced coagulation improves removal of disinfection byproduct (DBP) precursors and should therefore reduce DBP formation potential. This intervention provided a unique opportunity to study potential effects of DBPs, in particular trihalomethanes (THMs), on birth outcomes, particularly since

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potential confounders (eg, socioeconomic factors) did not change over the short period. Areas where no treatment changes occurred acted as a control. Our aim was to compare rates of stillbirth and low birth weight 3 years prior (2000–2002) to treatment changes occurring with rates 3 years after (2005–2007) the changes took place.

Methods: We linked information on THMs and enhanced coagulation status of water supply zones to births and stillbirths from the national birth register, using the point-in-polygon method in geographical information systems, with the third trimester as the critical exposure period. Differences in small-area rates of stillbirth and low birth weight before and after treatment changes were modelled against change in mean annual total THM (TTHM) concentrations using Poisson regression. Additionally, areas were categorized into low, medium, and high change in TTHM concentrations and the changes in rates of stillbirth and low birth weight were estimated in each category using Poisson regression. Models were adjusted for potential confounders such as maternal age and social deprivation (Carstairs' deprivation score).

Results: Enhanced coagulation reduced TTHM levels. Preliminary results suggest an association between reduction of stillbirth rates and change to enhanced coagulation, possibly mediated by reduction in TTHM. However, we found little association between reduction of low birth weight rates and change to enhanced coagulation.

Conclusion: Our preliminary findings are inconclusive. Further, analyses will investigate the individual THMs, bromodichloromethane, bromodichloromethane, bromoform, and chloroform.

S-29C6-4

Exposure to Trihalomethanes in Drinking Water and Risk of Small for Gestational Age Births

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Background/Aims: We investigated the association between exposure to trihalomethanes (THM) in drinking water and small for gestational age (SGA) births in 2 large metropolitan water supplies in New South Wales, Australia.

Methods: We geocoded mothers residential address at birth for live, singleton, term births to water distribution systems in Sydney/Illawarra (314,982 births between 1998 and 2004, 33 distribution systems) and the neighboring Hunter region of New South Wales (37,944 births between 1997 and 2004, 9 distribution systems). We classified births into gender specific gestational week SGA (<third and <10th percentiles) and appropriate for gestational age (10th percentile). Mean trimester and entire pregnancy exposure was estimated for THM based on monthly sampling in each distribution system. We estimated the relative risk of SGA compared to appropriate for gestational age births for exposure to THM's using log-binomial regression controlling for confounders.

Results: In the Sydney/Illawarra region SGA (<10th percentile) in Sydney/Illawarra. Effect estimates for the smaller study population in the Hunter region were similar to the Sydney/Illawarra results for SGA <third percentile but with wider confidence intervals, while no associations with SGA <10th percentile were found in the Hunter.

Conclusion: Our study indicates an association between SGA births and mother's exposure to total THM during pregnancy, as well as exposure to some specific THM species. Our results suggest that these effects mainly occur above threshold THM concentrations.

MANGANESE AND CHILDREN'S HEALTH

O-29C7-1

Case Study on Risk Assessment From Manganese Inhalation Impact on Children's Health

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Background/Aims: Manganese is neurotoxicant to which children are particularly susceptible. Metallurgical and chemical plants and burning of fossil fuels contribute to the increase of manganese concentrations in the ambient air of the cities. The aim of the study was to estimate the inhalation risk for the children's health formed by the ambient air pollution related to metallurgical enterprise emissions in one of the Ukrainian cities.

Methods: US EPA Human Health Risk Assessment Methodology was applied as the main method. On the hazard identification stage manganese was identified as 1 of 8 priority pollutants emitted by this enterprise. Calculation of averaged concentrations was done in AERMOD View taking into account point source parameters, meteorological data, and terrain and land use peculiarities. Concentrations were calculated for 72 receptor points.

Results: Daily averaged concentrations of manganese (0.33–6.98 îêã/m^3) were used for calculation for noncancer risk. It was defined that noncancer effects due to manganese presence in ambient air range from 7 to 138. Estimated risk was classified in 5 levels according to quantile distribution and overlaid with the layer of schools and kindergartens with the help of ArcGIS tools. Eight schools (3881 students) and 9 kindergartens (1295 children) situated in the first risk zone (HQ = 1–14). The second risk zone (HQ = 15–17) covers 8 schools (3681 students) and 13 kindergartens (2287 children); the third risk zone (HQ = 18–21)—7 schools (2720 students) and 4 kindergartens (603 children); the fourth (HQ = 22–30)—12 schools (7038 students) and 11 kindergartens (1212 children); and the fifth (HQ = 31–138)—1 school (645 students) and 3 kindergartens (557 children).

Conclusion: This study defined inconsistency between Ukrainian hygienic regulations and referent concentrations that proved the need for harmonization. Health measures and prophylactic programs for children could be optimized by municipal administration taking into account the results of this study.

O-29C7-2

The Effect of Between Blood Manganese Level and Attention Deficit/Hyperactivity Disorder Index in Early School Age Children

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Background/Aims: Manganese (Mn) is a naturally occurring element, and presence of Mn in water, food, and air low level are ubiquitous. Excessive exposure to Mn, in spite of its essentiality, in earlier life can affect neurodevelopment and could possibly be associated with development of

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neurodegenerative disorders in later life. The goal of this study was to examine the association between low levels of Mn in blood and symptoms of attention-deficit hyperactivity disorder (ADHD) among Korean school age children.

Methods: Subjects were recruited from a nationwide school age children's cohort, Children's Health and Environmental Research (CHEER) on the first graders of 22 elementary schools from 10 Korean cities in the year from 2005 to 2007. We have selected 1045 children (543 males and 497 females) between 6 and 8 years old (mean 6.9 ± 0.6 years) from 6 elementary schools in 3 metropolitan areas of Korea. We measured the blood Mn level and conducted DuPaul scale questionnaire for screening ADHD. Questionnaire on the general characteristics, developmental history, disease history, current behavioral features, computer using skill, environmental exposures including environmental tobacco smoking, and food frequency was done on the parents of the children.

Results: The mean blood Mn level was 14.9 μg/L (SD: 4.0 μg/L). The mean scores of sum of DuPaul scales were 8.87 ± 7.4. Mean DuPaul score of group categorized by children's blood Mn levels of <12.0, 12.0–18.0,18.0–24.0, and 24.0 μg/L was 9.17, 8.84, 7.70, and 10.56, respectively ($P < 0.05$). After adjusting for potential confounders: age, area of residence, gender, birth order, maternal age at delivery, education level, familiarity with computer, environmental tobacco smoke, calories of total intake, and frequency of outdoor activities; DuPaul scale level was significantly related with the blood Mn level group.

Conclusion: This study suggests that blood Mn level was significantly associated with ADHD scale improvement. Relatively narrow range of blood Mn levels in children without prominent environmental sources of Mn might have been a factor for this less strong relationship. Further study in a population with higher level of exposure may provide a different relationship.

O-29C7-3

Effect of in Utero Exposure to Manganese on the Neurodevelopment of the Infant

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Background/Aims: Manganese (Mn) is an essential trace element and common component of food, water and air. Prenatal Mn exposure during gestation may affect fetal and infantile neurodevelopment. However, reports on in utero Mn exposure and infant's neurodevelopment are rare. This study was conducted to establish a possible relationship between prenatal exposure to Mn and mental/psychomotor development of infant at 6 months of age.

Methods: We analyzed data from a birth cohort, Mothers and Children's Environmental Health (MOCEH). Study population included 259 pregnant women and infant (at 6 months of age) pairs, excluding infants <37 weeks of gestation. We assessed mental and psychomotor development in infancy using the Mental/Psychomotor Development Index (MDI/PDI) of Korean version of Bayley Scales of Infant Development II (BSID-II). The relationship between prenatal Mn exposure and MDI/PDI scores was evaluated with linear regression and ANOVA. Blood Mn was measured at third trimester of pregnancy.

Results: An adverse effect of prenatal Mn exposure on MDI scores at 6 months of age was not significant. PDI scores were significantly related to the prenatal maternal blood Mn level. A nonlinear relationship was associated between prenatal manganese levels and PDI scores after adjustment for potential confounders: gestational age, infant's gender, birth order, maternal body mass index, maternal age, maternal education, breastfeeding, exposure to environmental tobacco smoke during pregnancy, and presence of atopic dermatitis after birth.

Conclusion: The results of study show that prenatal manganese levels impairs psychomotor development in infancy. While no cut off point is established to define Mn poisoning, it is suggested that blood Mn level of ≥30μg/L may be associated with an adverse neurobehavioral function in infants.

O-29C7-4

Maternal Manganese Exposure and Infant Birth Weight

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Background/Aims: Manganese (Mn) is an essential trace element for humans and animals. However, excess intake of Mn can lead to neurotoxicity. Few studies have investigated about the effects of excess intake Mn on the human fetus. In the present study, we examined whether exposure high levels of Mn is associated with birth weight.

Methods: We performed a study in a cohort of 326 mother-infant pairs in the Mother and Children's Environmental Health (MOCEH), Korea. A questionnaire study on general characteristics, review medical records, and blood Mn analysis was done. We evaluated the effects of the exposure to Mn on the birth outcome by nonlinear regression and ANOVA.

Results: We found a nonlinear relationship between maternal blood Mn and birth weight after adjusting for potential confounders. After categorizing blood Mn into 10 μg/L interval, birth weight increased with blood Mn levels up to 30–39 μg/L, then decreasing in birth weight was observed at higher levels.

Conclusion: The findings of our study is low maternal blood Mn concentration during pregnancy was associated with lower birth weight with inverted u-shape dose-response relationship reflecting its essentiality.

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LOW LEVEL EXPOSURE TO ENVIRONMENTAL CONTAMINANTS AND HEALTH I

O-29C8-1

New Paradigm for Hazardous Agents Exposure Monitoring: A Trial Approach Using 24-hour Real-time Personal Exposure Monitoring

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Background/Aims: The objective of this study is to measure hazardous agents for 24 hour/7 days with the real-time exposure monitor and estimate total inhalation amount using breathing rate and time activity survey. First year in total 3 year project, we investigate particulate such as PM_{10}, $PM_{2.5}$, PM1 exposure for a week.

Methods: Five participants (3 graduate students, 1 office-worker, and 1 housewife) were surveyed for 7 days with real-time monitor set and heart rate was measured during survey. The inhalation rate was calculated from measured heart rate. Participants were asked to fill in a time-activity dairy (TAD).

Five microenvironments were categorized on TAD; House, Workplace/School, Other indoor, Outdoor, Transportation. The amount of inhaled PM_{10}, $PM_{2.5}$, and PM1 at each microenvironment was calculated from concentration of each particles, inhalation rate, and duration at microenvironment. We used GLM model to compare the geometric means of inhaled particle mass.

Results: The amount of inhaled PM_{10} was 10.86, 8.23, 8.23 mg/d for office-worker, student, and housewife, respectively. The amount of inhaled $PM_{2.5}$ was 6.97, 6.65, 6.13 mg/d for housewife, office-worker, and student, respectively. The amount of inhaled $PM_{1.0}$ was 6.44, 5.42, and 5.15 mg/d for housewife, office-worker, and student, respectively. The PM_{10} inhalation was high in office worker while both $PM_{2.5}$ and $PM_{1.0}$ was high in housewife because of gas stove use.

When considering exposure concentration and time, home indoor is the largest source of particulate inhalation followed by workplace, transportation, other indoor and outdoor in order. For example, inhalation amounts of PM_{10}, $PM_{2.5}$, and PM1 for student was 2.85 mg/d (home), 2.39 mg/d (school), 0.85 mg/d (transportation), 0.59 mg/d (other indoor), and 0.40 mg/d (outdoor). The breathing rate has little influenced on the inhalation amount differences in this study because all participants spent indoors without heavy excise while some influence during outdoor activity.

O-29C8-2

Secondhand Smoke Exposure and Blood Markers of Systemic Inflammation Among Nonsmokers in the US Trucking Industry

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Background/Aims: There is a large body of epidemiologic evidence supporting an association between secondhand smoke (SHS) exposure and adverse cardiovascular health effects in adults. In this study, we examined the association between secondhand smoke exposure and inflammatory markers related to cardiovascular disease, including high-sensitivity C-reactive protein (hs-CRP), soluble intercellular adhesion molecule-1 (sICAM-1), and interleukin-6 (IL-6), among the 199 nonsmoking workers in the US trucking industry.

Methods: The workers provided blood samples either by mail or on site, and completed a questionnaire with information on demographic characteristics, job title and work history, height and weight, smoking history, alcohol intake, health status, and medication use. Exposure to SHS was measured by plasma cotinine concentrations, which were analyzed by liquid chromatography-tandem mass spectrometry. Multiple regression analyses were used to determine important predictors of elevated inflammatory markers.

Results: The median cotinine level was 0.10 ng/mL, with an interquartile range (IQR) of 0.04–0.23 ng/mL. The median (IQR) was 0.93 (0.46–2.06) mg/L for hs-CRP, 246 (203–284) ng/mL for sICAM-1, and 1.38 (1.02–2.58) pg/mL for IL-6. The odds ratio (OR) of elevated hs-CRP (highest tertile, >1.5 mg/L) was 3.27 (95% CI: 1.11–9.22) for the "high cotinine" group (>0.215 ng/mL) and was 2.67 (95% CI: 1.05–6.81) for the "moderate cotinine" group, as compared to the "low cotinine" group (<0.05 ng/mL), adjusting for age, gender, race/ethnicity, educational level, obesity, previous smoking history, job title/work status, work shift, and medical history. We did not find a significant association between plasma cotinine levels and sICAM-1 or IL-6.

Conclusion: In this group of healthy workers, we found a positive relationship of SHS exposure, as measured by cotinine levels in plasma, with increased levels of hs-CRP, but not with sICAM-1 or IL-6.

O-29C8-3

Novel Single Nucleotide Polymorphisms Related to Arsenic-associated Bladder Cancer in a US Population-based Study

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Background/Aims: Arsenic is a carcinogen that contaminates drinking water worldwide. Arsenic concentrations above the current maximum contaminant level (MCL) of 10 micrograms per liter have been detected in over 10% of the unregulated private wells in New Hampshire. Previously, we observed an increased bladder cancer incidence with higher arsenic exposure among smokers in this population. Further, we and others have found evidence that genetic factors influence susceptibility to arsenic-associated malignancies.

Methods: We screened a subset of bladder cancer case to identify potential interactions between single nucleotide polymorphisms (SNPs) and elevated arsenic exposure using a panel of 10,000 non-synonymous SNPs. Top hits on the SNP array (Fisher exact test $P < 0.0001$) were then genotyped in our full case-control study (n = 832 cases, 1119 controls) to determine whether these SNPs were susceptibility loci for arsenic-related bladder cancer.

Results: We successfully genotyped SNPs in 2 of the 3 genes identified in the initial scan—one in the FSIP1 gene and another in a solute carrier family member gene. Among ever smokers, the FSIP1 polymorphism was associated with increased bladder cancer incidence (adjusted odds ratio for heterozygotes: 3.40; 95% CI: 1.38, 8.38, and odds ratio for homozygotes for the variant allele 4.61; 95% CI: 1.00, 21.17 compared to homozygotes for the wild type allele) in the high arsenic group and unrelated in the low arsenic group (P for interaction = 0.004). For the solute carrier family polymorphism, the adjusted odds ratios were 3.13; 95% CI: 1.20, 8.19 and 3.96; 95% CI: 1.19, 13.25) for heterozygote and homozygote variants, respectively, and close to one in the low arsenic group (P for interaction = 0.027).

Conclusion: In this exploratory analysis, we identified novel SNPs that potentially modify the effects of arsenic on bladder cancer incidence. Further work to understand the functional role of these SNPs is being pursued.

O-29C8-4

A Validated Approach for Assessing Exposure to Asbestos in Soil

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Background/Aims: Exposure to naturally occurring asbestos or asbestos containing materials at brownfield sites is becoming a significant public

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health threat. Naturally occurring asbestos is found in residential areas of all 50 states of the United States, Turkey, and South Korea. Asbestos contaminated industrial sites and potential for public exposures are also common, especially as these sites are re-developed for other uses. This research presents an approach to assess the public.

Methods: The Releasable Asbestos Field Sampler (RAFS) was designed to quantify asbestos emission rates from soil with less than 0.1% asbestos. The asbestos emission rate data is then input into an aerosol physics- and fluid dynamics-based model to predict the corresponding breathing zone concentration. This approach is an alternative to activity-based sampling (ABS), currently the only method to obtain inhalation exposure estimates. Collocated, simultaneous RAFS and ABS tests at 12 locations in the United States provided data to validate the RAFS-Model approach.

Results: Asbestos emission rates generated by the RAFS are highly correlated with ABS measured concentrations (R^2 = 0.98), but over-predict exposure (slope = 14) because of the RAFS measured asbestos emissions at the soil surface. RAFS measured concentrations vary from 2 fibers per cc to 0.001 fibers per cc. The breathing zone model accurately predicted actual exposure concentrations measured by ABS. Breathing zone concentrations ranged from 1 fiber per cc to less than 0.0001 fibers per cc. Regression statistics showed the slope equaled unity, intercept was zero, and the R^2 was still greater than 0.90.

Conclusion: The research conclusions support the RAFS-Model approach as an accurate, reliable and economical alternative to ABS for assessing the public health risk from asbestos exposure at contaminated sites. Further research will associate chronic, low-level asbestos exposure to one's lifetime risk of developing cancer.

O-29C8-5

Low-level Arsenic Exposure in Drinking Water and Diabetes Mellitus in Cyprus: Preliminary Findings

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Background/Aims: Arsenic (As) carcinogenicity to living organisms, including humans has well been established. Non-carcinogenic effects of As, such as, adverse pregnancy outcomes, hypertension, endocrine disruption, and diabetes mellitus have recently attracted attention by the scientific community. Although dose response relationships for these end points seem to be clearly defined for relatively high As exposures, that is, >100 ppb, the shape and magnitude of the effect for low-level exposures (>10–100 ppb) is still unclear. This is also the case for diabetes mellitus where low-level As effects on the prevalence of diabetes mellitus have yet to be confirmed.

Methods: This study was undertaken in a community of Cyprus where elevated As concentrations (median: 40 ppb; range: <10–100 ppb) were recently detected in the groundwater that was chronically used to satisfy their potable needs. A detailed questionnaire was filled out by 430 residents asking general, water use habits, and medical history questions. Cumulative lifetime As exposure was calculated using median As concentrations in water, individual water consumption rates, and individual exposure duration to that specific contaminated source of drinking-water.

Results: A logistic regression model for the presence of diabetes mellitus was developed, and logarithmically transformed As exposures were analyzed both as a continuous variable and also by comparing their 20th and 80th percentiles. Odd ratios were calculated both in a univariate analysis as well as in a multivariate model adjusting for age, sex, smoking status, and educational level. Water use habits, such as, use of As-contaminated well water, bottled water, and use of As-contaminated water for cooking were included in the regression models and their effect sizes were calculated.

Conclusion: Results from this study are expected to assess the relationship between low-level As exposures and the cases of diabetes mellitus recorded in this As-affected community of Cyprus.

O-29C8-6

Role of MAPKs in Low Level Methylmercury Induced Proliferation Inhibition of Neural Progenitor Cells

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Background/Aims: Methylmercury (MeHg) is a potent environmental neurotoxin that shows toxicity to developing central nervous system (CNS), causing brain damage in children even at very low exposure levels. However, the mechanisms for its effect on CNS are not well understood. Little is known about the effects of MeHg on cortical neural progenitor cells and neurogenesis. In current study, primary cultures of progenitor cells from embryonic cerebral cortex were used as a model system to study the potential effect and the underlying mechanism of MeHg on neural progenitor cells.

Methods: Cortices of Rat embryos at day 13 (E13) from Sprague-Dawley (SD) rat were isolated and cells were cultured. MeHg was added to the cultures at the final concentration of 2.5 nM, 5 nM, 50 nM, 500 nM, 5 uM, and 50 uM. Cultures were treated with MeHg in vitro for 48 hours. Samples incubated with D-Hank's solution without MeHg were used as controls. Then Western blotting of different MAPKs was performed.

Results: Forty-eight-hour exposure to low-levels of MeHg (at 2.5, 5, and 50 nM, respectively) caused proliferation inhibition of neural progenitor cells. Low-level of MeHg reduced the active form of ERK1/2. In contrast, p38 and JNK/Sapk were not altered under same treatments.

Conclusion: MeHg may induce proliferation inhibition of neural progenitor cells via perturbing a pathway that involves ERK1/2. These results suggest a role for the different MAPKs in proliferation inhibition induced by low level methylmercury in neural progenitor cells.

PP-29-151

Determination of Formaldehyde Benchmark Level in Blood Using the Model "Blood Concentration—Odds Ratio"

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Background/Aims: Determination of benchmark levels could be proposed as one of the first step in procedure of noncarcinogen risk assessment.

Methods: In order to determine benchmark levels, examined children (n = 233, average age, 8.6 ± 0.6 years) with chronic upper respiratory diseases living in areas with relatively low-level formaldehyde air pollution. The maximum formaldehyde air concentration was 0.0264 mg/m^3, the minimum concentration was 0.0002 mg/m^3 and the average annual concentration was 0.0062 ± 0.0032 mg/m^3. Blood formaldehyde concentrations were determined using high performance liquid chromatography. The concentrations ranged from 0.001 to 0.181 mg/dm^3. Data concerning the diseases of children were obtained from individual medical records containing all the cases when they were provided with medical care. The study analyzed recorded respiratory diseases, ie, rhinitis (J30.3, J30.4), asthma (J45.0), and other upper respiratory diseases (J35.0, J35.1, J35.2, and J35.3).

Results: A number of hypotheses concerning BMC values of formaldehyde in blood were evaluated. It was proposed that a BMC value that was used to divide the examined children into groups, ie, with no effects (blood

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concentration is lower than the suggested BMC value) and with effects (blood concentration is higher than the suggested BMC value). For each hypothesis, the study calculated odds ratio (OR) characterizing the link between the exposure and health disorders (ORmax = 1.42 DI = 2.46÷0.82). Using these calculations, they were built a mathematical models "blood concentration—odds ratio." Formaldehyde blood concentration corresponding to model upper 95% confidence limit at the OR = 1 level was considered as a benchmark level.

Conclusion: According to minimal, this criterion (for rhinitis incidence OR) was suggested the formaldehyde concentration of 0.023 mg/dm^3 as the benchmark level.

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PP-29-152

Quantification of Urinary Melamine Among Urolithiasis in Taiwan by Liquid Chromatography/Tandem Mass Spectrometry

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Background/Aims: Recently, the outbreak of melamine-tainted formula for infants result in the adverse renal outcomes in young children had been reported in China. However, there is no report whether ingestion of melamine-tainted milk or other related products can cause adult urolithiasis. Thus, the present study was designed to investigate the association between urinary melamine concentration and the risk of urolithiasis in Taiwan population.

Methods: Between 2003 and 2007, we had 11 patients with upper urinary tract uric acid urolithiasis and 22 sex- and age-matched calcium urolithiasis and controls individually from Kaohsiung Medical University Hospital. A triple quadrupole liquid chromatography tandem mass spectrometry (LC-MS/MS) method is presented for the quantitative determination of urinary melamine concentration. Wilcoxon rank sum test was used to compare the urinary melamine concentrations in uric acid urolithiasis with controls as well as in calcium urolithiasis with controls. FDR (false discovery rate) was used to correct the P values for 2 comparisons.

Results: Our results show that subjects with uric acid urolithiasis (median: 0.50 vs. 0.06 μg/mmol creatinine, Wilcoxon test: FDR_ P = 0.024) and with calcium urolithiasis (median: 0.14 vs. 0.06, FDR_ P = 0.024) had significantly higher urinary melamine concentration than controls. We also noted a significant increasing trend of risk across controls, calcium and uric acid urolithiasis on urinary melamine concentration (trend test, P = 0.006). Based on the ROC curves, subjects whose melamine levels were over 0.262 and 0.037 μg/mmol creatinine, respectively, might have significant risks to have uric acid and calcium urolithiasis.

Conclusion: This preliminary study suggests that exposure to even low-dose melamine-related products still have the potential to develop both uric acid and calcium urolithiasis in adults. We will further apply to more comprehend study to investigate the potential health effects of urolithiasis contributed by melamine-tainted dairy products.

PP-29-153

Effects of Low Level Arsenic Exposure on the Functioning of Renal Tubules

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Background/Aims: Chronic co-exposure to low level cadmium and arsenic has been reported to produce renal tubular damage. This study was performed to evaluate the possibility of renal tubular function impairment caused by exposures to low arsenic concentrations.

Methods: The study included 867 individuals (365 males and 502 females) who lived in rural area of Chungbuk Province, Republic of Korea. Information about demographical characteristics and lifestyle was gathered, and the urinary arsenic concentration and N-acetyl-β-D-glucosaminidase (NAG) activity were measured. Mean urinary arsenic concentrations were compared according to the gender, age, smoking and alcohol drinking, or recent seafood consumption. Study subjects were divided into 4 groups according to the urinary NAG activity and seafood consumption before urine sampling, and correlation between arsenic concentration and urinary NAG activity was tested in each group.

Results: Mean urinary arsenic level was higher in females, nonsmokers, and nondrinkers than those in males, smokers, and drinkers, respectively. Individuals who took seafood within 3 days before urine sampling showed a higher mean urinary arsenic level than those who did not. Mean urinary NAG activity differed by age and drinking water type, but not by gender. The correlation between urinary arsenic concentration and NAG activity in urine was significant only in subjects who did not consume seafood within 3 days before urine sampling and whose urinary NAG activity was 7.44 U/g creatinine (75th percentile) or higher. Urinary arsenic concentration was a significant determinant of urinary NAG activity in subjects whose NAG activity was higher than 7.44 U/g creatinine or higher, and especially in those without history of recent seafood intake.

Conclusion: These facts suggest that exposure to inorganic arsenic produces renal tubular damage in human beings even under the reference concentration for urinary arsenic.

PP-29-154

Exposure to Heavy Metals in Residents Living Near a Copper Refinery Plant

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Background/Aims: The purpose of this study was to investigate potential health effects associated with exposure to the heavy metals in residents living near the refinery plant.

Methods: The study subjects included 572 residents living near the refinery plant and 413 controls. We collected information about demographic characteristics, dietary habits, occupational history, smoking

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habit, alcohol consumption, duration of residence, and medical history. We conducted medical examination for all subjects, and measured the concentrations of heavy metals in blood (Pb, Cd, and Hg), serum (Zn, Ni, and Cu), and urine (Cd, As, Hg) to evaluate individual exposure to heavy metals. As renal tubular damage marker, urinary β2-microglobulin, N-acetyl-β-D-glucosaminidase activity, and total protein were measured.

Results: There were no statistically significant differences between the 2 subject groups regarding physical examination, blood pressure, blood chemistry, and bone mineral density. Levels of blood Cd and Pb, urinary Cd and As, and serum Cu and Ni were significantly higher in residents living near the refinery plant than in control group. Levels of blood Cd and Pb, urinay Cd, and serum Zn, Cu, and Ni were negatively correlated with the distance between the refinery plant and the place of residence. The levels of blood Cd and Pb, urinary Cd, and serum Zn were positively correlated with the duration of residence in the refinery area. The urinary N-acetyl-β-D-glucosaminidase activity and β2-microglobulin level were significantly higher in residents who lived within 1-km radius of the refinery plant than those who did not, and those were strongly correlated with blood and urinary cadmium levels.

Conclusion: These results suggest that residents living near the copper refinery plant have been exposed to high levels of heavy metals, and thus might be associated with a renal tubular damage.

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PP-29-157

Blood Lead Level of Residents Living Around 350 Abandoned Metal Mines in Korea

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Background/Aims: In 2007, as a pa-rt of the control and prevention of environmental contamination which threatens public health, Korean Ministry of Environment planned to implement a national biomonitoring survey of 3 metals (lead, cadmium, and mercury in blood) for residents living around 350 abandoned mines which were classified as contaminated and possible threats to health for inhabitants. We investigated the level of blood lead of residents living around 350 abandoned metal mines and to compare and contrast it with control subjects and demographic and lifestyle variables.

Methods: We measured blood lead concentrations of 14,849 subjects (14,132 from 350 abandoned metal mines and 717 subjects from 8 control areas). Questionnaire was provided to all subjects to characterize the information of gender, age, mining experience, total years of living around mines, smoking status, and personal perception of abandoned mines as a risk.

Results: The geometric means and 95% confidence intervals of the blood lead of residents living around the abandoned metal mines and control area were 3.01 (2.99–3.03 μg/dL) (female: 2.79 [2.76–2.81] μg/dL, male: 3.32 [3.29–3.36] μg/dL) and 2.66 (2.57–2.75 μg/dL) (female: 2.53 [2.42–2.64] μg/dL, male: 2.85 [2.70–3.02] μg/dL), respectively. Among residents of mine area, non-smoker and the resident who had no mine experience showed a significant lower mean blood lead than smoker, past smoker and the resident of mine experience. The mean blood lead concentration of residents who had some concern about abandoned mine was significantly higher than those without any concern about mine.

Conclusion: The mean blood lead concentration of residents living around the abandoned mines was significantly higher than those of resident living in control area and also significantly higher than the mean value of general adult Korean population. We also confirmed that smoking is important variable to increase blood lead concentration.

PP-29-158

Residual Detections of Erythromycin and Tylosin at Surface Water and Soils in Korea

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Background/Aims: The occurrence of 4 pharmaceuticals (erythromycin and tylosin) in Korean surface waters and soils were investigated. Four big rivers were selected, although over 90% of drinking water is produced from surface waters in this area that has a population of approximately 40 million inhabitants.

Methods: Samples were collected from upstream/downstream and near soils, along the Han, Geum, Youngsan, and Nakdong (South Korea) rivers twice a year and analyzed by liquid chromatography with tandem mass spectrometry (LC-MS/MS) with electrospray ionization (ESI).

Results: Two target compounds were detected in surface waters but not in benthos soil samples. Erythromycin was detected 61.3% of samples and the concentrations were nd ~0.028 ng/mL. Tylosin was detected 11.3% of samples and the concentrations were nd ~0.061 ng/mL. Detection rates and concentrations were different from the rivers. Analytical accuracy and precision (pooled CV) at surface water were as follows: erythromycin was 74.0%, 1.7% and tylosin was 95.7%, 1.5%. Analytical accuracy and precision at benthos soils were as follows: erythromycin was 71.6%, 1.2% and tylosin was 102.5%, 3.5%.

Conclusion: This level were similar or more lower than other countries.

PP-29-159

Evaluation of Associated Factors for Cadmium Exposure and Kidney Function in General Population

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Background/Aims: Cadmium (Cd) is a non-essential toxic metal which is widely distributed in the environment. General population is exposed to the low level Cd chronically and the kidney is the most sensitive target organ to Cd toxicity.

Methods: We interviewed demographic characteristics, lifestyles, medical histories, and diet intakes during the last 24 hours. We estimated daily Cd intake through diet in 643 adults who had not been occupationally exposed to Cd. Whole blood and spot urine samples were collected from study subjects, we analyzed internal exposure level of Cd and affecting factors, also evaluated renal function and oxidative stress biomarkers.

Results: The daily Cd intake from diet was 7.07 μg/day, the mean concentration of Cd was 1.21 μg/L in blood and 0.95 μg/g creatinine in urine. Blood Cd level was affected by age, sex, smoking habit, dietary Cd intakes. Urinary Cd level was affected by sex, age, and blood Cd level. Urinary Cd were positively correlated with MT, NAG activity, and MDA, but blood Cd only with MT. Increased NAG activity was observed at above 1.0 ug Cd/g creatinine in urine, which indicates that NAG responds

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to the urine Cd sensitively. However, NAG activity was also affected by age, hypertension, and diabetes histories. The urinary MT responded to the Cd in urine only, which finding suggests that MT is relatively specific to the chronic low level Cd exposure.

Conclusion: In conclusion, general population have been exposed to low level Cd and exposure levels were affected by diet and smoking habits, sex, and age which might cause tubular damage in kidney through the oxidative stress mechanism. Urinary NAG and MT could be useful biomarkers under the environmental exposure to Cd.

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PP-31-152

Blood Cadmium and Chronic Kidney Disease in Korean Adults

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Background/Aims: Cadmium, a widely distributed metal in the environment that accumulates in the kidney, is an established nephrotoxicant at high-level exposure. Few studies have evaluated the associations between low-level cadmium and renal function in Korean populations. To evaluate the associations of blood cadmium with estimated glomerular filtration rate (eGFR) as a measure of chronic kidney disease (CKD) in the Korean adult population.

Methods: The study population consisted of 1909 adults (955 men and 954 women) aged 20 years or older, who participated in the 2005 Korean National Health and Nutrition Examination Survey III and had blood cadmium measures. eGFR was calculated by using the Modification of Diet in Renal Disease equation.

Results: Mean eGFRs were 81.5 and 74.4 mL/min/1.73 m^2 in men and women, respectively. The geometric means of blood cadmium were 1.57 and 1.49 μg/L in men and women, respectively. After adjustment for sociodemographic factors, CKD risk factors, and blood lead levels, eGFR was 1.85 mL/min/1.73 m^2 (95% CI: −3.55, −0.16) lower, comparing the highest to the lowest cadmium tertile in women, with no substantial differences in analyses stratified by blood lead levels. However, the association between blood cadmium and eGFR was markedly different in analyses stratified by blood lead levels in men. Among men with blood lead ≤2.75 μg/dL, adjusted eGFR was 2.00 mL/min/1.73 m^2 (95% CI: −5.43, 1.42) lower, comparing men in the highest versus lowest cadmium tertile. Among men with blood lead >2.75 μg/dL, conversely, the corresponding eGFR was 2.47 (95% CI: 0.41, 4.53) mL/min/1.73 m^2 higher.

Conclusion: In this representative sample of the Korean population, elevated cadmium levels were associated with lower eGFR in women and in men with low blood lead levels, supporting the role of cadmium as a CKD risk factor. Among men with high blood lead levels, however, elevated cadmium levels were associated with higher eGFR, a finding that is potentially consistent with hyperfiltration.

ENVIRONMENTAL ASBESTOS PROBLEMS

S-29C9-1

Significant Clustering of Mesothelioma Caused by Neighborhood Exposure to Crocidolite From a Large Asbestos Cement Pipe Plant in Japan

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Background/Aims: More than 150 mesothelioma patients and bereaved families came forward after a newspaper article published on 29 June 2005. It reported that there found 5 residents with mesothelioma who had lived close to a now-defunct asbestos cement plant in Japan. The plant used 4700 tons of crocidolite on average from 1957 to 1975.

Methods: Potential subjects were all who applied for relief payment funded by Kubota Corporation, which is a major machinery company that ran the plant. A detailed interview study was conducted to confirm occupational and domestic exposures to asbestos and residential histories. Standardized mortality ratio (SMR) was used for expressing the risk of developing mesothelioma. Asbestos relative concentration in the study area was estimated using a simulation model for air pollutants.

Results: Out of 162 potential subjects, 79 (38 men and 41 women) who had no occupational exposure and died after 1 January 1995 when ICD-10 was in effect in Japan were enrolled for computing SMR. Significantly elevated SMRs of mesothelioma were observed in the areas of 600 m and 1500 m radii from the center of the plant for men and women, respectively. Women who had lived within a 300-meter radius from the plant's center had the highest SMR of 41.1 (95% CI: 15.2–90.1). A linear dose-response relationship was observed between relative asbestos concentration and SMR for both sexes. The area with a significantly elevated SMR reached beyond 2000 m from the plant in the same direction where the wind predominantly blew in the study area.

Conclusion: The present results demonstrate that the mesothelioma outbreak among the residents was causally associated with crocidolite used by the plant. Public health policy makers, health professionals, and companies should be cognizant of the serious risk of neighborhood exposure to asbestos across a wide area.

S-29C9-2

Increased Risk of Lung Cancer Mortality Among Residents Who Had Lived Near an Asbestos Product Manufacturing Plant

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Background/Aims: To investigate whether individuals with neighborhood asbestos exposure experience increased lung cancer mortality.

Methods: From 1943 to 1991, a manufacturing plant in Hashima city (Japan) produced insulation and packing material using amosite and chrysotile. Our study group comprised of 577 households who resided near this plant on January 1992 and had at least 1 household member remaining there through June 2007. We obtained demographic information by a questionnaire survey and determined the underlying cause of death for deceased household members from death certificates. Using meteorological data, we estimated relative asbestos concentration in the plant's vicinity and we classified subjects into 4 exposure groups based on the concentration. Finally, we calculated standardized mortality ratios (SMR).

Results: We obtained complete questionnaire information for 502 of the 577 (87%) households, yielding 951 men and 956 women in the study group. During the follow-up period (1 January 1992–30 June 2007), 22

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men and 5 women died from lung cancer; only the male SMR showed a statistically significant increase (SMR = 2.15, 95% confidence interval [CI]: 1.35–3.25 for men and 1.47, 95% CI: 0.48–3.42 for women). Seven of the male lung cancer deaths and one of the female lung cancer deaths had potential occupational asbestos exposure. Examining the remaining deaths (15 men and 4 women) according to their respective exposure groups, the lung cancer mortalities were the highest in the highest exposure group for both men and women—respectively, SMR = 2.94 (95% CI: 1.27–5.79) and SMR = 3.52 (95% CI: 0.73–10.3). Comparison between deceased persons from lung cancer and other causes showed that the proportions of the greatest asbestos exposure category were significantly higher in lung cancer deceased persons for both genders.

Conclusion: Our findings suggest that neighborhood asbestos exposure can increase the risk of lung cancer mortality in men and probably in women.

S-29C9-3

Environmental Exposure to Asbestos and Pleural Plaques Among Retirees in a Factory Without Asbestos Use in H City, Japan

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Background/Aims: A factory in H city, Japan had used a relatively large amount of asbestos until 1991. In the immediate vicinity of the factory, N spinning factory that did not use asbestos at all existed. Although adverse health effects of environmental exposure to asbestos are suspected among retirees of the N spinning factory, epidemiological assessment has never been conducted. Therefore, we evaluated the association between environmental exposure to asbestos and pleural plaque among the retirees.

Methods: We targeted 107 retirees of the N spinning factory. In the first survey, we mailed self-administered questionnaires to the subjects on April 2007, and asked employment duration, asbestos-related findings which were diagnosed by their own doctors, and other demographic characteristics. In the second survey, we obtained computed tomography (CT) scan films from those who got CT scans at their regular check up. Then, 1 respiratory specialist and 1 radiologist independently assessed the films. After that, we evaluated the association between the employment duration and their findings, especially plural plaque.

Results: Among 99 survivors, 65 subjects returned the questionnaire (65.7%), while information of 4 among 8 deaths was obtained from their relatives. Mean duration of employment was 74 months in men and 67 months in women. Among the survivors, 7 subjects had asbestosis and 1 subject had mesothelioma. The duration of employment was positively associated with prevalence of asbestos-related findings. We obtained 22 chest CT films from the survivors. The association between the duration of employment and asbestos-related findings (pleural plaque) was still positive.

Conclusion: Prevalence of asbestos-related findings was higher among the retirees of N factory, which did not use asbestos at all. Therefore, these findings implicate that environmental exposure to asbestos induces plural plaque. Given long induction period of asbestos-related effect, further cases will be likely to be detected in the future.

S-29C9-4

Environmental Exposures From Asbestos Textiles Process: Old Versus New

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Background/Aims: To estimate past environmental exposure among residents, we need to check current exposure level around asbestos factory in Indonesia.

Methods: The study was conducted during 26–28 August 2008 in Cibinong, Indonesia. The field survey was carried out to know current workers' exposure level, to evaluate environmental exposure level (air and soil) of outside factory. We used the US-EPA method for soil bulk sample analysis. Cross check procedure by PLM (NIOSH method 9002) was conducted. PCM analysis carried out NIOSH method 7400 and the counting procedure were blinded to count asbestos fibers. The observed asbestos was used to compare with atmospheric dispersion models (CALPUFF). For the modeling domain, the alternative meteorological fields with 3 km spatial resolution were interpolated to the CALMET with 0.1 km resolution. The vertical layers set to have 24 and 10 layers for MM5 and CALPUFF, respectively.

Results: Mean air asbestos level according to textile production process such as mixing, carding, spinning, twisting, weaving, and winding were 8.6 f/cc, 7.3 f/cc, 7.5 f/cc, 3.9 f/cc, 3.1 f/cc, and 4.3 f/cc, respectively. Average asbestos concentrations of personal and regional air monitoring were 5.7 f/cc and 2.4 f/cc. The distribution of asbestos concentration for air monitoring in 5 m distance from windows of the factory was found in the order: south (0.154 f/cc), west (0.067 f/cc), east (0.016 f/cc), and north (0.001 f/cc). Asbestos were found in soil monitoring samples within 100 m from the factory. Distribution of 1 hour max asbestos in ambient air around the factories by CALPUFF is plotted below during study period (26 August 2008–28 August 2008). Determination coefficient (r2) between air monitoring data and CALPUFF (US EPA, Air Quality Models) simulation data in monitoring site was 0.72.

Conclusion: The effect range of asbestos is more than 10 km.

TRAVEL-TIME AIR POLLUTION EXPOSURE, ENERGY EXPENDITURE, AND HEALTH OUTCOMES: USE OF NEW TECHNOLOGIES AND RESULTS

S-30A1-1

Do the Health Benefits of Cycling Outweigh the Risks?

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Background/Aims: Although from a societal point of view a modal shift from car to bicycle may have beneficial health effects due to decreased air pollution and greenhouse gas emissions and increased levels of physical activity, from an individual point of view adverse health effects such as higher exposure to air pollution and risk of a traffic accident may prevail. This paper describes whether the health benefits from the increased physical activity of a modal shift for urban commutes outweigh the health risks.

Methods: We have summarized the literature for air pollution, traffic accidents, and physical activity using systematic reviews supplemented with recent key studies. Next, we quantified the impact on all-cause mortality when 500,000 people would make a transition from a car to a bicycle for the short roundtrips (<7 km) on a daily basis in the Netherlands. We have expressed mortality impacts in life years gained or lost making use of life table calculations.

Results: For the people who shift from car to bicycle, we estimated that beneficial effects of the increased physical activity are substantially larger (3–14 months life gained) than the potential mortality effect of increased

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inhaled air pollution doses (10–41 days life lost) and the effect on traffic accidents (0.6–1 day lost).

Conclusion: The health benefits of cycling are 11 times larger than the risks relative to car driving for the individual subjects shifting mode of transport. Societal benefits are even larger due to a modest reduction in air pollution emissions and traffic accidents.

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S-30A1-2

Respiratory Health Effects of Commuters

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Background/Aims: People spend a significant amount of time in traffic, during which they are exposed to high levels of air pollution. Very few studies measured acute health effects after real life exposure in traffic. The large TRAVEL study assessed exposure and related acute health effects of people commuting by bicycle, car, and bus.

Methods: Exposure to and inhalation of ultrafine particles, particulate matter (PM_{10}), $PM_{2.5}$, and soot were measured during 2-hour commutes in Arnhem, a medium-sized city in the Netherlands. Commuting took place from 8 till 10 AM. Before, immediately after, and 6 hours after exposure, we measured lung function, airway resistance, and nitric oxide in exhaled air as a marker of lung inflammation.

Results: During the 47 measurement days, we collected 352 pre- and post-health measurements of 34 healthy, nonsmoking, adult volunteers. Exposures differed by mode of transport, route, and fuel type. Using mixed model analysis, we found negative associations between ultrafines and FEV1, and positive associations between ultrafines and airway resistance, and exhaled NO. Ambient NO_2, but not ambient ozone, was significantly associated with increased exhaled NO levels.

Conclusion: Two hour in-traffic exposures to particle number counts were associated with decrease in FEV1, increase in airway resistance, and increase in exhaled NO, a marker of airway inflammation. Effects of exposure in traffic to $PM_{2.5}$, PM_{10}, and soot were not consistently associated with respiratory health outcomes.

S-30A1-3

Traffic Exposure and Modal Choice: A New Zealand Case Study

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Background/Aims: There is an evidence that the daily commute though occupying a relatively short period of time, can account for a significant proportion of an individual's daily pollution exposure. Many cities are developing new policies to encourage active travel (walking and cycling) to reduce congestion and pollution, and improve health. It is therefore important to understand how travel choices may affect personal exposures and health. Although most research to date has looked at densely populated, highly trafficked cities, there is also a need to understand what is happening in other types of urban area.

Methods: This research assessed the comparative risk associated with traffic exposure when travelling on different transport modes in 2 New Zealand cities, Auckland and Christchurch. Data on particulate matter (PM_{10}), $PM_{2.5}$, PM_1, and CO were collected along with time activity data using a combination of GPS, sounds, and photos. Comparison was made car, bus, train (Auckland only), on-road bike, and off-road bike. Additional sampling examined the impact of cycle route and its proximity to traffic and the impact on pollution exposure.

Results: Results show that the choice of mode has significant implications for exposure, individual events on journeys can result in significant spikes in exposure, and locating cycle routes even relatively short distances from traffic can significantly reduce exposure.

Conclusion: Even in cities is lower population densities, and less traffic congestion, there are still significant differences in pollution exposure between transport modes.

S-30A1-4

Within-city Variation in Exposures to Air Pollution and Physical Inactivity

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Background/Aims: The environmentally mediated risks associated with mobility vary among travel modes. Rates of active travel (walking, bicycling) vary within urban areas, and population exposures to these risks depend in part on urban design.

Methods: We use a time-activity diary to compare intra-urban variability of 1 health outcome (ischemic heart disease) for 2 exposure variables (exercise; air pollution) that are important for mode shifts to active travel. Monte Carlo simulations were used to extract weekly physical activity levels from survey data which include active trips and fitness activities in Los Angeles, CA. Those physical activity estimates were then compared against home address air pollution estimates to calculate aggregate risks for each survey participant (n = 27,196).

Results: Preliminary results for ischemic heart disease risks in Los Angeles suggest that variability in the levels of physical activity and exposure to air pollutants ($PM_{2.5}$, NOx, O_3) are similar in magnitude.

Conclusion: This research highlights the need for time-activity diaries that more accurately capture weekly minutes of physical activity. Furthermore, survey respondents may underreport trips; that fact highlights the benefits of employing objectively measured physical activity. The authors plan to apply this methodology to other urban areas (with more appropriate datasets), which provide better estimates of a given individual's level of physical activity.

S-30A1-5

Traffic Exposures and Inhalations of Barcelona Commuters

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Background/Aims: Barcelona presents characteristics that make travel microenvironments of particularly relevant health concern. Traffic, with its high proportion of diesel vehicles, dominates emissions sources. Canyon streets and bike lanes predominately situated along heavy traffic streets may put pedestrians and cyclists at risk of elevated exposures. We designed a study aimed at comparing exposure and inhalation of air contaminants across modes in Barcelona.

Methods: Commuters equipped with a GPS unit, an accelerometer, and air quality samplers were monitored on 4 routes in 4 travel modes. Pairs of commuters traveling at the same time on the same route in 2 different modes and during 4 periods of the day were monitored during 3 weeks in June 2009. Black carbon was estimated with a new portable microaethalometer (Magee), as well as with reflectance measurements of particulate matter ($PM_{2.5}$) filters collected with high-flow gravimetric sampler (Adams 2001). $PM_{2.5}$ was also measured continuously with a Dust-Trak (TSI). Two different instruments were used for comparisons of

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ultrafine particulates (P-Trak and CPC 3007), and Q-Traks measured CO (all TSI).

Results: Trends for most pollutants show highest exposure concentration for car occupants, followed by bus riders, cyclists, and pedestrians. We found pedestrians were exposed on average to: 1.1 ppm of CO, 44,540 pt/cm^3 of ultrafine particulate, 30.7 μg/m^3 $PM_{2.5}$, and 5855 ng/m^3 of black carbon. Pairwise comparisons show car drivers are exposed to close to 3 times greater concentrations of ultrafine and black carbon than pedestrians, and respectively 50% and 33% higher $PM_{2.5}$ and CO.

Conclusion: The presentation further compares exposures and inhalation across modes, with a discussion on factors influencing exposures (eg, location of bike lane, intersections, street type) and equipment used.

S-30A1-6

An Interactive Route Planner Incorporating Air Pollution and Cycling Determinants to Facilitate and Promote Cycling in Metro Vancouver, Canada

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Background/Aims: With increasing fuel costs, greater awareness of greenhouse gas emissions and increasing obesity levels, cycling is promoted as a health promoting and sustainable transport mode. To facilitate cycling amongst the general public and to optimize new cycling route design by transportation planners, we developed a cycling route planner (http://cyclevancouver.ubc.ca) for Metro Vancouver, Canada.

Methods: The geographical information system-based planner is unique in its incorporation of multiple user-specified factors that influence the choice to bicycle (eg distance, elevation gain, safety, route features, and links to transit) and traffic-related air pollutant exposures in selecting the preferred routing. Using a familiar and user-friendly Google Maps interface, the planner allows individuals to seek optimized cycling routes throughout the region based on their own preferences. In addition to the incorporation of multiple user preferences in route selection, the planner is unique in its use of topology to minimize data storage redundancy, reliance on node/vertex index tables to increase the efficiency of optimal route selection process and the use of web services and asynchronous technology to create a rich media application with quick data delivery.

Results: In addition to route output, the planner also provides route-specific information on distance, net elevation gain, duration, calories burned, air pollution exposure, and carbon dioxide emissions reduction (relative to travel by automobile). The code and input data requirements are readily transferable to other locations, making possible the development of similar planning tools elsewhere.

Conclusion: Use of this tool can help promote bicycle travel as a form of active transportation and help lower CO_2 and air pollutant emissions by reducing car trips.

THE CARDIOVASCULAR EFFECT OF AIR POLLUTION IN EAST ASIA

S-30A2-1

The Indoor and Outdoor Fine Particulate Matter Exposure and Heart Rate Variability in Healthy Older Subjects in Beijing

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Background/Aims: It has been hypothesized that particulate matter with an aerodynamic diameter of 2.5 μm or less ($PM_{2.5}$) can lead to the increases in cardiovascular morbidity and mortality via the dysfunction of cardiac autonervous system. Previous studies found the heterogeneous associations between ambient $PM_{2.5}$ and the cardiac autonervous system measured as heart rate variability (HRV) indices in the elderly with cardiopulmonary diseases. However, few attentions have been focused on the healthy older population and the effect of indoor $PM_{2.5}$ on HRV. We evaluate the association between the indoor and outdoor exposure to $PM_{2.5}$ and the changes in HRV in a panel of healthy older subjects.

Methods: We measured the exposure to $PM_{2.5}$ and 24 hour HRV in 30 healthy older subjects from 14 August–4 September 2008 in Beijing. The 5-min HRV frequency indices were regressed on the real-time simultaneous 5-min $PM_{2.5}$ moving average adjusting for the potential confounders (nitrogen oxides, meteorological factors, and subjects characteristics) using the mixed linear model to evaluate the effect of $PM_{2.5}$ on HRV. We distinguished the indoor and outdoor period based on the time-activity recorded by the subjects.

Results: Elevated indoor $PM_{2.5}$ exposure was associated with high frequency ($\beta = 0.00062$, $P = 0.03$) and low frequency ($\beta = 0.00057$, $P = 0.02$). However, we found no association between outdoor $PM_{2.5}$ exposure and high frequency ($\beta = -0.00053$, $P = 0.48$) or low frequency ($\beta = -0.00055$, $P = 0.38$) in the healthy older subjects.

Conclusion: Exposures to indoor $PM_{2.5}$ was associated with the disturbance of HRV frequency indices in the healthy older subjects. This association may be related to the composition of $PM_{2.5}$.

S-30A2-2

Marked Changes in Particulate Air Pollution in Beijing in 2008 and Heart Rate Variability in Taxi Drivers

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Background/Aims: The effect of particulate matter (PM) exposure on cardiac autonomic function in young healthy adults, as reflected by changes in heart rate variability (HRV), has received less attention. The purpose of this study was to evaluate the relationship between the traffic-related $PM_{2.5}$ (particulate matter with an aerodynamic diameter $\leq$2.5 μm) exposure and HRV in a group of young healthy taxi drivers.

Methods: Continuous measurements of personal exposure to $PM_{2.5}$ and ambulatory electrocardiogram monitoring were conducted on 11 young healthy taxi drivers for a 12-hour work shift during their work time (09:00–21:00) before, during, and after the Beijing 2008 Olympic Games, respectively. Mixed-effects regression models were used to estimate associations between $PM_{2.5}$ exposure and percent changes in 5-minute HRV indices after combining data from the 3 time periods for each subject, and controlling for potentially confounding variables.

Results: Mean personal exposure levels to $PM_{2.5}$ inside the taxicab of taxi drivers were 105.5 μg/m^3, 45.2 μg/m^3, and 80.4 μg/m^3 before, during, and after the Beijing 2008 Olympic Games, respectively. The standard deviation of normal-to-normal intervals decreased by 2.2% (95% confidence interval [CI]: −3.8% to −0.6%) with an interquartile range (69.5 μg/m^3) increase in the 30-minute $PM_{2.5}$ moving average. The low-frequency and high-frequency powers decreased by 4.2% (95% CI: −9.0%, 0.8%) and 6.2% (95% CI: −10.7%, −1.5%) in association with an interquartile range increase in the 2-hour $PM_{2.5}$ moving average. Additionally, subject-specific regression models indicated that there were 3, 5, and 4 subjects showed positive associations with 30-minute $PM_{2.5}$ moving average in standard deviation of normal-to-normal intervals, low-frequency power, and high-frequency power, respectively.

Conclusion: Traffic-related $PM_{2.5}$ exposure was associated with altered cardiac autonomic function in young adults. However, further study is needed to explore the mechanisms behind the different responses to PM exposure in individuals.

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S-30A2-3

Long-term Exposure to Particulate Matter and Cardiovascular Mortality in a Representative Japanese Cohort: NIPPON DATA80

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Background/Aims: Previous studies from North America and Europe have shown that long-term exposure to ambient particles was positively associated with mortality. However, it is uncertain whether chronic exposure to air pollution is associated with increased mortality in Asian countries, which have different spatial distribution patterns of cardiovascular mortality, risk factors, and particulate matter (PM) levels. We investigated the association between long-term exposure to PM and cardiovascular mortality risk using NIPPON DATA80, a representative Japanese cohort.

Methods: A total of 7250 participants aged 30 years and older from randomly selected 232 census areas, both rural and urban, throughout Japan were followed from 1980 to 2004. We linked the averaged annual concentrations of PM from 1985–2004 to each cohort participant who resided in the census area at the time of the baseline survey. Study participants were divided into quintiles of average PM concentration. We applied the Cox proportional hazard model adjusting for sex, age, body mass index, blood pressure, total cholesterol, blood glucose, smoking categories, drinking categories, and the municipality population size.

Results: During follow-up (a total of 137,440 person-years), there were 1716 deaths from all causes; 571 from cardiovascular disease, 116 from coronary heart disease, and 250 from stroke. Hazard ratios were not different among the quintiles and those for trend per 10 $\mu g/m^3$ increase in annual PM concentration were 0.98, 0.90, 0.92, and 0.86 for all-cause, cardiovascular, coronary heart disease, and stroke mortality, respectively.

Conclusion: Long-term exposure to PM was not associated with increased cardiovascular mortality risk in Japan. Further studies in Asian countries are necessary.

S-30A2-4

Nickel and Disrupted Endothelial Integrity: Implications to $PM_{2.5}$-associated Cardiovascular Disorders

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Background/Aims: It has been well documented that exposure to ambient fine particulate matter ($PM_{2.5}$) induces increased risks for cardiovascular disorders (CVD) in humans. However, the mechanism(s) and component(s) responsible for $PM_{2.5}$-associated CVD are still poorly understood. This study was conducted to test the hypothesis that nickel (Ni) plays critical roles in $PM_{2.5}$-associated CVD.

Methods: To test this hypothesis, we identified 2 areas, Jinchang and Zhangye, in China with comparable $PM_{2.5}$, but different Ni exposures. In all, 30 healthy nonsmoking female subjects aged between 60 and 65 were recruited from each area to measure the following: (1) CVD risk biomarkers [C-reactive protein, MCP-1, IL-6, ICAM-1, and VCAM-1]; (2) markers of vascular integrity (intima-media thickness [IMT] of carotid artery); and (3) vascular endothelial repair marker (circulating endothelial progenitor cells [CEPCs]).

Results: The ambient concentrations of $PM_{2.5}$ were 43.0 ± 40.7 and 45.5 ± 47.7 $\mu g/m^3$ in Jinchang and Zhangye, respectively, with no significant difference. However, the ambient level of Ni in Jinchang (204.8 ± 268.6 ng/m^3) was approximately 76-fold higher than that in Zhangye (2.7 ± 4.3 ng/m^3). No differences were detected between the 2 groups of recruited subjects in age, body mass index, blood pressure, and lipid profiles. All CVD risk markers, except ICAM-1, were higher in subjects from Jinchang as compared with those from Zhangye; and significant differences in C-reactive protein and IL-6 were detected between the 2 groups. The IMT measured by B-mode ultrasound imaging was significantly thicker in subjects recruited from Jinchang than that in those from Zhangye. CEPCs, enumerated by flow cytometry, were significantly lower in subjects recruited from Jinchang than that in those from Zhangye. Correlation analyses further indicated that IMT correlated negatively with the number of CEPCs while positively with MCP-1.

Conclusion: These results may suggest the following: (1) Ni is an important component responsible for $PM_{2.5}$-induced cardiovascular effects; (2) the reduced capacity of vascular endothelial repair may partially explain the critical roles of Ni in $PM_{2.5}$-associated CVD.

CHEMICALS AND ENVIRONMENTAL HEALTH ISSUES: BISPHENOL A AND FLAME RETARDANTS

O-30A4-1

Urine Bisphenol-a (BPA) Level in Relation to Semen Quality and Sexual Dysfunction

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Background/Aims: The human population is widely exposed to Bisphenol-A (BPA). The present study was designed to examine the adverse effects of BPA exposure on the male reproductive system including poor semen quality and sexual dysfunction.

Methods: We examined the relationship between urine BPA levels and semen quality among 302 male workers who provided both urine and semen specimens. Urine BPA was assayed to determine BPA exposure level. Semen specimens were obtained and analyzed according to WHO criteria.

Results: After adjustment for potential confounders, a linear dose-response association was observed between an increasing urine BPA level and reduced semen quality: decreased semen sperm concentration, total sperm count, vitality, and motility (A+B movements). Using ordinal logistic regression, compared to those without a detectable urine BPA level, odds ratios for urine BPA levels in tertile levels from lowest to highest are 1.6 (95% confidence interval [CI]: 0.8–3.2), 2.4 (95% CI: 1.2–4.8), 2.7 (95% CI: 1.3–5.3) for reduced semen density; 1.5 (95% CI: 0.8–3.0), 1.9 (95% CI: 0.9–3.7), 1.8 (95% CI: 0.9–3.6) for reduced semen concentration; 1.2 (95% CI: 0.6–2.4), 1.9 (95% CI: 1.0–3.9), 2.6 (95% CI: 1.3–5.3) for reduced sperm vitality; and 1.2 (95% CI: 0.6–2.3), 1.9 (95% CI: 1.0–3.8), and 2.1 (95% CI: 1.1–4.2) for reduced sperm motility. Semen volume and abnormal morphology were not associated with urine BPA level. A similar linear dose-response relationship was also observed between urine BPA level and male sexual function

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measurements. In addition, we observed a similar pattern of the association among those exposed to low BPA levels from environmental sources only, although many of the estimates were no longer statistically significant due to smaller sample sizes.

Conclusion: Our findings provide the first epidemiologic evidence of BPA adverse effect on the male reproductive system including reduced semen quality and sexual dysfunction.

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O-30A4-2

The Effect of Bisphenol a Exposure on Heart Rate Variability and Blood Pressure

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Background/Aims: Bisphenol A (BPA) is a chemical being used in manufacturing plastics, and a great amount is used worldwide. Though BPA is considered as one of the endocrine disrupting chemicals (EDCs), the knowledge on the health effects of BPA exposure is still limited. We conducted a panel study to investigate the effect of urinary level of BPA on heart rate variability (HRV) and blood pressure.

Methods: We recruited 411 elderly citizens who were not institutionalized, in Seoul, Korea. The participants visited examination site up to 3 times between August 2008 and October 2009. We measured urinary level of BPA, HRV, and blood pressure at each visit. We conducted interviews to obtain information on the medical history and demographic characteristics when each participant was enrolled. We used linear regression to assess the association between BPA and outcomes in cross-sectional analyses of each visit. We also constructed linear mixed model to assess the effects using repeated-measurement data. We excluded 24 participants who reported previous history of ischemic heart disease or myocardial infarction from the final analyses. Sex, age, examination date, height and weight were adjusted in the analyses.

Results: The mean age of the participants was 70.5 ± 5.2 years. LF was significantly associated with urinary level of BPA and regression coefficients of repeated measurement were −24.02 ($P = 0.032$). HF had marginally significant association with urinary BPA (regression coefficient = −16.32; $P = 0.086$). Systolic and diastolic blood pressures also were significantly associated with urinary level of BPA and correlation coefficients were 1.64 ($P < 0.001$), respectively. Cross sectional analyses for each of the 3 visits showed similar associations.

Conclusion: The present study showed that urinary level of BPA is significantly associated with HRV and blood pressure. This suggests that exposure to BPA could have adverse health effect on cardiovascular function.

O-30A4-3

Flame Retardants in Airplanes

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Background/Aims: Brominated flame retardants (BFRs) are chemicals with a variety of applications in eg, polymers and textiles. Among all BFRs, the group of polybrominated diphenyl ethers (PBDEs) is the most well known and nowadays rated as hazardous compounds with impact on health and environment. In airplanes, flame retardants are abundant in construction, electronic equipment, and furnishings. A previous preliminary study revealed high levels of PBDEs in dust from passenger airplanes and increased concentrations of several PBDE congeners in serum from passengers after an intercontinental flight. It could be assumed that the exposure of the aircraft crew could be even higher.

Methods: In the present study, we sampled air and dust in the cockpit and cabin during flights. Air sampling was performed using a sampler with glass fibre filter and XAD-2 adsorbent attached to a pump. Settled dust was sampled by wiping 0.05 m^2 of hard surfaces with a cotton stick. In total, 24 air and 27 dust samples were collected during 13 long distance flights in 3 different models of passenger airplanes. Analysis of the whole spectrum of PBDE congeners was performed by GC-MS.

Results: Preliminary analysis of dust found all technical products of PBDEs (PentaBDE, OctaBDE and DecaBDE) but the amount differed substantially between the samples. BDE-209 had the highest median concentration (6020 ng/m^2), followed by BDE-99 (143 ng/m^2) and BDE-47 (131 ng/m^2). In addition, we found other BFRs including hexabromocyclododecane, decabromodiphenyl ethane, and bis(2,4,6-tribromodiphenyl) ethane. An impression during the collection of samples was that there was relatively much dust on surfaces in the cockpit and the results confirm especially high levels there.

Conclusion: In conclusion, the project indicates a high potential exposure risk to BFRs in airplanes.

O-30A4-4

Exposure to Flame Retardants in Commercial Aircraft

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Background/Aims: Limited information is available regarding exposure to flame retardants on commercial aircraft. A study of exposure to polybrominated diphenyl ethers (PBDEs) in aircraft found that while body burdens of PBDEs in air travelers were similar to levels measured in the general population, the post-flight body burdens were higher than pre-flight body burdens suggesting travel-related exposure. That study, the only peer-reviewed paper specific to environmental exposures to flame retardants on commercial aircraft, also reported concentrations of PBDEs in dust from aircraft that often exceed the highest dust concentrations found in homes.

Methods: In research associated with the US Federal Aviation Administration (FAA) Airliner Cabin Environment Research (ACER), and in cooperation with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., we collected air samples from commercial aircraft cabins (n = 22) and analyzed them for 4 PBDE congeners—BDEs 47, 99, 100, and 209.

Results: Median concentrations for the 4 congeners were 2.0, ●●● dl, ●●● dl, and 0.68 ng/m^3, respectively. For BDE 47, the median and maximum concentrations (maximum, 12.7 ng/m^3) were an order of magnitude greater than median and maximum levels typically found in US homes. For BDE 209, the median concentration was similar to median levels in homes and the maximum concentration (2050 ng/m^3) was an order of magnitude greater than the maximum air concentrations measured for occupationally exposed workers. Ongoing research includes analysis of additional air samples and dust samples for PBDEs and other flame retardants.

Conclusion: Along with consideration of potential exposures to the public, flight attendants' potential for prolonged exposures highlights the need for continued assessment of exposure to these compounds in commercial aircraft.

Although the FAA has sponsored this project, it neither endorses nor rejects the findings of this research. Results of Cooperative Research between the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., and Battelle Memorial Institute.

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O-30A4-5

Predictors of Serum Polybrominated Diphenyl Ether (PBDE) Exposure Among Pregnant Women Living in California, and Comparison of Maternal and Child Levels

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Background/Aims: We measured levels of 10 Polybrominated Diphenyl Ether (PBDE) congeners in serum from 417 pregnant women, and their 7-year-old children, in a predominantly Latino community of Monterey County, California. The most frequently detected congeners in maternal and child serum were BDEs 47, 99, 100, and 153, all of which were detected in more than 97% of maternal samples, and in 100% of child samples.

Methods: We created multivariate regression models to examine associations between maternal concentrations of individual PBDE congeners as well as their total molar sum (pmol/g lipid) and predictors of exposure. We also compared maternal and child serum PBDE levels.

Results: Modeling results indicate that length of time residing in the United States and having ≥3 (vs. <0.01). Women's total PBDE levels increased 4.1% (95% CI: 2.7, 5.4) for each additional year residing in the United States, after adjustment for pre-pregnancy BMI, weight gain during pregnancy, and SES. Having ≥3 pieces of stuffed furniture in the home was associated with a 75.4% (95% CI: 22.7, 150.8) increase in women's PBDE serum levels. When we examined the interaction between number of pieces of stuffed furniture in the home and SES, we found that women living below the US poverty threshold intensifies the effect of having 3 pieces of stuffed furniture in the home. Child PBDE levels (n = 272) were consistently higher compared to maternal levels with geometric mean BDE-47 levels that were over 3 times higher in the child samples (47.5 ng/g lipid [43.0, 52.5] vs. 14.5 ng/g lipid [13.1, 15.9]).

Conclusion: Overall study findings suggest that PBDE contamination in California homes is contributing to human exposures in a population of recent immigrant families.

O-30A4-6

Current Fetal Exposure Level of Endocrine Disruptors, Heavy Metals and Brominated Flame Retardants in Japan

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Background/Aims: The current fetal exposure level of endocrine disruptors, heavy metals, and brominated flame retardants (BFRs), and the correlation among them in Japan will be introduced.

Methods: More than 300 umbilical cords were collected in Chiba City and concentration levels of endocrine disruptors (polychlorinated biphenyls [PCBs], p,p′-DDTs, p,p′-DDEs, trans-nonachlor, oxychlordane, hexachlorobenzene [HCB], mirex, β-hexachlorocyclohexane [HCH]), heavy metals (Pb, Hg, Cd) and BFRs (polybrominated diphenyl ethers [PBDEs]) in the cord tissue were measured.

Results: The average concentrations of total PCBs, p,p′-DDTs, p,p′-DDEs, trans-nonachlor, oxychlordane, HCB, mirex, and β-HCH in umbilical cords were found to be 74.8, 4.3, 128.2, 17.9, 9.1, 23.2, 1.1, and 74.4, respectively (all the data are shown in pg/g wet). The average concentrations of Pb and Hg were found to be 7.8 and 26. The concentration of Cd was lower than the detection level. The concentration of total PBDEs was found to be 25. BDE-47 and BDE-209 were the dominant compounds, the average concentration of BDE-47 and BDE-209 were 7.3 and 7.0, respectively. Among the 27 PBDE congeners, the following 12 were lower than the detection level in all samples: BDE-3, 7, 71, 77, 119, 126, 138, 156, 184, 191, 196, and 206.

Conclusion: Significant correlation among each concentration level of endocrine disruptors were found. However, the correlation between endocrine disruptors and heavy metals was not found. Our results indicate that Japanese fetuses are exposed to endocrine disruptors, heavy metals, and BFRs.

AIR POLLUTION - SPATIAL ANALYSIS

O-30A5-1

National Satellite-based Land Use Regression: NO_2 in the United States

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Background/Aims: A land use regression (LUR) model is developed for NO_2 in the continental United States. Hourly NO_2 concentrations were obtained for EPA's 426 fixed site monitoring stations for year 2006. Independent variables include land use characteristics and satellite-based NO_2 measurements from the Ozone monitoring Instrument aboard the NASA Aura satellite.

Methods: Land use characteristics (population density; percent impervious surfaces; percent tree canopy; and length of major and minor roads) were examined at buffer lengths between 100 and 10,000 m. Additional parameters investigated are elevation, distance to the nearest coast, and satellite NO_2 measurements. LUR models are compared with and without satellite-derived concentration, and with land use datasets that are available globally (1-km grid resolution) versus only in the United States (30-m grid resolution).

Results: Based on R^2 values, the "best" model employs globally-available land use data and satellite estimates of air pollution (R^2 = 0.78). Excluding satellite estimates of air pollution reduces model performance (to R^2 = 0.68). Employing the finer scale, US-only land use data yields only a minor change in model performance (R^2 = 0.77). Seasonal models using the 1-km resolution dataset show only minor seasonal variability in performance (R^2 = 0.75 for fall, 0.73 for spring, 0.76 for summer, and 0.73 for winter). Hourly models show best performance mid-day (R^2 = 0.80 for 12:00–1:00 PM) and comparatively weaker performance in the early morning (R^2 = 0.65 for 4:00–5:00 AM).

Conclusion: Our methods, which employ satellite-derived concentrations and globally-available land use data sets, could be transferred to other areas of the world if the road network data can be obtained.

O-30A5-2

Development and Application of Spatially Disaggregated Exposure Series in Time-series Analyses of Air Pollution-related Health Effects in Chennai, India

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Background/Aims: A recent meta-analysis of the health effects of outdoor air pollution conducted in Asia emphasizes the need to include countries and cities where few studies have previously been conducted. We report here the results of such a time-series analysis of short-term effect on mortality due to measured PM_{10} and modeled PM_{10}, $PM_{2.5}$, and O_3 in Chennai, India. The primary focus in the study was on developing a representative exposure series of PM_{10} for Chennai population in order to estimate the associated relative risk (RR) for all-cause mortality within the

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limitations imposed by routinely collected retrospective data and to validate the estimates of RR by modeled PM_{10}, $PM_{2.5}$, and O_3 data.

Methods: We used data on PM_{10} collected from AQMs throughout the city and all-cause mortality collected from all city zones for the period 2004–2007. Modeled pollutant data were generated for 1 year (2007), using the WRF-CHEM model. We developed a zonally disaggregated exposure series and subsequently used quasi-Poisson regression with smooth functions of time, weather parameters to estimate the RR for mortality, using zonally disaggregated exposure series and the modeled data exposure series.

Results: The model estimated an RR of 1.0037 (1.0008, 1.0067) per 10 $\mu g/m^3$ increase in daily PM_{10} concentrations while using empirical data and estimated an RR of 1.0014 (0.9994–1.0034), 1.0033 (0.9878–1.0189), and 1.0103 (0.9787–1.0429) for modeled PM_{10}, $PM_{2.5}$, and O_3, respectively.

Conclusion: Our estimates obtained using empirical data are robust and comparable to similar estimates from other countries. The development of methodological refinements to address specific data limitations (missing measurements and small footprints of AQM) could be useful for routine analysis in the developing country where similar issues prevail. However, the modeled data estimates indicate the relative inability of the emission inventory based models to capture daily difference in emission. But, the refinements being made are expected to improve their application in India.

O-30A5-3

Estimating Long-term Exposure to Air Pollution in 38 Study Areas in Europe in a Harmonized Way Using Land Use Regression Modeling (ESCAPE Project)

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Background/Aims: The ESCAPE (European Study of Cohorts for Air Pollution Effects) project investigates the long-term health effects of exposure to air pollutants in Europe. Land use regression (LUR) modeling based on dedicated measurement campaigns will be used to estimate exposure to ambient air pollution for study participants of ongoing health studies.

Methods: In 38 study areas in Europe, PM and NO_x measurements are being conducted in a harmonized way in the period 2008–2011. In each study area, there are 40 NO_x measurements and in selected areas 20 additional PM measurements are being conducted. Monitoring is being conducted in three 2-week periods in different seasons. In half of the study areas, the measurements have been successfully completed with few problems (eg, less than 5% of the NO_x samplers have been stolen), resulting in more than 2000 measured concentrations. The monitored concentrations will then be used as independent variables to develop a LUR model for each study area. Data derived with Geographic Information Systems (GIS) will be used as predictor variables in the LUR models. European-wide GIS variables (such as CORINE land use, road network) are available for all study areas. In addition, local GIS variables (such as traffic intensity, street configuration, population density) will be used. The LUR models will be developed in a harmonized way in order to estimate exposures at addresses of study participants of health studies in the different areas.

Results: At a workshop in April 2010, initial LUR models were developed for the different study areas. The LUR models were finalized before summer 2010.

Conclusion: The study areas differ with respect to the variation in the measured concentrations and also the availability of local GIS data differs between study areas. We will discuss the performance, the agreement, and the differences between the different area-specific LUR models.

O-30A5-4

A Bayesian Kriging Model to Predict PM_{10} Annual Average Concentrations for the Lombardy Region (Italy)

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Background/Aims: Recent literature on long-range spatial exposure assessment focused on Kriging or atmospheric pollution models. We develop a full Bayesian approach to Universal Kriging which allows appropriate treatment of prediction uncertainty.

Methods: Data on air pollutants concentration (PM_{10}) for the year 2007 came from the air quality network of Environmental Protection Agency of the Lombardy Region (Italy). Information are available for 77 monitoring stations. A Geographic Information System (GIS) with data on meteorology, pollution monitor, traffic and industrial emission sources, elevation, land use, and population was used. We specified a full Spatial Exponential Gaussian Bayesian model to predict pollutants concentration for the 1546 municipalities of the Lombardy Region. The spatial correlation structure was specified as a function of distance between monitors. Prior values for the parameters of the distance function were chosen to assure that the correlation between any pair of points be 0.07 at the maximum distance (250 km) and 0.97 at the minimum distance (3 km). GIS covariates at monitors location were used to characterize the spatial trend of pollutants concentration. Within the model, the regression coefficients were then used to make predictions at each grid point. Since over the whole Lombardy Region the grid points are in large excess compared to the sampling points (pollutants monitors), we made predictions for 5 mutually exclusive grid samples and then hierarchically combined the results. All computation were obtained by MCMC methods.

Results: The predicted surface shows annual average values of PM_{10} above 50 mcg/cm for the metropolitan area of Milan and the city of Brescia. Large part of the Po valley has predicted concentrations above 40 mcg/cm.

Conclusion: Our findings are in strong agreement with atmospheric pollution models like the MINNI integrated model (Zanini, 2009) and the model developed by the Environmental Protection Agency of Lombardy Region ($r = 0.88$).

O-30A5-5

Geographic Clustering of Disease: Comparison of the Statistical Power of GAMs and Satscan

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Background/Aims: The spatial scan statistic SaTScan is commonly used to test for disease clusters. The generalized additive model (GAM) provides a regression-based alternative to this problem and produces a map of risk. It uses a bivariate smooth of location of outcomes in space

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while adjusting for covariates. We determine the degree of smoothing (span size) by minimizing the AIC and use a permutation test of the null hypothesis that the map is flat.

Methods: We used synthetic data generated under the null to evaluate the type I error rates of hypothesis tests. We examined several variations of the GAM approach: the χ^2 test provided by R or Splus, a conditional permutation test (using the span of the observed data for all permutations), a fixed-span permutation test (using multiple span sizes selected a priori with a Bonferroni-like correction), and an unconditional permutation test (recomputing the optimal span for each permutation). We compared the methods under 3 alternative hypotheses: a circular area of elevated risk (hot spot); a point source where risk decreases with distance; and a line source where risk decreases with distance. The theoretical power for each hypothesis was computed.

Results: SatScan and the fixed-span and unconditional permutation tests had appropriate type I error rates. The type I error rates for the conditional and χ^2 tests were elevated. We proposed a simple correction for the former. SaTScan had better power than the GAM methods for the hot spot (SaTScan is designed to find the most likely circular cluster). The GAM methods had superior power to SaTScan for other alternative hypotheses. The unconditional permutation test had reduced power when it was examined and was computationally intensive.

Conclusion: The relative power of the methods depended on the alternative hypothesis under consideration. SaTScan performed better for the circular hot spot; GAM performed better for the other hypotheses.

EXPOSURE ASSESSMENT BY VARIOUS MEDIA AND PATHWAYS

O-30A6-2

Retrospective Exposure Estimation for Perfluorooctanoic Acid (PFOA) for Participants in the C8 Health Project

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Background/Aims: The primary source of PFOA in the environment of eastern Ohio and western West Virginia is believed to be the Washington Works facility. Percolation of deposited PFOA through the soil and pumping by industrial and municipal wells near the contaminated Ohio River is thought to explain elevated well water concentrations and human serum concentrations measured in recent years. Our objective is to estimate historical PFOA exposures and serum concentrations experienced by each of about 45,276 non-occupationally exposed participants in the C8 Health Project, based on their residential histories.

Methods: We linked several environmental fate and transport models including AERMOD, PRZM3, BREZO, MODFLOW, and MT3D to simultaneously model PFOA air dispersion, transit through the unsaturated soil zone, surface water transport, and groundwater flow and transport. Annual PFOA exposure rates were estimated for each individual based on predicted calibrated water concentrations and predicted air concentrations, and default assumptions from the EPA Exposure Factors Handbook. Self-reported municipal water sources were verified using geocoded addresses and historical water distribution network maps for 6 municipal water districts. Individual exposure estimates were coupled with a one-compartment pharmacokinetic model to estimate annual serum PFOA concentrations.

Results: Predicted water concentrations were within 2.3 times the observed mean water concentrations for all 6 municipal water districts. Predicted and observed median serum concentrations in 2005–2006 are 28.2 and 24.3 ppb, respectively (Spearman's rho = 0.66). Stratified by municipal water source at the time of the serum sample, Spearman rho ranges from 0.19 to 0.34.

Conclusion: State-of-the-art fate and transport models provide the most defensible retrospective exposure estimates for epidemiologic studies when historical environmental measurements are lacking but source emissions rates are known. Our models predict recently observed municipal water PFOA concentrations and human serum PFOA concentrations surprisingly well, and will be used in a variety of epidemiologic studies being conducted in this region.

O-30A6-3

Dietary Exposure Assessment of the 18-month-old Guadeloupian Toddlers to Chlordecone

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Background/Aims: Chlordecone is an organochlorine insecticide used in the banana culture of the French West Indies until 1993. Previous studies revealed its wide presence in water and soils. Consumption of contaminated food is a source of exposure. Because of physiological and behavioral differences, toddlers are expected to be differently exposed than children and adults. The aim of the study is to assess the dietary exposure to chlordecone of 18-month-old Guadeloupian toddlers.

Methods: Dietary exposure of chlordecone is estimated through models using consumption and contamination data. Consumption data derive from a dietary survey joined to the epidemiological mother-child cohort TIMOUN conducted between 2005 and 2008 and focused on 240 children aged 18 months. Food contamination data come from the RESO study performed in Guadeloupe during years 2005–2006. Different scenarios are studied depending on whether the subjects live on a soil-contaminated place or not and on their supply habits.

Results: Mean dietary exposure of chlordecone is estimated in a range of 0.02–0.04 μg/kg bw/d (P95: 0.04–0.11) for toddlers living in a noncontaminated area while it is estimated between 0.04 and 0.07 μg/kg bw/d (P95: 0.08–0.13) for toddlers living in a contaminated area. Whatever the dietary exposure scenario considered, the probability of exceeding the chronic health-based guidance value of 0.5 μg/kg bw/d is null.

Conclusion: The study shows that 18-month-old toddlers appear to be less exposed than older population subgroup. This is explained by consumption pattern mostly based on milk and fruits, which are not highly contaminated. Fish products and tropical roots, which are the main contributors to the food exposure of the older people, have not been yet introduced in the diet or are not consumed in important quantities by toddlers. These dietary exposure estimates have now to be associated to the developmental milestones measured in the TIMOUN cohort.

O-30A6-4

Total-body Exposure to Metal Sensitizers: Inhalation, Ingestion, and Skin Contact

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Background/Aims: Exposures to sensitizing metals are a significant public and occupational health problem. Once sensitized, a person must avoid repeated exposures to specific metal(s) to prevent elicitation of adverse responses. Exposures may occur via inhalation, ingestion, and skin contact, with each pathway contributing to the total-body insult. The purpose of this study was to evaluate the solubility and absorption potential of 2 model metal allergens, cobalt, and beryllium, in the lung, gastrointestinal, and skin compartments.

Methods: Solubility of cobalt and beryllium metal particles was evaluated using 1 or more biologically relevant artificial solvents: lung airway lining

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fluid, lung alveolar macrophage phagolysosomal fluid, gastrointestinal fluid, and skin sweat. Solubility tests provided estimates of bioaccessibility (amount available for absorption). Absorption across biological barriers was estimated using published human and animal toxicology literature.

Results: Dissolution rates for cobalt metal particles, in units of g/(cm^2 × day), were fastest in gastrointestinal fluid (3.7 ± 1.6 × 10 − 4) and slower in skin sweat (4.4 ± 0.4 × 10 − 5), lung alveolar macrophage phagolysosomal fluid (2.8 ± 0.8 × 10 − 5), and airway lining fluid (1.0 ± 0.3 × 10 − 5). For beryllium metal particles, dissolution rates were fastest in gastrointestinal fluid (4.1 ± 0.2 × 10 − 7) and slower in phagolysosomal fluid (1.1 ± 1.4 × 10 − 7), skin sweat (1.7 ± 0.6 × 10 − 8), and airway lining fluid (1.5 ± 0.8 × 10 − 9). Literature indicates the absorption of particulate cobalt compounds is 30% via inhalation, 3% to 50% via ingestion, and 0.024% and 3.6% via intact and abraded skin, respectively. Absorption of particulate beryllium compounds is <1% via ingestion. In the absence of inhalation and skin absorption values for particulate beryllium, levels were assumed to be similar to divalent cations such as cobalt.

Conclusion: Cobalt and beryllium metal particles are soluble in biological fluids and may be absorbed via multiple exposure pathways. Based on the range of absorption values among biological compartments, systemic dose may be limited by dissolution rates.

O-30A6-5

A Case Study for the Validation of the Framework of the Aggregate Exposure Assessment—Phthalates

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Background/Aims: The framework for the human exposure assessment was firstly formulized by NRC (1991). The main idea of the framework is to apply and combine 3 different approaches such as the scenario evaluation approach, the point-of-contact approach, and dose-reconstruction approach. After then, several types of technical documents for the human exposure assessment were applied to the human risk assessment. However, there was seldom validation study for the framework covering the all of media including air, water, soil/dust, food, and consumer product. Recently, a validation study based on \'Scenario-based Population Exposure Assessment\' was published by a research group in ETH/Zurich. They successfully calculated aggregated exposure rates for phthalates from all of human exposure media and compared with the total exposure rates reconstructed from urinary biomarker level. They used a huge database for food, consumer product, soil, and dust in the scale of EU to estimate the aggregated exposure level.

Methods: Here is another type of case study for phthalates, which is a panel study with 90 volunteers in Korea. In this study, the aggregated exposure levels was calculated from multi-media including microenvironment in the individual basis, and then was compared with the total exposure level back-calculated from urinary metabolites level in the same person.

Results: After including the exposure from consumer product, the aggregated exposure for DEHP was in the same range of the total exposure. In contrast to DEHP, the aggregated exposures for DBP and BBP were 5∼100 times lower than the back-calculated values. These results mean that some important exposure scenarios for consumer products are skipped.

Conclusion: From this case study, it is evident that the individual exposure assessment approach in a panel study can take a role of redefining the exposure scenario for the population exposure assessment, which is the only way to assess the population at risk.

O-30A6-6

Probabilistic Modeling of Dietary Permethrin Exposure Using 1999–2006 Nhanes Data, and Evaluation of Model Results With Duplicate Diet Data

Jianping Xue and Valerie Zartarian *EPA, NC.*

Background/Aims: Dietary permethrin exposure has not been well studied, and estimates are needed to help address the Food Quality Protection Act for pyrethroid pesticides.

Methods: This modeling assessment was designed to: quantify dietary permethrin exposure in the general US population; analyze the major contributors; evaluate model predictions; and compare CDC's 1999–2006 National Health and Nutrition Examination Survey (NHANES) and USDA's 1994–1996, 1998 Continuing Survey of Food Intakes by Individuals (CSFII) consumption data for use in dietary exposure assessments. The SHEDS-Dietary model was applied, using residue data from USDA's pesticide database program and NHANES consumption data. Model estimates were compared with measured duplicate diet data from USEPA's The Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants study. The importance of food consumption data was analyzed using a bootstrap method, and comparing food intake and exposure results using NHANES and CSFII.

Results: The mean modeled dietary permethrin exposure ranged from 0.44 to 2.2 μg/d; as age increases, exposure increases. By body weight, young children and adults over 50 years have the highest exposures. Results are similar for cis- and transpermethrin. Three major food contributors were spinach, lettuce, and cabbage. For the upper tails, lettuce was more important; removing lettuce alone reduced modeled exposures by 50% for the 95th and 99th percentiles. The exposure results using NHANES versus CSFII were very comparable (relative error percentage <5% for 95th percentile), and modeled estimates matched well against duplicate diet measurements.

Conclusion: The model evaluation results provide more confidence in SHEDS-Dietary, which is useful for identifying factors of dietary exposure. Uncertainty analyses showed the importance of dietary consumption data. These data and analyses can support critical decisions about the use of the dietary exposure route in the assessment of aggregate exposure and health risks from permethrin.

O-30B6-1

Health Risk Assessment of Organophosphate Pesticides Exposure for Chilli-growing Farmers in Ubon Ratchathani Province, Northeastern, Thailand

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Background/Aims: Health risk assessment of organophosphate pesticides exposure associated with dermal exposure in chilli-growing farmers was conducted during growing season from December 2009 to January 2010 at one of the biggest area for chilli farm in Thailand located at Ubon Ratchathani province, Northeastern, Thailand.

Methods: From 330 chilli-growing farmers interviewed, organophosphate insecticides, that is, profenofos and chlorpyrifos were commonly used in this area. These wide-spectrum insecticides are used to control insect pests. Profenofos and chlorpyrifos residues on chilli-growing farmers' hand after spraying were collected using hand-wiping technique. Liquid-liquid extraction technique was used and then analyzed by gas

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chromatography equipped with a selective detector, flame photometric detector.

Results: The mean concentration of profenofos and chlorpyrifos was 5.89 and 6.95 mg/kg, respectively. A deterministic risk assessment associated with dermal exposure was evaluated using reasonable maximum exposure of both central tendency and 95th percentile (upper bound) point estimates for all variables in the risk equation. Average daily dose (mg/kg/d) of profenofos and chlorpyrifos were $1.89 \times 10 - 8$ mg/kg/d and $2.00 \times 10 - 8$ mg/kg/d, respectively. The worst-case risk scenario characterized that these insecticides may not potentially pose a risk of noncarcinogenic effects to the chilli-growing farmers related to dermal exposure (hazard quotient [HQ] <1).

Conclusion: This study suggested that an assessment of inhalation exposure is needed because the farmers mentioned an acute and repeated or prolonged effects of organophosphates after their application.

O-30B6-2

Pesticide Exposure Calculation Among Farmers in Bueng Nium Sub-district, Khon Kaen, Thailand

Kallaya Harnpicharnchai and Lertchai Charerntanyarak *Khon Kaen University, Khon Kaen, Thailand.*

Background/Aims: Pesticide usage and environmental distribution are common to rural and urban areas of Thailand. The application of pesticides can cause potential adverse health effects to humans by contaminating soil, water, air, plants, and animal life. However, human exposure to pesticides continues to be a problem because of their presence in the environment.

Methods: This was a cross-sectional study that investigated pesticide exposure and its risk factors targeting vegetable farmers in Bueng Nium sub-district, which is also well known as the leading vegetable growing place of Khon Kaen.

Results: The mean amount of pesticide used in an application was 31.2 L per application. Risk factors included damaged backpack sprayer (42.1%), spills on hands (31.8%), and spraying against the wind (58%). Eighty-five percent of farmers have worked with or used pesticides in their lifetime. The vegetables commonly grown in the area were Chinese kale (63.1%), cabbage (58.2%), and coriander (36.8%). The top 3 pesticides used were organophosphates (28.2%), carbamates (25.3%), and pyrethroid (24.4%). Those who were exposed to fungicides and insecticides also had higher total pesticide exposure. Furthermore, a farmer who was a pesticide applicator, mixer, loader, and who had not been given instructions through training was at risk of having higher pesticide exposure.

Conclusion: The data can be helped in assessing the human exposure to toxic pesticides and also used for the formulation of an integrated program on safety and health in the vegetable industry.

O-30B6-3

Quantifying Children's Dietary Pesticide Intakes Using Measured Versus Estimated Pesticide Residues on Foods

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Background/Aims: National databases of pesticide residues in food can be useful for estimating dietary pesticide intakes where empirical data are lacking. We compared intakes measured in the longitudinal Children's Pesticide Exposure Study (CPES) with intakes estimated using CPES consumption data and residue data from the US Pesticide Data Program (PDP) to illustrate the magnitude of potential error associated with using national residue data to estimate intakes for smaller cohorts.

Methods: CPES included 2 cohorts of 23 children (age, 3–11) each in Seattle, WA (CPES-WA; 2003–2004) and Atlanta, GA (CPES-GA; 2006–2007). Multiple days of consumption data and duplicate diet samples were collected in summer and winter. Diet samples were comprised of conventional fruits, fruit juices, and vegetables; 5 organophosphate (OP) and 3 pyrethroid insecticides were detected (results reported elsewhere).

For each CPES child, we calculated daily measured pesticide intakes (mg/d) by multiplying reported grams eaten with the measured concentrations, substituting the detection limit divided by $\sqrt{2}$ for residues below the detection limit. To calculate estimated intakes, we combined the CPES grams data with PDP residue data, excluding organic samples and those from non-retail/wholesale outlets. We randomly sampled the PDP data 5000 times to create distributions of daily intakes for each cohort, then compared the means of the simulated distributions with the means of the measured intakes.

Results: For CPES-GA, commonly collected foods were orange juice, strawberries, apple juice, carrots, and watermelon in summer, and orange juice and apples in winter. Measured intakes ranged from 0.02–8 μg/d (phosalone) in summer and 0.02–18 μg/d (acephate) in winter. In this paper, we report measured intakes from both cohorts as well as the results from the measured versus estimated intake comparisons.

Conclusion: These comparisons can help risk assessors to evaluate the uncertainty associated with using surrogate residue data to estimate children's dietary pesticide intakes.

O-30B6-4

Private Drinking Water Wells as a Source of Exposure to Perfluorooctanoic Acid in Communities Surrounding a Washington, West Virginia Fluoropolymer Production Facility

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Background/Aims: The C8 Health Project was established in 2005 to collect data on perfluorooctanoic acid (PFOA, or C8) and human health in Ohio and West Virginia communities contaminated by a fluoropolymer production facility. This study assesses PFOA exposure via contaminated drinking water in a subset of C8 Health Project participants, using private drinking water wells.

Methods: Participants provided demographic information, and residential, occupational, and medical histories. Laboratory analyses were conducted to determine serum PFOA concentrations. PFOA monitoring data was collected from 2001 to 2005 in 62 private drinking water wells. We examined the relationship between drinking water and serum PFOA levels using robust regression methods. As a comparison, we used 2 first-order, single compartment pharmacokinetic models to estimate the serum to drinking water concentration ratio: a steady-state model assuming well water PFOA concentrations were constant, and a nonsteady-state model accounting for PFOA variability over time.

Results: The median serum PFOA concentration in 108 study participants using private wells was 75.7 μg/L, approximately 20 times greater than the US general population levels, but similar to local residents drinking public water. Each μg/L increase in drinking water PFOA increased serum concentrations by 138.7 μg/L (95% confidence interval: 132.2–145.3). The serum to drinking water concentration ratio for the steady-state pharmacokinetic model was 113.9. Nonsteady-state predictions were similar because water PFOA concentrations were relatively stable over time.

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Conclusion: PFOA contaminated drinking water is a significant contributor to serum levels in this population. Regression methods and pharmacokinetic modeling produced similar estimates of the relationship.

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O-31A6-1

Traffic-related Air Pollution and Personal Exposure to Nitrogen Oxides in School Children in Beijing

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Background/Aims: Several studies have shown association between traffic-related nitrogen oxides (NO_x) pollution and adverse health effects in children. Most of these studies, however, used ambient or indoor NO_x concentrations as surrogate of personal exposure. The studies on personal exposure to NO_x in children are still limited. In this study, we evaluated personal exposure to NO_x, nitrogen dioxide (NO_2), and nitric oxide (NO) in children from 2 primary schools located in 2 areas in Beijing with different levels of traffic-related air pollution.

Methods: A study of personal exposure to NO_x, NO_2, and NO was conducted in 30 children from a school near a main road with high traffic density (School 1) 4 times from 2007 to 2008, and in 40 children from a school (School 2) located far from the main road in 2008, respectively. Personal exposure to NO_x, NO_2, and NO were measured with passive samplers. Repeated Measures Test in General Linear model was used to analyze the differences of exposures among the 4 periods in children from School 1. And the differences between 2 schools were analyzed by Mann-Whitney *U* Rank test.

Results: In children from School 1, the highest exposure to NO_2 was observed in January 2008, whereas there was no significant difference among the other 3 periods. The lowest and highest exposures to NO and NO_x were seen in October and April 2008, respectively. There was no significant difference between the other 2 periods. At the same period of investigation, personal exposure to NO_2, NO, and NO_x in children from School 1 were 99%, 145%, and 129% higher than those in children from School 2, respectively.

Conclusion: Our results suggested that traffic-related air pollution significantly contributed to the personal exposure to NO_x, NO_2, and NO in school children in Beijing.

O-31A6-2

Indoor, Outdoor, and Personal Exposure to Nitrogen Dioxide Comparing Industrial Complex Area With Country Area

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Background/Aims: Indoor air quality can be affected by indoor sources, ventilation, decay, and outdoor levels. Various indoor and outdoor combustion sources produce nitrogen dioxide (NO_2), which is a by-product of high temperature fossil fuel combustion. Especially, the presence of gas ranges and smoking have been identified as major factors contributing to indoor NO_2 exposures. In this study, we compared an industrial complex area with a country area by assessing the personal exposure to NO_2 with measurements of indoor and outdoor NO_2 levels in residences and by house characteristics and questionnaire.

Methods: Residential indoor and outdoor NO_2 concentrations and personal NO_2 exposures were measured for 90 participants in industrial complex area and 30 participants in country area, respectively. Questionnaires related personal life-style and house characteristic were administrated. All measurements were used passive air sampler.

Results: Personal exposure concentrations were significantly correlated with indoor NO_2 concentrations of residences in both the industrial complex area and the country area with correlation coefficients of 0.561 and 0.664, respectively, compared to outdoors. Multiple regression analysis indicated that indoor NO_2 levels in residences were only affected by outdoor levels ($P = 0.000$) despite higher indoor sources such as smoking.

Conclusion: This study is suggested that outdoor air quality as well as indoor air quality should be considered in the reduction of the personal exposure to air pollutants.

O-31A6-3

Influence of Spatial and Temporal Variability in Coarse and Fine Particulate Matter Concentrations on Exposures in Birmingham, Alabama

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Background/Aims: A particulate matter saturation monitoring study was conducted in Birmingham, AL in the spring and fall 2008. The study objectives were to investigate spatial and temporal variability in $PM_{10-2.5}$ and $PM_{2.5}$ exposure concentrations on a neighborhood scale. The impact of local sources, topography, meteorology, weekday versus weekend, and season were investigated. The study findings will support future $PM_{10-2.5}$ exposure assessment and epidemiology studies.

Methods: Eleven sample collection locations across the Birmingham metropolitan area were selected. Eight sites were located near traffic and industrial sources, and 3 "rural" sites were located more than 10 km from the nearest industrial source. PM_{10} and $PM_{2.5}$ BGI Omni or MiniVol PM_{10} and $PM_{2.5}$ monitors were deployed at each location for 24-hour sample collection. $PM_{10-2.5}$ concentration was calculated by difference. A central site also had PM_{10} and $PM_{2.5}$ FRMs, dichotomous samplers, and a Thermo $PM_{10-2.5}$ TEOM.

Results: Overall, spatial distribution pattern between $PM_{10-2.5}$ and $PM_{2.5}$ was different. $PM_{2.5}$ concentrations between sites, including the far downwind sites, were uniform indicating long-range transport of fine particles. $PM_{10-2.5}$ concentrations were significantly higher at sites near downtown Birmingham, which was located in the valley and close to multiple industrial sources. PM concentrations at 10 monitoring sites and annual $PM_{10-2.5}$ emissions from nearby point sources were significantly correlated, indicating that industrial sources impact spatial variability. $PM_{10-2.5}$ and $PM_{2.5}$ concentration temporal variability between sites was similar. Both PM levels at most of the sites varied significantly by day, showing the highest concentrations on Tuesday and Thursday and the lowest on Sunday. The "Near-Road" site, exclusively selected for roadway emissions, did not show any temporal variations.

Conclusion: Statistical modeling determined PM exposure concentrations on a neighborhood scale were significantly influenced by day of the week, annual PM emissions from industrial sources, and precipitation. [This abstract does not necessarily reflect EPA policy.]

O-31A6-4

Exposure to VOCs and NO_2 According to Similar Time-activity Group

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Background/Aims: The information about time spent in microenvironments plays a critical role for personal exposure to environmental pollutants. Human activity patterns of timing and location

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play a key role in explaining exposure variation along with the level of pollutant in microenvironments. The purpose of this paper was to present time activity patterns of Korean and to characterize the exposure according to similar time-activity group.

Methods: Time-activity pattern was analyzed with 31,634 subjects from 12,651 households, provided by the Korea National Statistical Office (KNSA) survey. The activity pattern survey was initially collected for social and economical purposes in 2004. Detailed study population method was presented in KNSA web site (kostat.go.kr). We classified participants into similar time-activity groups using cluster analysis, and measured time activity pattern and personal volatile organic compounds (VOCs) and nitrogen dioxide (NO_2) exposures of about 400 subjects with 3 similar time-activity groups (workers, housewives, university students), along with microenvironmental concentrations such as residential indoors, residential outdoors, and workplace indoors.

Results: Korea population spent the majority of their time indoors (87%), outdoors (5%) and in transportation (7%). Specially, residential indoor time (59%) in Korea was different from those of western countries (about 65%–75%). By cluster analysis of time-activity pattern, about 10 similar time-activity groups were classified. Among 10 similar time-activity groups, 3 similar time-activity groups were worker, housewife, and university student. Exposures to VOCs and NO_2 for 3 similar time-activity groups were different.

Conclusion: Similar time-activity group may cause different exposure and risk to air pollutants such as VOCs and NO_2. This exposure study can provide valuable information to understand population exposure and impact from exposure related behaviors.

O-31A6-5

Assessment of the Contribution of Indoor Dermal Pathways to Exposure to Svocs

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Background/Aims: Increasingly available biomonitoring data provide evidence of widespread human exposure to large numbers of chemicals. In some cases, dominant exposure pathways are evident. However, in the case of nonoccupational exposures to chemicals found in consumer products, multiple exposure pathways may be relatively important contributors. Although attempts to parse aggregate exposures are becoming common, data sets that actually permit use of a mass balance approach remain relatively rare. Even where mass balance is possible, use of uncertain or conservative estimates may conceal a gap between the sum of predicted inputs and observed outputs. Aggregate assessments often contain component estimates that vary dramatically in quality. Dermal exposures in particular are often dismissed on the basis of calculations that are not well considered.

Methods: Prior experience with selected pesticide data (chlorpyrifos, 2,4-D, pentachlorophenol) from CTEPP suggests that dermal exposure contributed non-negligibly to children's exposures to those compounds in that study. Building on that work, we have constructed a fugacity-based indoor fate and transport model that includes a multi-compartment human with a credible skin barrier.

Results: Application of the fate and transport model to indoor exposure scenarios for multiple chemicals for which appropriate environmental and biomarker data are available is proceeding in pursuit of mass-transfer-related factors that lead to consistent explanations for dermal phenomena across a range of chemicals.

Conclusion: In the case of SVOCs that persist in indoor environments, chronic dermal exposures are inevitable. This is especially true for chemicals present in bulk quantities in building materials such as plasticizers and flame-retardants. Credible estimates of the magnitude of those inevitable exposures are needed to inform future consumer product regulations.

This work was supported in part by US EPA via STAR Grant RD-83184401. Results have not been reviewed by EPA and no Agency approval should be inferred.

O-31A6-6

Long-term Monitoring and Source Estimation of PCDD/F Near Municipal Waste Incinerators

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Background/Aims: The emission of PCDD/F (Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans) is a serious issue in many countries. Previous references indicated that human activities are major sources of PCDD/F, including from waste incineration, power generation, energy industries, and other high-temperature emission sources. Several studies in England and the United States reported that waste incinerator was one of important contributors to the ambient PCDD/F concentration. In Taiwan, municipal waste incinerators were founded in 1991. It is important to assess the long-term exposure to PCDD/F. The objective of this study is to compare the PCDD/F concentration differences among 3 municipal waste incinerators in Taipei and identify the major sources, using long-term environmental monitoring data.

Methods: The atmospheric PCDD/F concentration data (N = 284) in the neighborhood of 3 municipal waste incinerators (Beitou, Neihu and Mucha) in Taipei from 2003 to 2008 were collected. Each sample was collected for 3 days by using PS-1 high volume samplers. The procedure of sample collections followed the Taiwan EPA Method NIEA 809.10B, and 17 compounds were analyzed with HRGC/HRMS. Principle component analysis was used to identify the major sources of PCDD/F.

Results: The averages of toxic equivalents at Beitou, Neihu, and Mucha from 2003 to 2008 are 0.067, 0.024, and 0.028 pg I-TEQ/Nm^3, respectively, and the standard deviations are 0.281, 0.014, and 0.029. OCDD has the highest percentage among these 17 compounds at the 3 municipal waste incinerators. For principle component analysis, 2 factors explained 87.2%, 80.3%, and 86% of the variance. Municipal waste incinerations and traffic were the main PCDD/F sources at Beitou and Neihu.

Conclusion: However, only traffic emissions were correlated with PCDD/F at Mucha. Traffic was identified as a common source in this study. Further modeling is needed to quantify the contribution from each source.

PP-30-086

Research on Evaluation of the Pipeline Direct Drinking Water Quality With Improved Comprehensive Index Method

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Background/Aims: To establish a comprehensive index methodology applicable to the water quality comprehensive evaluation against pipeline direct drinking.

Methods: Common methods of comprehensive index were improved, through adopting flexibly the methods of Nemerow index, minimum operator, and weighted average; the direct drinking water quality in 10 residential areas in some district of Shanghai in December 2008 was evaluated comprehensively using this improved methodology.

Results: The comprehensive index values of water samples of direct drinking water were in the range of 0.32–1.23, significantly lower than

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those of municipal network water supply. The main factors influencing the direct drinking water quality were pH, turbidity, oxygen consumption, carbon tetrachloride, and the total number of colonies.

Conclusion: The quality of direct drinking water was comparatively better than that of municipal network water supply, but some indicators of water quality required special attention against polluting the direct drinking water supply. The comprehensive evaluation results using the improved index approach were in accordance with the practical situation in the direct drinking water supply to a substantial extent.

PP-30-087

Three Methodologies for Estimating Cumulative Human Exposures to Current-use Pyrethroid Pesticides

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Background/Aims: We estimated cumulative residential pesticide exposures for a group of 9 young children (4–6 years), using 3 different methodologies developed by the US Environmental Protection Agency and compared the results with estimates derived from measured urinary metabolite concentrations.

Methods: The Standard Operating Procedures (SOPs) for Residential Exposure Assessment are intended to provide a screening level assessment to estimate exposure for regulatory purposes.

Results: Nonetheless, dermal exposure estimates were typically lower from the SOP (1–1300 nmol/d) than from SHEDS (5–19,000 nmol/d) or any of the 4 different approaches for estimating dermal exposure using the Draft Protocol for measuring children's nonoccupational exposure to pesticides by all relevant pathways (Draft Protocol) (5–11,000 nmol/d). Indirect ingestion exposure estimates ranged 0.02–21.5 nmol/d for the SOP, 0.5–188 nmol/d for SHEDS, and 0–3.38 nmol/d for the Draft Protocol. Estimates of total absorbed dose ranged 3–37 nmol/d for the SOPs, 0.5–100 nmol/d for SHEDS, and 1–216 nmol/d for the Draft Protocol. The concentrations estimated using the Draft Protocol and SHEDS showed strong, positive relationships with the 3-phenoxybenzoic acid (3-PBA) metabolite measured in the children's urine samples (R^2 = 0.90 for the Draft Protocol; R^2 = 0.92 for SHEDS; R^2 = 0.13 for the SOPs). Analysis of different approaches (uniform distribution; fractional loading from socks; hand; apportioning) for estimating dermal exposure suggested that the approach assuming an even distribution (uniform distribution) of pesticide residue on the child's body was most reasonable.

Conclusion: With all 3 methodologies providing reasonable estimates of exposure and dose, selection should depend on the available data and the objectives of the analysis. Further research would be useful to better understand how best to estimate dermal exposure for children and what exposure factors (eg, activities, transfer coefficients, measurement techniques) are most relevant in making dermal exposure estimates.

PP-30-088

Probabilistic Evaluation of Dietary Exposure to Lead in Jiangsu Province, China

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Background/Aims: Lead (Pb) is a systemic toxicant to humans with the possibility for widespread exposures. Dietary exposure assessment to Pb is a current concern in various countries during the recent decade. Deterministic approaches are applied in the risk analysis and decision making by now in China, which usually turn out estimated risks exceed the level of concern, but no further studies have been reported. This paper presents the evaluation of dietary Pb exposure by a probabilistic approach for the inhabitants in Jiangsu Province, China.

Methods: Pb contamination data were from the national food contamination monitoring program during 2001–2006 collected by multistage stratified sampling method. In all, 2600 samples from 38 commodities from Jiangsu Province were included. Food consumption data were obtained from the national diet and nutrition survey conducted in 2002 by 24-hour recall method, including 3938 consumers aged 2–89 years and 192 children of 2–6 years old with 3 consecutive days in Jiangsu province. Monte Carlo simulation was applied to derive the intake distribution, and the uncertainty of each percentile was estimated by Bootstrap sampling.

Results: The probabilities of each daily Pb intake at risk were nearly 25% and 10% for children and the general population respectively, and the P99.9 of their daily exposure reached 10.41 and 6.94 times of the provisional tolerable weekly intakes divided into daily intakes (PTWI/7), respectively. The exposure level of most rural people was higher than that of urban ones. Rice contributed most to the total Pb intake.

Conclusion: Probabilistic approaches on exposure evaluation can make good use of available data and quantify measures of variability and uncertainty. Results of this study indicated that the Pb dietary exposure in Jiangsu Province would be a public health concern.

PP-30-089

Development and Verification of China Dietary Exposure Evaluation Model Software

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Background/Aims: To develop the dietary exposure evaluation model software possessed of China intellectual property rights and to verify the rationality and accuracy of the results from the probabilistic model in China dietary exposure evaluation model software according to the international standards.

Methods: Using SAS to build various evaluation model based on the data from Chinese dietary survey and the chemical compound in food surveillance and to design an operation interface. The results from probabilistic model of 2–7 years children dietary exposure were compared with that from duplicate portion study of 2–7 years children dietary exposure in Jinhu, Jiangsu province in order to analyze the rationality of model. To verify the correction of the probabilistic model, the results from probabilistic model of dietary exposure were compared with the results from @Risk software using the same data of randomized selected 10,000 people from national dietary survey. And using mean drift as an internal index to illustrate the accuracy of the computation.

Results: Develop the China dietary exposure evaluation software successfully. On the rationality, the results from probabilistic model were lower than that from the point estimation and higher than the results of duplicate portion study. On accuracy, the results from @Risk and the probabilistic model were highly consistent, and the mean drift was of random distribution, the drift region varied from 0.05%–11.9%.

Conclusion: The results computed by the software of China dietary exposure evaluation model are correct and reasonable. This is a meaningful step to improve the dietary exposure evaluation technique of China.

PP-30-091

Evaluation of Background Mercury Level From the Residents Living in Vicinity of Fishing Area Around Taiwan

Huiu-Ling Chen and Ching-Chang Lee *Hung Kuang University, Sa-Lu, Taichung, Taiwan.*

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Background/Aims: The chemicals form of mercury (T-Hg) that is of primary methylmercury (MeHg), a well-known neurotoxicant. The primary public health significance is MeHg, which was usually emitted from industrial and man-made activities and final bioaccumulated to people. This study aims to investigate the blood Hg and MeHg concentration in people living in the vicinity of 4 coastal sites and 4 suburban sites around Taiwan. Meanwhile, the fish consumption and dietary habits are also been included to evaluate the association between dietary intake and MeHg accumulation.

Methods: For measurement of human blood T-Hg and MeHg levels, 4 areas, 8 sampling sites around 4 areas, in east, south, west, and north of Taiwan were selected. In each area, one town was selected as coastal sites and other one was reference site. A total of 565 T-Hg measurements and 414 MeHg measurements were completed in this study.

Results: Significantly higher average blood T-Hg level was found in coastal area (16.1 ng/L) than in reference site (11.8 ng/L), as well as significantly higher blood MeHg level was found in coastal area (16.5 ng/L) than in reference site (11.8 ng/L). Meanwhile, significantly higher T-Hg level was found in east, following in south, and the lower was in north and centre Taiwan. Multiple liner regression also showed the positive associations for fish consumption, age, whether living in coastal or suburban areas, and locations of where they lived around Taiwan.

Conclusion: Fish consumption is the popular food in Taiwanese. The present showed fish consumption was a significant influence factor for people's T-Hg and MeHg accumulation. However, the highest T-Hg and MeHg levels were found in some area, such as east, an unpolluted area in Taiwan. The considerable strong point and local mercury sources need to be concerned.

PP-30-092

Exposure Assessment of Hexabromocyclododecane Among Japanese Population

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Background/Aims: Hexabromocyclododecane (HBCD) is a brominated frame retardant used for insulation and textile coating. In the near future, HBCD may be prohibited internationally because of a persistent organic pollutant. We estimated the exposure levels of HBCD among Japanese people and attempted to quantify the health risk of HBCD.

Methods: We estimated HBCD intake through the 3-stage exposure analysis. At the first stage, HBCD concentrations in 4 environmental media such as air, soil, water, and sediment were calculated by using Fugacity Model (multi-media environmental fate model), based on HBCD emissions in 2008, which were estimated from the substance flow analysis in Japan. In the second stage, the concentrations in 9 exposure media such as ambient air, indoor air, house dust, leaf vegetables, root vegetables, meat, milk, fish, and tap water were calculated. Then, intake level of HBCD through each exposure media was computed by multiplying the HBCD concentration in each exposure media by personal daily consumption of each media, and was summed up.

Results: Average HBCD intake was estimated to be 6.45 ng/kg-BW/d (via ingestion: 4.74 ng/kg-BW/d, via inhalation: 1.71 ng/kg-BW/d), and the level is significantly lower than NOAEL for HBCD (10.2 mg/kg-BW/d).

Conclusion: This study suggests that the urgent action for HBCD might be not necessary in Japan.

PP-30-093

Cancer Risk Assessment of Inorganic Arsenic Among Japanese Population

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Background/Aims: Japanese people consume large amounts of seafood and seaweed containing arsenic at high concentration. Most of the arsenicals are organic with low toxicity; however, the foods also contain trace amount of inorganic arsenic (iAs), which is a human toxicant and carcinogen. However, to date, detailed exposure assessment of iAs in Japanese has not been carried out. In this study, we estimated daily iAs intake of 25 Japanese from diet and other exposure sources (soil, indoor dust, and ambient air), and we assessed their cancer risk posed by the iAs exposure.

Methods: Duplicate portion diet samples were collected from 25 households, and soil and indoor dust samples were from the other 20 households. These samples were extracted by a synthetic gastric juice to obtain bioaccessible fraction. The concentration of iAs in the bioaccessible fraction was measured by LC-ICP-MS with a photo-oxidation/hydride generation system. Inhalation iAs intake was estimated by atmospheric monitoring data.

Results: The median daily consumption of dietary iAs was estimated to be 3.84 μg/d with the range of 1.98–57.1 μg/d. The estimated iAs intakes from nondietary oral sources and inhalation were negligible (<1% of dietary intake or 0.0286–0.100 μg/d) when default soil/indoor dust ingestion rate and inhalation rate were assumed. The maximum dietary intake of iAs was observed for the person who ate Hijiki seaweed (*Sargassum fusiforme*) on the sampling day. Based on this result and EPA Oral Slope Factor (1.5[mg/kg/d]-[1]), skin cancer risk of Japanese was estimated to be $1.4 \times 10^{-}$[**graphic**].

Conclusion: Cancer risk posed by the iAs intake of Japanese may be significant.

PP-30-094

The Survey of Drinking Water Intake of Beijing Residents

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Background/Aims: To assess drinking water health risk for Beijing residents.

Methods: We had interviewed 270 residents of Beijing resident (≥12 years of age) during November to December in 2009. We used a multistage sampling method to assess the drinking water intake between weekends and weekdays. First, 5 counties were drawn from Beijing region by the simple random sample. Second, 27 districts were randomly taken from 5 counties. Third, 2 blocks/villages were randomly sampled from the districts. Fourth, 5 families from the blocks/villages were randomly drawn from the blocks. Finally, 1 person was sampled from the 5 families by KISH table.

Results: The mean consumption of water was estimated to be 2.76 L/d of Beijing residents in the weekdays and 2.49 L/d in the weekends, which significant difference in amounts of water consumed. Consumption of drinking water in males was more than females in both weekdays and weekend. Apparent significance was shown between genders. In weekdays, 64% of the residents are used to drink water after getting up, 33% of them are used to drink porridge in the breakfast, 37% of them are used to drink amounts of tea in the morning, 36% of them are used to drink soup at lunch, 43% of them are used to drink amounts of tea in the

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afternoon, 46% of them are used to drink porridge at dinner. The percent of drinking milk and soymilk for breakfast was relatively higher, which attained 28% and 17%, respectively. Drinking habits on weekends were similar to the weekdays, but the water intake was less than the weekdays. Very few residents used to drink unboiled water, coffee, and fruit juice.

Conclusion: The habits of dinking water consumed of Beijing residents varied according to the stage of 1 day.

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PP-30-095

The Pollution Levels of PAHs in Chinese Food

Jing Nie, Xiaoli Duan, and Jinliang Zhang *Beijing, People's Republic of China*

Background/Aims: In the 1980s, many cities of China began to carry out the study of food PAHs. At that time, most work mainly concentrated on the BaP content of vegetable crops. In the 1990s, researchers started to analyze the PAHs in food such as fish, meat, etc. In recent years, it was also reported that the level of daily dietary exposure to PAHs.

Methods: The PAHs contents in food of Chinese provinces are as follows: in 2007, through detecting dried fish and meat floss in Fujian, 12 kinds of PAHs were found. In which the content of naphthalene and phenanthrene is relatively large; the study of population exposure levels of Tianjin showed us that dietary and respiratory exposure is the main way which people exposure to PAHs in Tianjin area. Dietary exposure in the daily exposure is 75%. In dietary intake, the biggest contribution is the grain, almost 38.3%. In 2003, the detection of guangdong foshan vegetable samples showed us that the average content of PAHs is 180.0 μg/kg, the PAHs levels of leafy vegetables is higher than fruit and legumes; 2006 in Guiyang, Guizhou Province, through detecting Fried foods, researchers found that there is excessive amount of BaP in some fried dough sticks; Guangxi Zhuang people have the habit of preserving and eating bacon, they marinate meat with high salt dipping and smoked it to make bacon. The PAHs content of such food is higher; Chongqing locals like to use smoked meat and fish ways to preserve food, which will generated PAHs pollution; Shanghai people like Fried food, such as fried fish/meat, fried pasta, fried eggs, and fried peanuts, which increases the risk of exposure to PAHs.

Results: The differences of diet in various regions of China led to the pollution of PAHs in food is not the same.

Conclusion: In order to reduce pollution of PAHs in food, we suggest to change the traditional diet in some areas, reduce the consumption of fried and barbecue food.

PP-30-096

Exposures and Potential Risks in the Neighborhoods of 5 Different Restaurants Emitting Particulate Polycyclic Aromatic Hydrocarbons

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Background/Aims: Cooking is a very important air pollutant source in urban areas. Especially in oriental countries, multifarious cooking practices may result in significant emission of particulate pollutants such as particulate polycyclic aromatic hydrocarbons (pPAHs), some of which are probable carcinogens. Most restaurants in Taiwan do not equip with emission control devices. Emission of cooking fume results in constant pollutant exposure of neighbors in densely populated urban areas.

Methods: This work assessed pPAH levels in the breathing zones of neighborhood residents close to the exhaust outlets of 5 restaurants with different cooking practices, namely, an international fried chicken franchise, a local fried chicken store, a Chinese mom-and-pop place, a Cantonese-style barbeque restaurant, and a Korean barbeque store. A high-volume sampler was used to collect samples under 2 conditions, with or without the operation of the control devices. In all, 21 species of PAH were analyzed with LC/MS/MS.

Results: Preliminary results showed that the concentrations of total PAHs were 1.1–2.5 ng/m^3 and 1.1–14.8 ng/m^3 with and without the control devises, respectively. For the international fried chicken franchise and the local fried chicken store, it was obvious that the control devices did not reduce PAH levels. As for the Cantonese-style barbeque restaurant, the control device can reduce the end-of-pipe PAH level down to 16%. Without the control device, the Cantonese-style barbeque restaurant had the highest PAH level near their exhaust outlet, ie, 14.8 ng/m^3. Based on benzo[a]pyrene toxic equivalent factors, PAH exposure levels are in the range of 0.01−0.8 ng-TEQ/m^3. The potential health risks of neighbors of such exposure were one order of magnitude higher than risks from pPAH exposure during commuting.

Conclusion: Current control devices had no effects to reduce pPAH levels from fried chickens. In addition, the resulting health risks with/without control devices were all higher than those from traffic emission. Cooking emission deserved more attentions in researches and regulations.

PP-30-098

Comparison of Individual Food Analyses to Composites for Pyrethroid Pesticides

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Background/Aims: Dietary exposure can be measured through analysis of foods that comprise the intake for an individual over a specified period. Collection and analysis of many individual foods can be too expensive. To minimize cost and participant burden while maximizing the quality of information obtained from the data, experiments were conducted to facilitate comparison of pyrethroid pesticides concentrations in composite and individual food samples. This would determine whether composite food samples would give comparable results, and thus allow for a more cost-effective analytical scheme.

Methods: Using foods commonly consumed and collected from 9 participants from a well-defined community, assessments of various compositing schemes were made using extant food consumption and pesticide residue data from What We Eat in America, National Health and Nutrition Examination Survey, and Pesticide Data Program databases. Simulation experiments used the expected distribution of pesticides in foods to design an effective scheme to yield 20 composites from 67 individual samples. The composite scheme was largely driven by 4 food types that, according to the Pesticide Data Program database, were expected to have high levels of permethrin: tomatoes, apples, broccoli, and lettuce. Using this information, the expected amount of permethrin in each individual collected sample was estimated, and then proportioned into the 20 composites.

Results: The analysis of the 67 individual and 20 composite samples indicated that piperonyl butoxide was detected in 16 of 20 composite samples, bifenthrin was detected in 11 composites, and permethrin and esfenvalerate were detected in 10 composites. These pyrethroids were also detected in the individual samples at about the same percentages.

Conclusion: The a priori determination of permethrin using extant databases was useful in creating the composites, but was unable to ensure measurable levels detected in every sample. Therefore, using extant databases alone should not only replace actual measurements, but should also prove to be valuable in developing a compositing scheme that yields similar numbers of detectable levels.

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PP-30-099

Assessing the Value of Including Global Position System in Personal Exposure Monitoring Studies

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Background/Aims: Time spent in different locations can be a significant predictor of personal particulate matter ($PM_{2.5}$) exposures. Continuous personal $PM_{2.5}$ measurements enable characterization of differential exposure; however, these data are rarely available. Typically, locations are noted in time-activity diaries (TAD). However, these are limited by the following: (*a*) relatively coarse temporal resolution of reporting, and (*b*) the subject's ability to accurately report daily activities. In this study, we use personal global position system (GPS) to examine the role that proximity to point and mobile sources plays in altering exposure profiles.

Methods: Eighteen Hamilton-based pregnant women participated in a 2007 exposure study. To evaluate the accuracy of participant-reported location, TAD entries (15-minute resolution) were compared to activity classifications based on GPS location (1 second time-step). We used GIS software to develop an automated method for classifying participants' activities at each second of the GPS time series. Other exposure predictors examined included road type and proximity to point sources. This method used various spatial attribute, and temporal decision rules, and used road networks, building, footprints, and so on.

Results: For each of the 18 participants, we often found significant misclassification when comparing participant-reported TAD location, with the location derived using our automated method. For example, on average, subjects over-reported the amount of time spent indoors at home by as much as 10%–15%, when GPS indicates they were either outdoors or travelling in a car. In the worst case, subject misclassification for this activity was as high as 60%. Other misclassifications will be discussed in this presentation.

Conclusion: We found that incorporating GPS data into personal exposure monitoring studies helps to reduce subject-location misclassification found when using TAD. Future work will examine whether classifying continuous $PM_{2.5}$ measurements according to GPS location increases the power to detect different exposure levels across locations. We will also investigate whether road type and proximity to point sources are significant predictors of exposure.

PP-30-100

Water-related Activity Mode and Dermal Exposure Factors of People in Typical Northern City in China

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Background/Aims: There has been a growing awareness of the importance of dermal exposure in recent years. However, researches on the dermal exposure factors of Chinese people so far are still very limited. This study is going to investigate the water-related dermal exposure factors in Chinese people.

Methods: Twenty-five hundred people in Miyang county in Henan province were selected as research subjects in this study. Their water-related activities were acquired by questionnaires and field measurements.

Results: Results showed that surface areas of adults in these subjects are 1.68 m^2. The surface areas of male and female are 1.75 and 1.62 m^2, respectively, which are 3.6% and 7.3% higher than those of Japanese people, and 10.7% and 4.1% lower than those of American people. The exposed dermal areas vary a little on different situation and in different seasons. The water-related activities and frequencies vary in subject groups with different ages and genders. The water-related activities of adults between genders show significant difference and the male adults spend less time. The concrete time percentages for major water-related activity of the male adults are 51% for bathing, 12% for hands-washing, 12% for face-washing, 9% for clothes-washing, and 9% for head-washing, respectively. However, the concrete time percentages for major water-related activity of the female adults are 29% for clothes-washing, 23% for bathing, 16% for dishes-washing, and 13% for vegetables-washing, respectively.

Conclusion: This pilot study indicates that the exposure factors of people in China are different from the other countries, and it is necessary to carry out further studies on dermal exposure factors in Chinese people.

PP-30-101

Occurrence of Disinfection By-products in Drinking Water in Different Italian Northern Regions

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Background/Aims: Drinking water chlorination treatments produce different disinfection by-products (DBPs) as a consequence of the reaction between chlorine in water and natural organic matter. This study is part of the international project HiWATE (Health Impacts of Long-Term Exposure to Disinfection By-Products in Drinking Water) supported by the EU Sixth Framework programme (FP6). The aim was to investigate the presence of DBPs in drinking water in different northern regions in Italy, where groundwater with low organic matter is generally supplied and where the use of chlorine dioxide as chlorination treatment is widespread.

Methods: Bromate, chlorite, chlorate, haloacetic acids and 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) and trihalomethanes levels were investigated in drinking water samples collected form 12 waterworks located in Emilia Romagna, Friuli Venezia Giulia, and Lombardia Regions. To investigate seasonal variability, water samples were collected for 4 seasons between 2007 and 2008.

Results: MX and haloacetic acids were never detected (detection limit: 0.5 ng/L and 1 μg/L, respectively). Trihalomethanes were always found at very low concentrations regardless of the disinfection treatment (mean: 2.04 μg/L, maximum value: 26.9 μg/L). Bromate was detected only in one waterworks in which disinfection was performed by ozone and chloride dioxide (range: 2–14 μg/L). Chlorite was found only in chlorine dioxide-disinfected drinking water (4 waterworks; mean value: 136 μg/L; range:28–523 μg/L), whereas chlorate resulted the most widespread DBP (>85% of the samples), with concentrations ranging from 1 to 399 μg/L. No consistent general trends were observed, for DBPs seasonal variations, in the investigated Italian drinking waters.

Conclusion: DBPs levels in Italian drinking water appear generally low; however, individual DBPs and levels vary according to the different disinfection treatments: when chlorine dioxide is applied as disinfection method, high values of chlorite and chlorate could have been detected. Because of their potential health effects, the presence of chlorite and chlorate in drinking water deserve further investigation.

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PP-30-102

Perfluorinated Compounds Exposure Through Tap Waters in Korea

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Background/Aims: Drinking water is considered as a significant human exposure source to particularly soluble perfluorinated compounds (PFCs), such as perfluorooctanoate (PFOA) or perfluorooctane sulfonate (PFOS). This work aimed to investigate the local characteristics in the contamination levels of PFCs in tap water and the exposure levels through drinking water.

Methods: Together with neighboring ambient river/stream water, tap waters were taken at 16 houses of 8 cities with water supplies of different sources from May to July, 2009. Seven perfluorinated carboxylic acids (C7–C13) and 4 PFASs (C4, C6, C8, and C10) in waters were quantified by solid-phase extraction and subsequent chromatography coupled with tandem mass spectrometry analysis.

Results: Concentrations of 2 predominant compounds, PFOA and PFOS, in tap water ranged from <LOQ (limit of quantification) to 32.6 ng/L (mean = 5.35) and <LOQ to 3.63 ng/L (mean = 1.09), respectively, nationwide with elevated levels (mean = 18.2 ng/L for PFOA and 2.59 ng/L for PFOS; n = 4) in the waters from 2 cities to whose citizens Nakdong river waters was supplied as raw waters. Elevated PFOA levels (20.2–733 ng/L, mean = 143; n = 10) were also observed in river waters of Narkdong watershed. Compared with these 2 cities, the tap waters of other 6 cities contained a little below LOQs or 15-fold lower for PFOA. The relatively clean headwaters were known to be supplied to these 6 cities. Mean estimated daily intakes of PFOA and PFOS via drinking water were 0.12 and 0.02 ng/kg/d nationwide, respectively, with greater levels in 2 cities in the Nakdong river watershed.

Conclusion: These values were several folds lower than the estimates back-calculated by one-compartment steady-state pharmacokinetic model from internal concentration of PFOA and PFOS observed in Korean citizen serums, indicating the existence of other significant exposure pathways including food intake.

PP-30-103

Exposure Assessment of Traffic-related Air pollution in Sao Paulo, Brazil

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Background/Aims: Traffic density (TD) has been used as a proxy to exposure assessment of traffic-related air pollution in Sao Paulo. Vehicle emissions are a major source of air pollution in the city with approximately 11 million inhabitants. Vehicle's fleet is approximately 6 million and road extension is about 17,000 km. Air monitoring stations are sparse to characterize the differences in pollutant's concentrations for small intraurban areas, and the Census block groups are also very heterogeneous in area.

Methods: In this study, urban area was divided in grids with 500 × 500 m cells with calculated TD. The numbers of cars, motorcycles, buses, and trucks were measured in 681 points of urban area. The median value of volume for each class of road (expressway, arterial 1, arterial 2, arterial 3, collector 1, collector 2, and local) was attributed for other roads without measured information. All the traffic information was inserted in a georeferenced road's database. The software ET Geowizards 9.9 for ArcGIS 9.2 was used for constructing the vectorial grid of analysis unit. TD was calculated with software ArcGIS ArcInfo 9.3. Others variables from Census Information, necessary for epidemiological studies, like population of a specific age group and Human Development Indexwere converted into grid scales.

Results: The variation of TD was from 0.001 to 148.80. Population living in high TD cells (TD > median) represents 75%. Regarding social and economical conditions (Human Development Index), they were higher in heavy TD areas than in lower TD ones.

Conclusion: Sao Paulo has a very dense distribution of roads with high volume of traffic, turning it difficult to monitor air pollution in a geographically representative way. In this case, TD is an available alternative for exposure assessment of traffic-related air pollution. Population most exposed in their living spaces is in better social and economic conditions.

PP-30-104

Exposure Assessment of the Chemicals in Personal Care Products

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Background/Aims: The development of the chemical industry during the past centuries has supplied the products with a vast amount of chemical. From these, several chemicals are known to cause adverse effects to human health and ecosystem. Personal care products are widely used and directly applied to the body, including skin or hair. Therefore, an evaluation of consumer products' safety is very important. For the sake of assessments, the information of components' exposure mass as well as individual concentration in consumer products should be known.

Methods: In this study, 50 consumer products including cosmetic and body care products (such as shampoo, facial soap, body cleanser, hair-gel, and nutrient cream) were analyzed by official method for the concentration of 12 components including presence of 1,4-dioxane, formaldehyde, benzoic acid, salicylic acid, and 8 heavy metals.

Results: The result of this study takes to estimate the exposure mass of these ingredients absorbed into the skin from a cosmetic/body care products and to assess whether these components are adverse effects on human health using the hazardous quotient and margin of exposure or not.

Conclusion: In 5 primarily surveyed product types, detection frequency of 1,4-dioxane was high in shampoo and body cleanser; benzoic acid and salicylic acid in shampoo; and cadmium in nutrient cream. In cosmetic/body care product types, content of 1,4-dioxane was high in shampoo and body cleanser, benzoic acid in shampoo and facial soap, salicylic acid in shampoo, and formaldehyde in hair-gel. Results of calculated dermal exposure mass in cosmetic/body care product types, because of hazardous quotient less than 1, are not expected to result in adverse health effects.

PP-30-105

Contributions of Dermal and Pulmonary Routes to Chloroform Exposure in Swimming Pool: A Comparison Between 3 Estimation Approaches

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Background/Aims: Excluding ingestion, inhalation is commonly considered as the main route of exposure to chloroform (trichloromethane), an abundant water chlorination by-product suspected for carcinogenicity. However, cases were also reported concluding that

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dermal absorption could prevail (up to 80%). This work aimed at investigating this question by simulating swimming pool exposure scenarios excerpted from literature through 3 different estimation approaches, using the following: (i) a physiologically based pharmacokinetic (PBPK) model previously developed by our team; (ii) the swimmer exposure assessment model (SWIMODEL) developed by US Environmental Protection Agency; (iii) uptake factors (UF) as proposed by Villanueva et al (2007) on the basis of previous works of Whitaker et al (2003).

Methods: Five studies documenting precisely the exposure conditions, especially both water and air trichloromethane concentrations (7–550 μg/L and 30–8000 $\mu g/m^3$, respectively), as well as biological levels in blood and/or alveolar air of exposed volunteers, were selected for this simulation exercise. Ingestion, usually low (30 mL), was not accounted for. For the other parameters, typical default values were used.

Results: Predicted uptakes vary greatly between the various approaches (eg, the range of uptake ratios were [0.18–2.98] and [0.17–3.25] for (ii)/(i) and (iii)/(i), respectively). Besides, the contributions of dermal absorption to global exposure comprised between (1%; 12%), and (7%; 87%), for the approach (i) and (ii) respectively (Not calculable by approach (iii)).

Conclusion: Interestingly, the PBPK approach confirms the contradictory conclusions reported in the literature as for the relative importance of dermal and pulmonary absorptions. We believe PBPK modeling is the most reliable approach (still to be further improved, especially regarding simulation of the dermal pathway) to assess exposure in swimming pools for epidemiological purposes.

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PP-30-106

Environmental Tobacco Smoke Exposure Among Korean Workers: National Working Condition Survey

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Background/Aims: We investigated worker's environmental tobacco smoke (ETS) exposures by industry type and socioeconomic variables.

Methods: The study population comprised 10,043 workers who participated in Korea National Working Condition Survey in 2006. Interviewers visited randomly selected households and interviewed every worker. Chi-square tests and multiple logistic regression models were used for the analysis

Results: ETS exposure of men (23%) was twice that of women (12%). High ETS exposure occurred in construction (39.5%), machinery (34.1%), entertainment (30.3%), transportation (29.8%), and electric/electronics (27.7%) population. Low exposure was reported in education/science (3%), finance (6%), religion (7%), health (7%) and communication (7%) jobs. Non-regular job was more likely exposed to ETS than did regular job (OR: 1.33, 95% CI: 1.11, 1.59). Longer working hours (above 45 hours) were associated with ETS exposure (OR: 1.38, 95% CI: 1.19, 1.59). Smoking (OR: 1.16, 95% CI: 0.99, 1.36) and drinking alcohol (OR: 1.38, 95% CI: 1.13, 1.68) were also associated with higher exposure. Especially among women, ETS exposure showed greater association with smoking (OR: 2.5, 95% CI: 1.48, 4.3) and drinking (OR: 2.51, 95% CI: 1.48, 4.25). Higher income (above 3000$/month vs. below 1000$/month, OR: 0.48, 95% CI: 0.34, 0.69), higher education (graduate school vs. middle school, OR: 0.55, 95% CI: 0.34, 0.91), and lager company (above 1000 employees vs. below 100 employees, OR: 0.61, 95% CI: 0.49, 0.76) were predictors for lower ETS exposure.

Conclusion: Since 1995, even though smoke-free workplace policy has been gradually strengthened in South Korea, the protection of workers from ETS exposures still has a large room for improvement. Blue-collar and service workers are more likely than other types of workers to be exposed to ETS in the workplace. ETS exposure also showed inequality by socioeconomic position (education, occupational class, employment status, and household income). Additional measures are needed to increase the number of smoke-free workplaces.

PP-30-107

Partitioning Theory Applied to Paired Indoor Air and House Dust SVOC Measurements: Implications for Residential Exposure Measurements in Epidemiology Studies

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Background/Aims: Individuals encounter a wide range of pollutants indoors, and semivolatile organic compounds (SVOCs), which are found both in the gas and condensed phase, are of particular interest because they can be redistributed over time from their original source to indoor air, dust, and surfaces.

Methods: As part of the Northern California Household Exposure Study, house dust and indoor air samples were collected in 50 homes: 40 homes in Richmond, CA, and 10 homes in Bolinas, CA. Dust samples were analyzed for 79 SVOCs, and air samples were analyzed for 106 SVOCs and particulate matter ($PM_{2.5}$). Seventy-six SVOCs were analyzed in both air and dust, including 24 polycyclic aromatic hydrocarbons, 3 polychlorinated biphenyls, 2 polybrominated diphenyl ethers (PBDEs), 36 pesticides, and 11 phthalates.

Results: Overall, we detected 58 target analytes in house dust above method reporting limits. Phthalates and flame retardants were generally detected at the highest concentrations; DEHP, BBP, PBDE 99, PBDE 47, DBP were the 5 chemicals with the highest concentrations at the 95th percentile. Empirical data were used to explore theoretical partitioning relationships between air and dust in a manner similar to recent work by Weschler and Nazaroff. Specifically, gas-phase only concentrations were estimated from total air (particulate and gas phase) concentrations, assuming equilibrium and using residence-specific particulate concentrations. Correlation analyses for gas-phase air and dust concentrations revealed significant associations for several phthalates, pesticides, and PBDE 47. Gas-phase air concentrations, fraction of organic matter, octanol-air partition coefficient, and dust density were used to predict dust concentrations, which were compared with measured values using regression models ($R^2 \sim 0.7$). Sensitivity analyses were conducted to evaluate the influence of assumed parameter values.

Conclusion: Understanding partitioning relationships between air and dust will advance our understanding of exposure pathways in the indoor environment, and can be used to prioritize exposure measures in large-scale epidemiological studies.

PP-30-108

Toenail, Blood and Urine as Biomarkers of Occupational Exposure to Manganese

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Background/Aims: Increasing interest in the health effects of cumulative manganese exposure has focused attention on suitable manganese biomarkers. Although blood and urine manganese may reflect recent exposure, toenail manganese may integrate exposure over longer periods. Although toenail has been shown to correlate with exposures to arsenic and selenium, it has not been validated for manganese exposures.

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Methods: In this study, we examined the correlation between toenail manganese and cumulative manganese exposure among welders at a Boston area local Union hall (n = 49). Cumulative exposure in months 1–6, 7–9, 10–12, 7–12, and 1–12 before toenail clipping were calculated from detailed work histories and air manganese measurements during different tasks. The correlation with blood and urine manganese (n = 21) as well as between manganese exposure over a workshift—assessed with personal air monitoring—and change in blood and urine manganese over the day (n = 26) were assessed.

Results: Toenail manganese was significantly correlated (using Spearman correlations) with cumulative exposure in 3 windows: months 7–9 (r = 0.35, P = 0.02), months 10–12 (r = 0.32, P = 0.03), and months 7–12 (r = 0.32, P = 0.03) before the clipping date, adjusting for age and dietary manganese. Toenail manganese did not correlate with blood (r = 0.11, P = 0.66) or urine (r = −0.18, P = 0.46) manganese. The correlation between blood and urine manganese, however, approached significance (Pearson r = 0.34, P = 0.08). Manganese exposure across a work shift was not correlated with changes in blood (r = −0.06, P = 0.80) nor urine (r = 0.21, P = 0.32).

Conclusion: In conclusion, toenail appeared to be a valid measure of long-term manganese exposure 7–12 months earlier. In populations with more consistent external manganese exposures than welders, toenail likely reflects other exposure windows as well. Neither change in blood nor urine manganese appeared to be suitable indicators of manganese exposure over a typical work shift.

PP-30-109

Daily Intake of DEHP and Other Phthalates by Korean—-Estimated by Determination of Urinary Concentration of Phthalate Metabolites

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Background/Aims: It is very difficult to exactly estimate the dose of dialkylated phthalates taken up by the general population because of environmental contamination, especially in the case of di-(2-ethylhexyl) phthalate (DEHP). We performed this study to estimate daily intake of DEHP, diethyl phthalate (DEP), and dibutyl phthalate (DBP) by urinary metabolites.

Methods: We used LC/MS/MS with on-line enrichment and column-switching techniques for the biological monitoring. Metabolites determined were 4 primary metabolites: mono(2-ethylhexyl)phthalate (MEHP), mono(n-butyl)phthalate (MnBP), mono(iso-butyl)phthalate (MiBP), mono-ethylphthalate (MEP); and 2 secondary metabolites of DEHP: mono(2-ethyl-5-hydroxyhexyl)phthalate (5OH-MEHP) and mono(2-ethyl-5-oxo-hexyl)phthalate (5oxo-MEHP). The subjects of the study (n = 332) were divided into 60 children, 62 middle and high school student, 139 adults, and 61 elderly man in Korea. The subjects were not occupationally exposed to phthalates.

Results: Determined median daily DEHP, DBP, and DEP intake was 8.3, 7.9, and 5.8 μg/kg body weight (bw)/d, respectively. For DEHP, 5 people (1.5%) exceeded the value of the tolerable daily intake of the European Food Safety authority of 50 μg/kg bw/d, whereas 7.2% exceeded the reference dose of 20 μg/kg bw/d of the US Environmental Protection Agency.

Conclusion: Determination of urinary metabolites of phthalates enabled to estimate internal exposure to phthalate diesters, such as DEHP, DBP, and DEP.

PP-30-110

Persistent Organic Pollutants and Their Effect on Gene Expression in Exposed Children

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[1]Howard University, Washington, DC; [2]University of California Davis, Davis, CA; [3]Slovak Medical University, Bratislava, Slovakia; and [4]Children's National Medical Center, Washington, DC.

Background/Aims: The chemical composition of the persistent organic pollutants (POP) contains many structurally different lipophilic compounds with distinctive toxicogenomic properties. The extensive works on PCB indicated that the composite effect is entirely different from the effect of the individual PCB congeners studied in vitro, and may be synergistic or antagonistic in nature. Our differential gene expression work in evaluating the POP-related toxicities on human being may help to understand the composite effect of the exposure as a collective entity.

Methods: The exposed Slovakian children (mean age, 45 month) were placed in high (>75% tile,) and low (<25% tile) prevalent POP groups, on the basis of blood concentration of POPs including polychlorinated biphenyls, 2,2′-bis(4-chlorophenyl)-1,1-dichloroethylene (p,p'-DDE), 2,2′-bis(4-chlorophenyl)-1,1,1-trichloro-ethane p,p-DDT), hexachlorobenzene, and β-hexachlorocyclohexane (β-HCH). The microarray studies were performed on Affymetrix platform (GeneChip Human genome U133 Plus 2.0 Array) using RNA from peripheral blood mononuclear cells of the children. The qRT-PCR method was used to validate differential gene expression. The global gene expressions in children of high- and low-POP exposure groups were compared by GeneSpring GX10.

Results: The significant set of differentially expressed genes was analyzed using Ingenuity Pathway Analysis. The mostly affected network functions are cell cycle, cancer, genetic disorder lipid metabolism, small molecule biochemistry, drug metabolism, etc, and the top Tox list included anti-apoptosis, fatty acid metabolism, p53 signaling phenomenon; in higher POP exposure. The incidence of cancer and the metabolic impairments is often reported pathophysiologically in epidemiological studies.

Conclusion: The gene expressions profile provided the molecular mechanism of POP-related toxicities. The future gene expression data from populations exposed to POPs of different chemical profiles are highly essential to understand the complex nature of this collective injury on human health.

PP-30-111

Dietary Patterns for Unique Populations Not Represented in US National Dietary Surveys: Application to Exposure Assessment Methods and Relevance to Any Population Group

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Background/Aims: United States national dietary surveys once served as the only knowledgebase for aggregate exposure and risk assessment models such as LifeLine, SHEDS, CARES, and DEEM. National surveys (Food and Drug administration's National Health and Nutrition Examination Survey and US Department of Agriculture Continuing Survey's of Food Intakes by Individuals) were statistically designed to represent large regions of the continental United States, 4 socioeconomic groups and broad-ethnic groupings. They are not representative of diets in Tribal, Arctic, Mexican, Asian, rural hunter, religious/ethnic-oriented, medical/weight control, or variants of vegan/vegetarians.

Methods: Dietary patterns for any unique subpopulation can be constructed using atypical information from traditional knowledge, economic and retail data, harvest and food disappearance data, and so on.

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On the basis of 3 principles of menu selection and using probabilistic methods, dietary patterns have been created for Mexican-influenced US communities, 5 Alaskan community types, and 15 Canadian Arctic regions and Southwestern US Tribal groups. These dietary intake patterns were applied to dietary exposure assessments despite the large national dietary surveys.

Results: Exposure opportunity differences are significant among these unique communities, especially for food oils, proteins, and fruits/vegetables and translate to significant differences in risk to pesticides and environmental contaminants. High risks to Mexican/SW Tribal populations originate from very different chemical exposure patterns than high exposure scenarios for populations eating Arctic-type diets.

Conclusion: Previously, these differences were invisible, but now are viewable using this methodology. These techniques can be applied to climate change issues, exposure assessment for any population or community for which no formal dietary survey exists, updating old dietary surveys for use in exposure assessment, Brownfields and superfund dietary assessments, environmental impact assessments, water and pesticide safety assessments, and so on. This presentation shows the construction of the dietary patterns using 3 basic principles; 5 very different patterns in the United States and Canada not considered in national surveys; and differences in oil, meat, processed sweet (commercial), and vegetable consumption across age groups.

PP-30-112

Investigation of Chemical Distribution and Uptake at Low Skin Loads

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Background/Aims: Analysis of selected data from US Environmental Protection Agency's Children's Total Exposure to Persistent Pesticides and Other Persistent Pollutants study reveals that observed outputs of urinary metabolites cannot be fully accounted for by conventionally estimated inputs of those pesticides for which mass balance can be feasibly attempted. Evidence that much of this shortfall can be explained by a phenomenon designated persistent low-level ambient contact exposure has been presented previously. An assumption essential to this hypothesis is that dermal absorption of semivolatile organic chemicals (SVOCs) is more efficient at low ($\sim$1 ng/cm^2) loads than at skin loads typically applied in laboratory absorption experiments; therefore, the uptake of SVOCs into skin under common conditions is significantly greater than previously assumed.

Methods: Although this assumption is theoretically well-founded, difficulties in reliably applying very small quantities of SVOCs to human skin while maintaining uniform spatial distribution impede empirical quantification of the efficiency of dermal absorption at low loads. To address this issue, a glass and Teflon chamber was constructed that permits deposition of aerosols generated by a Collison nebulizer onto skin coupons.

Results: The results from experiments in which a fluorescent tracer was used provide visual evidence that distribution of tracer on human cadaver skin after low-load aerosol deposition differs substantially from that observed following application in solvent by pipette. Subsequent experiments involving nebulization of an ethanol-based solution of 14C-labeled pentachlorophenol have demonstrated that pentachlorophenol loads on the order of 1 ng/cm^2 can be reproducibly applied to, and quantitatively recovered from, human cadaver skin. In the current phase of experimentation, residue remaining in/on skin after washing with soap and water serves as a surrogate for dermal absorption. Greater absorption efficiency at lower initial loads is hypothesized.

Conclusion: Further research into the persistent low-level ambient contact exposure hypothesis will lead to a better understanding of long-term residential exposure to potentially harmful chemicals.

PP-30-113

Multimedia and Multipathway Aggregate Exposure Assessment for Phthalates in Korean Volunteers

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Background/Aims: Multimedia and multipathway aggregate exposure assessment for 4 phthalates were conducted for total 98 individuals belonging to different age groups.

Methods: Benzyl butyl phthalate (BBP), Dibutyl phthalate (DBP), Bis(2-ethylhexyl)phthalate (DEHP), and Di-isononyl phthalate were analyzed in several types of samples for inhalation exposure route (indoor air [at house, school, office], outdoor air) and oral exposure route (indoor floor dust, dust adhering to hand, soil, food/beverage). The 98 individuals were divided into 5 groups: toddler (0–6 years), children and teenagers (7–18), and 3 adult groups including housekeeper (19–60), office worker (19–60), and pregnant women (19–44). Urinary biomarkers were also monitored in the participants to estimate the total exposure for the phthalates. The estimated aggregated exposures were compared with the total exposure calculated from biomarker monitoring data by dose reconstruction method.

Results: The median concentrations are ranged from $<$0.22 (BBP) to 192 ng/m^3 (DEHP) for air samples, $<$0.17 (BBP) to 389 ng/g (DEHP) for dust and soil samples, and $<$0.5 (BBP) to 70 ng/g (DEHP) for food/beverage samples. Median exposure estimates (ng/kg/d) in toddler group was 1.4–5.9 times higher than those in the other age-groups. Food intake was found as a major exposure route (68.4%–99.9%). Except for food exposure, dust ingestion by hand-to-mouth activity was the most important exposure route in toddler group (51.2%–92.3%). In addition, exposure by consumer products was estimated for toddler and adult groups. Phthalates exposure by consumer products for adult and toddler groups were 118 and 3550 ng/kg/d for DEHP, 5 and 560 ng/kg/d for DBP, 1.7 and 4140 ng/kg/d for Di-isononyl phthalate, respectively.

Conclusion: The median daily phthalate exposures (ng/kg/d) estimated from determination of urinary phthalate metabolites in toddler group were 1.2–3.9 times higher than those in other age groups. Median daily aggregated exposure for DEHP in 98 individuals was in the same range as the total exposure back-calculated values from urinary metabolites. In contrast, median daily aggregated exposures for DBP and BBP were 5–100 times lower than the back-calculated values.

PP-30-114

Multimedia and Multipathway Aggregate Exposure Assessment for Polycyclic Aromatic Hydrocarbons in Korean Volunteers

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Background/Aims: Multimedia and multipathway aggregate exposure assessment for polycyclic aromatic hydrocarbons (PAHs) was conducted for 180 individuals in different age groups.

Methods: PAHs were analyzed in several types of samples for inhalation exposure (personal air, indoor air [at house, school, office, and kitchen], outdoor air) and oral exposure (indoor floor dust, dust adhering to hand, soil, and food/beverage) routes. The 180 persons were divided into 5 groups: toddler (0–6 years), children and teenagers (7–18), and 3 adult groups including housekeeper (19–60), office worker (19–60) and the elder ($>$60). The concentrations of PAHs were expressed as sum of

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toxicity equivalent quotients (TEQs) for the 15 individual PAH concentrations in the samples.

Results: The median concentrations (Σ15 PAHs) ranged from 0.073 to 11 ng-TEQ/m^3 for personal air samples, 0.073 to 2.2 ng-TEQ/m^3 for indoor air samples, 0.073 to 4.1 ng-TEQ/m^3 for outdoor air samples, 0.0029 to 41 ng-TEQ/g for dust and soil samples, and 0.32 to 2.6 ng-TEQ/g for food/beverage samples. Average daily dose in toddler group was 27.5 ng-TEQ/kg/d (median), which was 2.8–4.1 times higher than those in the other age groups (6.7–9.7 ng-TEQ/kg/d). Lifetime average daily dose for all the subjects was 16.9 ng-TEQ/kg/d.

Conclusion: Food intake for all age groups was found as a major exposure route in all age groups (96.0%–99.5%). Except for food ingestion, dust ingestion by mouthing activities, such as hand-to-mouth activity, was the most important exposure route in toddler group (76.8%). In other age groups, inhalation of gaseous and particulate PAHs is the most important exposure route (92.9%–97.1%).

PP-30-115

Multimedia and Multipathway Aggregate Exposure Assessment for Polycyclic Aromatic Hydrocarbons to the Inhabitant in Taean County After Hebei-Spirit Oil Spill

Jong-Hyeon Lee,[1] Chan-Kook Kim,[1,2] Woo-Chul Jeong,[3] Jong-il Hur,[3] Pan-Soo Park,[1] Jin-Ho Park,[1] Tae-Woo Lee,[1] Hwi-Soo Seol,[1] Jong-Heop Lee,[2] Jong-Ho Kim,[2] Byeong-Kyu Kwak,[2] and Jung-Hyeon Park[1] *[1]NeoEnBiz Co, Bucheon, Republic of Korea; [2]Seoul National University, Seoul, Republic of Korea; and [3]Taean Institute of Environmental Health, Taeangun, Republic of Korea.*

Background/Aims: Two years after the Hebei-Spirit oil spill occurred, aggregate exposure assessment to polycyclic aromatic hydrocarbons (PAHs) including alkylated PAHs was conducted for the inhabitants in Taean county, multimedia and multipathway aggregate exposure assessment for PAHs were conducted for 45 nonsmoking residents in the following 2 age groups; children (11–13 years), adult (>20).

Methods: A total of 34 PAHs were analyzed in several types of samples for inhalation exposure route (ambient air), ingestion exposure route (soil, house dust, 24-hour duplicate diet, fish, and shellfish collected near the spill area), and dermal exposure route (soil and floor dust).

Results: PAHs concentrations ranged from 0.27 to 8.26 ng/m^3 for air, 0.72 to 69.37 ng/g for food, 1.39 to 49.90 ng/g for fish and shellfish, 0.11 to 80.66 ng/m^2 for floor dust, and 0.36 to 55.32 ng/g for soil. The average daily PAHs exposures of children and adult were 126.89 (geometric mean: 99.38) ng/kg/d and 135.79 (43.92) ng/kg/d, respectively.

Conclusion: The exposure levels were lower than those (15 PAHs) obtained in other urban and rural areas of Korea. Food intake was found as a major exposure route (>99%). Fish and shellfish caught from Taean county contributed to only 10% of 34 PAHs exposure through food intake. It is confirmed that the exposure level to PAHs, including alkylated PAH, was recovered to the baseline condition within the 2 years after the Hebei-Spirit oil spill.

PP-30-116

Exposure Assessment of Polycyclic Aromatic Hydrocarbons and Alkylated Polycyclic Aromatic Hydrocarbons to the Participants in the Cleanup Activity of the Hebei-Spirit Oil Spill

Jong-Hyeon Lee,[1] Chan-Kook Kim,[1,2] Jongil Hur,[3] Woo-Chul Jeong,[3] and Jung-Hyeon Park[1] *[1]NeoEnBiz Co., Bucheon, Republic of Korea; [2]Seoul National University, Seoul, Republic of Korea; and [3]Taean Institute of Environmental Health, Taean, Republic of Korea.*

Background/Aims: After the Hebei-Spirit oil spill, the exposure history to polycyclic aromatic hydrocarbons (PAHs) and alkylated PAHs was simulated for volunteers and residents for oil cleanup activity, and children and adults living near the oil spill area.

Methods: Time series of PAHs and alkylated PAHs concentrations in the spilled residual oil at Taean county were simulated by using CalPUFF model, and then aggregate exposure assessment was conducted for different exposure groups during specific periods after the accident; 0 to 3 days, ~1 month, ~4 months, ~1 year, and ~2 years.

Results: At the beginning of the accident (0–3 days), the average PAHs exposures of the participants (residents and volunteers) in the oil cleanup activity were respectively 0.020 and 0.0068 mg/kg/d, and these exposure levels decreased with time, and then reached 1.65 and 0.12 ng/kg/d, respectively, within 1- to 2-year interval after the oil spill. At the beginning of the accident (0–3 days), the average alkylated PAHs exposures of the participants (residents and volunteers) in the oil cleanup activity were 0.87 and 0.29 mg/kg/d, respectively, and these exposure levels decreased with time, and then reached 220 and 13 ng/kg/d, respectively, within 1- to 2-year interval after the oil spill. The ratio of alkylated PAHs exposure to PAHs exposure for 2 groups was 30:40 at 0 to 3 days, and then increased by about 120 in 1- to 2-year interval after the oil spill as a result of more abundance and persistence of alkylated PAHs than their parent compounds.

Conclusion: Each exposure decreased with time and reached the present exposure level for PAHs in 4 months for local residents, and in 1 year for oil cleanup volunteers and inhabitants. However, the exposure levels for alkylated PAHs were underestimated. Human exposure to the oil spill accident should be assessed on the basis of total PAHs, including alkylated PAHs.

PP-30-117

A Computational Framework for Aggregate and Cumulative Exposure Assessment

Denis Sarigiannis, Alberto Gotti, and Spyros Karakitsios *European Commission, Joint Research Centre, Institute for Health and Consumer Protection, Ispra, Italy.*

Background/Aims: The complexity in quantitatively estimating human exposure to environmental chemicals originates from the need to assess aggregate (single pollutants through multiple sources and routes of exposure) and cumulative (all the contaminants through multiple exposure pathways) exposure; the assessment becomes even more complex when mixture effects need to be taken into account.

The objective of the study was to develop a framework for the quantitative aggregate and cumulative assessment of the biologically effective dose of several interacting environmental chemicals.

Methods: An integrated modeling environment was compiled in a single computational platform (asclXtreme) including emissions, dispersion, exposure modeling, internal dose, and health risk. The main component of the platform is a generic Physiology-Based ToxicoKinetic model, coupled to a Biology-Based Dose Response model. Uncertainty and variability of the affecting parameters were implemented in each stage through Marcov Chain Monte Carlo simulation.

Results: Benzene, toluene, ethylbenzene, and xylenes were selected as case study under different environmental exposure scenarios. The methodology permits the estimation of benzene carcinogenic risks, capturing the continuously changing environmental and biological dynamics. The integrated modeling platform was tested in several benzene, toluene, ethylbenzene, and xylenes exposure scenarios (occupational and environmental).

Conclusion: The estimation of health risk because of benzene was much refined when the internal dose of the parent substance and its metabolites

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was taken into account rather than only personal exposure linked to epidemiological relations. This is due to the following 2 reasons:

1. Aggregation of exposure through different microenvironments with continuously changing ambient concentrations provides differences at the daily variation time profile between personal exposure and internal dose, significantly affecting the overall risk estimation.
2. The presence of co-exposure to the other volatile organic compounds in the mixture affects the levels of benzene metabolites through inhibition of benzene metabolism.

PP-30-118

Analysis of Temporal and Spatial Variability in Disinfection By-product Concentrations for Exposure Assessment Applications

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Background/Aims: Most epidemiological studies of disinfection by-products rely on aggregate water system average total trihalomethane (TTHM) and total haloacetic acid concentrations as surrogate measures for individual-level exposure. It is critical that these surrogates accurately reflect temporal and spatial variability in disinfection by-product concentrations to reduce exposure misclassification.

Methods: We assessed temporal and spatial variability in routinely collected TTHM monitoring data for 201 public water systems (PWSs) in Massachusetts from 1995 to 2004.

Results: The annual TTHM average across 46 PWSs with complete quarterly data remained relatively unchanged during the study period (1995: 41.3 μg/L; 2004: 42.4 μg/L). However, average TTHM among systems disinfecting with chloramination (n = 5 PWSs) increased considerably (1995: 23.6 μg/L; 2004: 43.0 μg/L), while TTHM levels increased slightly among chlorinated systems (n = 30 PWSs). The quarterly averages across 46 PWSs showed consistent seasonality with a 30%–50% higher summer average TTHM compared to winter. High spatial variability (ie, $\geq$1 sampling date with TTHM between-location differences was $\geq$30 μg/L) was noted in 49% of PWSs. Over half of these PWSs had high spatial variability for at least 25% of their sampling dates. We also examined spatial variability based on different disinfection practices for 4 PWSs that used chloramination at some point during the study period. Among these systems, 64% of the chlorinated sample dates had high spatial variability compared to 1% of the chloraminated sample dates reported.

Conclusion: Our seasonal variability findings emphasize the need for quarterly sampling dates to adequately capture short-term temporal trends. We found considerable spatial variability across several water systems, which could result in misclassification bias if system averages are used to estimate individual-level TTHM and THAA exposures. Therefore, exposure assessment approaches should target systems with minimal spatial variability and sensitivity analyses should examine potential exposure misclassification in larger epidemiological studies based on water systems using different types of disinfectants.

PP-30-119

Method Development for Residential and Occupational Sampling of Organophosphorus Pesticides and Oxygen Analogs in Yakima Valley, WA

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Background/Aims: A recent air monitoring study of organophosphorus (OP) pesticides in Washington State found substantial amounts of the oxygen analog of chlorpyrifos (CPF). Follow-up laboratory studies indicated that oxygen analog (CPF-O) could be produced artificially on the XAD-2 Resin OVS sampling tubes that are recommended by the US National Institute for Occupational Safety and Health (NIOSH Method 5600).

Methods: The goals of this study were to measure the actual chlorpyrifos oxygen analog (CPF-O) levels during and following pesticide applications, and to develop optimal sampling procedures. Two air sampling media, OVS and polyurethane foam (PUF) tubes, were spiked in the laboratory with varying amounts of CPF (60, 200, 2000 ng) and air was drawn through the tubes at 2 L per minute for 24 hours. In addition, a side-by-side comparison of sampling methods was performed during orchard spraying of CPF. Samplers were located upwind and downwind, at distances $\geq$150 m and $\leq$10 m from the orchard perimeter.

Results: The laboratory percentage CPF transformed to CPF-O on the OVS tubes ranged from 3% to 15%, and was inversely related to the spiking level. CPF-O was not detected on the PUF tubes for any of the spiking levels except the highest, where CPF-O represented 0.01% (SD: $\pm$0.01%) of the total CPF.

Conclusion: We concluded that (1) OP pesticide concentrations can be under-estimated using OVS sampling tubes if analysis for oxygen analogs is not conducted, (2) oxygen analogs measured on OVS sampling tubes do not represent the true concentration of these compounds in air, and (3) PUF sampling tubes appear to be a promising alternative sampling medium. The results will be used to document the presence or absence of CPF-O in air and on surfaces, to inform workers and nearby communities about potential exposures, and to develop recommendations on optimal air sampling procedures for both OP pesticides and oxygen analogs.

PP-30-120

Research on Inhalation Exposure Factors of Tai Yuan Residents

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Background/Aims: To study the Inhalation exposure parameters of the residents of Taiyuan, Shanxi Province of China.

Methods: Questionnaire was used to survey the time-activity patterns of a number of 2860 participants from Taiyuan, the data was input by "Epidata," analyzing by "Spss15.0," and then calculated respiration rate parameters by energy of inhalation rate estimation method.

Results: The daily average time of Taiyuan residents spent indoor was 16.1–18.4 hours, while the outdoor time was 5.6–7.9 hours. Overall, the daily average time adult spent at home, workplace, other indoor places, transiting and other outdoor activities were 13.7, 5.6, 1.0, 0.4, and 3.3 hours, respectively, and there were great difference between the sexes, age groups, urban and rural residents; the daily average time the adults spent at different intensity activities vary a lot, with engaged in sleeping, mild exercise, moderate exercise, and severe exercise were 8.2, 13.5, 1.6, and 0.7 hours respectively; the long-term exposure daily inhalation rates of Taiyuan male and female residents were 15.7 and 11.0 m^3/d, respectively.

Conclusion: (1) The daily average time of Taiyuan residents spent indoor were 16.1–18.4 hours, while the outdoor time were 5.6–7.9 hours. (2) The daily average time adult spent at home, workplace, other indoor places, transiting, and other outdoor activities were 13.7, 5.6, 1.0, 0.4, and 3.3 hours, respectively. (3) He daily average time adult engaged in sleeping, mild exercise, moderate exercise, and severe exercise were 8.2, 13.5, 1.6, and 0.7 hours, respectively. (4) The long-term exposure daily inhalation rates of Taiyuan male and female residents were 15.7 and 11.0 m^3/d, respectively.

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PP-30-121

A Novel Approach to Estimating Average Long-term Endotoxin Exposure for Children: The Endotoxin Exposure Matrix

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Background/Aims: A major limitation to quantitative endotoxin exposure assessment is that it only effectively captures endotoxin exposure level at 1 time-point. Thus far, no feasible or economical method has been proposed to estimate average long-term endotoxin exposure. A potential solution to this difficulty is to borrow from occupational epidemiology and adapt the concepts of job exposure matrices to estimate cumulative endotoxin exposure, which acts as a proxy for average exposure over time, in a new exposure matrix—the Endotoxin Exposure Matrix (EEM).
Methods: The EEM is designed to estimate the environmental (background) levels of endotoxin and incorporate intensifying factors (factors affecting background levels). These environmental factors (location of residence, degree of parental interaction, and household dust) are assigned an endotoxin exposure score in an a priori fashion (with the exception of household dust). Household levels of endotoxin will be measured from collected dust samples using the LAL Assay and converted into endotoxin exposure scores, which is assessed along a 3-point ordinal scale. This quantitative measure will also allow internal validation of the EEM. Exposure status for various intensifying endotoxin factors will act as multipliers for their corresponding environmental factors (eg, infrequent house cleaning increases the endotoxin exposure from household dust). To capture the long-term nature of exposure, duration of exposure (years lived) will be taken into account. Endotoxin exposure scores associated with the environmental factors will be multiplied by the duration of exposure and corresponding intensifying factors and summed to give an endotoxin exposure index (EEI).
Results: As the EEI is semiquantitative, its interpretation is on an ordinal scale, such that a higher EEI value corresponds to a higher level of endotoxin exposure and the absolute value of the index is not meaningful.
Conclusion: Therefore, the EEM allows average long-term endotoxin exposure to be estimated in a feasible and economical fashion.

PP-30-122

Levels of Human Steroid Hormones in Water and Sediment From 4 Major Rivers in Korea

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Background/Aims: Steroid hormones remained in river water or soil may influence endocrine disrupting effects to ecological system even though low level of concentration. This study was performed to assess the residual level of 4 steroid hormones at river water and sediment.
Methods: Estrone (E1), 17-β-estradiol (E2), estriol (E3), and 17-α-ethinylestradiol (EE2) were analyzed at water (n = 80) and sediment (n = 8) from 4 major river in Korea by LC-MS/MS technique. Water and sediment samples were prepared by continuous solid phase extraction method subsequent by liquid-liquid extraction.
Results: The concentration of steroid hormone ranged ND ~59.4 ng/L for E1, ND ~52.8 ng/L for E2, ND ~8.6 ng/L for E3 in river water and ND ~5.75 ng/g for E1, ND ~1.29 ng/g for E2 in sediment samples, respectively. EE2 was not found at any of the samples. The occurrence rate of E1 was most high; 21.3% for river water samples and 75% for sediment samples.
Conclusion: We detected low concentration of steroid hormones in river water sediments in Korea.

PP-30-123

Comparison of VOCs Personal Exposure Levels According to Time-activity Patterns in Korea

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Background/Aims: This study analyzed relationships between time-activity patterns and personal exposure to VOCs (benzene, toluene, ethylbenzene, o-xylene, m,p-xylene).
Methods: This analysis of time-activity patterns is based on data from "Time Use Survey" (2004) by the Korea National Statistical Office (KNSA). Personal exposure to VOCs were monitored for 800 inhabitants (about 303 households) of 4 areas.
Results: Korean people spent more than 87% (21 hours) of their times indoors. There showed differences in time spent in microenvironments (residential indoors, other indoors such as office, factories, schools and public buildings, transportation, outdoors) according to variables such as occupational status, gender, age, living habits (smoking etc), and seasonal factors, etc. We see that Korean people are exposed for the largest amount of time in the home (59.2%), followed by other indoors (28.3%), transportation (7.5%), and outdoors (5.0%). Especially, Korean people came home late because of activities related with occupation, education, and meetings with others.

Personal exposure to VOCs was affected by time-activity patterns. The differences of time for staying for other indoors between housewives and employed men were 3 times and increased exposures to VOCs were observed for employed men and smokers. Of 5 VOCs, personal exposure to Benzene was mainly affected by Benzene level of residential indoors, followed by Benzene level of offices, the time for staying in offices and the time for staying at home.
Conclusion: Therefore, it will be needed active managements such as non-smoking, environmental improvement in public places, and healthy lifestyle to reduce the personal exposure to pollutants. Further, NIER is planning to predict personal exposure by categorizing subgroups according to time-activity patterns and analyzing the cause of exposure to pollutants.

PP-30-124

Evidence of Policy Impact on Population Exposure Improvement

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Background/Aims: Ultimate goal of exposure science is to improve public health through comprehensive assessment of exposure. Implementation of preventive policy is often limited by lack of visible

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evidence of prevention. Policy makers often react to disaster events but are rarely to promote preventive measures.

Methods: I present 2 evidences of exposure reduction to emphasize need of preventive policy.

Results: One of the most significant preventive measures is smoke-free policy. Tobacco smoke substantially contributes to indoor particle concentration in hospitality venues and can be greatly reduced by implementation of smoke-free air laws. In addition, improvement of internal dose and respiratory function was determined after smoke-free laws. When indoor $PM_{2.5}$ levels were measured in hospitality venues before and after smoke-free laws, indoor $PM_{2.5}$ level decreased 80%–90%. The effect of smoke-free laws is not only significant but also immediate. These studies demonstrate that comprehensive smoke-free laws reduce indoor air pollution to safe levels for workers and the public. Another example is implementation of indoor air quality standard in Korea. The Indoor Air Quality (IAQ) Control in Public Use Facilities Act in Korea, effective from 1 January 2006, sets the standards for benzene, toluene, ethylbenzene, xylenes, styrene, and formaldehyde. After the regulation was implemented, the individual VOC levels in unoccupied apartments were significantly reduced and none of measured unoccupied apartments exceed the standards. The reduction of VOC levels was also significantly associated with flooring materials, adhesive, and paint. The findings demonstrated that regulation could reduce VOCs concentrations in new apartments through the use of building materials with low emission.

Conclusion: Such evidences should be promoted to enhance exposure science and provide preventive measures to protect public health.

SPECIAL WORK ENVIRONMENT AND HEALTH

O-30A8-1

Psychological Outcome of Injured Workers After Occupational Injury

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Background/Aims: The workers who have been exposed to a traumatic event may display significant psychiatric disorders that make them unable to return to the workplace. This study aimed to determine the prevalence of post-traumatic stress disorder (PTSD) and other psychiatric morbidity among workers after occupational injuries.

Methods: A 2-staged survey study was conducted. The first stage of investigation involved a self-reported questionnaire including Brief Symptom Rating Scale (BSRS-50) and SPAN (an acronym for 4 items: startle, physiological arousal, anger, and numbness)-C (Chinese version), which was sent to injured workers at 3 months after injury, for screening of mental conditions. Those scored at or higher than 2 standard deviations higher than norm were included for the second stage phone interview using Mini-international Neuropsychiatric Interview (MINI) by psychiatrists.

Results: A total of 2001 workers had completed the self-report questionnaire (response rate 45.5%). Among them, 389 (19.4%) scored high in the screening questionnaire and were entered for MINI. This study found that the estimated rates of PTSD, post-traumatic stress symptoms (PTSS), major depression, comorbid PTSD/PTSS and major depression, and either PTSD/PTSS or major depression were 3.1%, 3.7%, 2.7%, 2.0%, and 7.2%, respectively, after work injuries.

Conclusion: This study showed that occupational injuries can cause psychological impact in the injured workers.

METHYLMERCURY, MINAMATA AND MODERN MENACES

S-30A9-1

The History of Minamata Disease and Public Health Policy

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Background/Aims: I introduce the history of Minamata disease mostly in a chronological order from the public health point of view. The history of Minamata disease can be divided into 2 periods. The first period is from the year that the first 2 patients, 2 young girls were notified to the local public health center, to the year that waste water from the causal factory was stopped (from 1956 to 1968). The second period is from the ban of the waste water up to now (from 1968–to date). Each period has specific problems. In the first period, because the appropriate public health response—to investigate and control the outbreak—as set out in the Food Sanitation Act was not conducted, no one knew how many residents fell ill following the outbreak. Furthermore, exposure could not be stopped, so the pollution and the disease spread to the whole inland sea area (Shiranui Sea). The problem in the second period is accreditation system of the disease. Most non-Japanese researchers believe that the number of methyl mercury poisoning patients was 2271 (as of January 2010), as per government information. This number, however, is underestimated, for the accreditation system.

Methods: In the presentation, we offer reasons behind the problems. Especially, we present why the Japanese public health agencies did not apply the Food Sanitation Act. Furthermore, we introduce the accreditation system in the session, and then discuss its problem.

Results: The first period of the history of Minamata disease shows us the consequences when public health responses are not implemented. Minamata disease should be an invaluable lesson for future public health responses. In the second period, the unusual "accreditation" system is problematic, which was also induced by a lack of investigation based on the Food Sanitation Act. The system is also based on erroneous causal inference.

Conclusion: Public health officials and other officials tend to seek reasons for no action in a large disease outbreak. A public health official, however, should be better likened to a fire chief than to a philosopher or a scientist. We need sufficient reasons for action, not sufficient reasons for brief.

S-30A9-2

Recent Findings in Minamata Disease From a Population-based Study Conducted in 1971

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Background/Aims: It is well known that large-scale poisonings caused by methyl mercury occurred in Japan (Minamata, in the 1950s). However, there have been few population-based epidemiologic studies in Minamata. Therefore, we evaluated the effect of methyl mercury on neurological signs and hypertension using data from a 1971 population-based study. We also evaluated the association between hair mercury level and both outcomes.

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Methods: Villages in 3 areas were selected for study: the Minamata area (a high-exposure area), the Goshonoura area (a medium-exposure area), and the Ariake area (a low-exposure area). We used place of residence as the exposure indicator. We examined associations between methyl mercury exposure and the neurological signs as well as hypertension.

Results: Total population was 1120 in the high-exposure villages, 1845 in the medium-exposure villages, and 1165 in the low-exposure villages. In the Minamata area, 87% (833) of the eligible population (aged 10 and older) participated in the 1971 investigations, in the Goshonoura area 93% (1450), and in the Ariake area, 77% (755). Compared with subjects in the Ariake area, the subjects in the Minamata area manifested neurological signs and hypertension more frequently. The highest prevalence odds ratio was observed for perioral sensory loss around the mouth (110; 95% confidence interval = 16–820). Furthermore, hair mercury levels were associated with perioral sensory loss in a dose–response relationship.

Conclusion: Long-term exposure to methyl mercury has a strong adverse impact on neurological signs and hypertension among residents in a local community.

S-30A9-3

Minamata Disease at Present

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Background/Aims: Fifty-four years have passed since Minamata disease (MD) was discovered in 1956. By concealing policy by administrations, the whole picture of MD is unknown, but symptoms and signs of the residents have been studied, which were not known internationally. After 15 October 2004, when the Japanese Supreme Court judged that the Government is responsible to the cause and spread of MD, we have come to be able to examine more and younger residents in the polluted area. I would like to reveal the present figures of MD.

Methods: After 2004, we have examined thousands of residents and patients in the methyl mercury-polluted areas. History taking questionnaires on pollution and background, physical examination, and physiological and psychological tests have been performed. In this symposium, I would like to present health problems which we have obtained recently including younger people, emerging form of symptoms and signs, and the "easily concealed" characteristics of methyl mercury poisoning.

Results: The population of the polluted area is about 500,000. Before 2004, officially certified MD patients was only about 2265 and 17,000 people were partially compensated but not certified as MD. After 2004, 7500 residents have been applying for MD, and 25,000 residents have received partial compensation. They have the same symptoms as patients confirmed before. Younger generation (who were born after 1969) also had MD symptoms and signs. The onset of MD showed great diversity in the social discrimination to the MD and lack of information which causing the MD patients to having been "concealed." In the polluted areas, we can find a great number of "newly discovered" MD patients even now.

Conclusion: Long-term and from-lower-to-heavier pollutions around Minamata have great negative effects on health states in the residents. So, to avoid underestimation, environmental and health surveys should be performed continuously in the methyl mercury-polluted areas.

S-30A9-4

Epidemiology of Congenital Minamata Disease Patients

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Background/Aims: The episode of Minamata disease is a famous case of food poisoning caused by fish contaminated with methyl mercury (Harada, 1995). The exposed patients manifested neurological signs, including sensory loss, ataxia, visual field constriction, dysarthria, and hearing difficulties. Furthermore, a considerable number of children with conditions resembling cerebral palsy were born in the exposed areas (Kitamura et al, 1959). Although many researchers did not initially believe that methyl mercury could pass through the placenta, subsequent epidemiological and pathological investigations demonstrated that methyl mercury exposure affected the fetus in utero after maternal ingestion (Harada, 1979). Subsequently, these cerebral palsy-like children started to be referred to as congenital Minamata disease patients (Harada, 1978), and they were made famous in a photo collection by Eugene Smith. Many congenital Minamata Disease patients are still alive.

Methods: In the present presentation, we want to introduce epidemiology of congenital Minamata disease patients. We also want to introduce the current health status of congenital Minamata disease patients and the residents who were exposed in there mothers' uterus.

Results: Not only congenital Minamata disease patients but also many residents who were also exposed in their mothers' uterus still have neurological sings.

Conclusion: This historical incident several decades ago in Minamata and neighboring communities clearly shows that regional pollution affected the environment in utero.

S-30A9-5

The Blood Mercury Concentration and Related Factors in a Urban Coast Area, Korea

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Background/Aims: This study was carried out for the purpose of evaluating the blood mercury concentration of the residents of Busan, Korea, as well as the relationship between the mercury concentration and the pattern of consuming fishes and other epidemiological factors.

Methods: A total of 295 adult subjects and 59 pregnant women were recruited into this study after obtaining informed consent. Adult blood samples and 59 sets of maternal and cord blood samples were measured using a gold-amalgam collection method after randomization.

Results: (1) The geometric mean concentration of mercury in the adult subjects was 8.63 ppb. According to the multivariate analysis, the blood mercury concentration was significantly affected by the pattern of alcohol drinking and consuming fish but other epidemiological factors were not related. (2) The mean levels of total mercury concentrations were 3.16 ± 1.21 ppb in maternal blood of pregnant women and 5.43 ± 2.22 ppb in cord blood. Total mercury and methyl mercury concentrations of random 36 pregnant women were respectively 3.06 ± 1.17 ppb, 2.60 ± 1.11 ppb in maternal and 5.20 ± 2.36 ppb, 4.70 ± 1.97 ppb in cord blood. Methyl mercury account for 85.0% of the amount of total mercury in maternal blood and 90.4% in cord blood.

Conclusion: It was found that the subjects who have consumed a large amount of fish, may have high blood mercury concentration. It seems that fish consumption can influence blood mercury concentration. Therefore, guidelines for fish consumption that will decrease blood mercury concentration might be necessary in Korea.

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ADDRESSING LIMITATIONS AND IMPROVING LUR MODELS FOR ESTIMATING EXPOSURE IN AIR POLLUTION HEALTH STUDIES

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S-30B1-2

Land-use Regression Models for Estimating Short-term and Seasonal Average Exposures to Air Pollution Using Coupled Regional and Local Scale Air Quality Models

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Background/Aims: Land-use regression (LUR) models have emerged as a widely used methodology for estimating individual exposure to air pollution in epidemiologic studies. However, LUR models have several limitations including limited transferability and lack of fine-scale temporal resolution.

Methods: We produced a detailed characterization of ambient concentrations for multiple air pollutants in New Haven, Connecticut using regional (CMAQ) and local scale (AERMOD) air quality (AQ) models, which were then evaluated against available monitoring data to assure their performance. We combined daily average pollutant concentrations predicted by these coupled AQ models with land-use variables for 318 census block groups to develop seasonal and short-term LUR models in a hierarchical manner, using an iterative site selection approach. We evaluated fitted LUR models for benzene, particulate matter ($PM_{2.5}$), and nitrogen oxides (NOx) using a variety of approaches including comparison of predicted versus observed pollutant concentrations at independent test sites not used in model development.

Results: LUR models for benzene, $PM_{2.5}$, and NOx were similar in terms of model characteristics, fit, and performance. Traffic was an important predictor of concentration across seasons for all 3 pollutants, explaining 50%–70% of the variation in benzene and NOx and 10% of the variation in $PM_{2.5}$. LUR performance was highly dependent on the number of training sites used to fit the models. Mean R2 for benzene models based on 25 sites was 90% in training datasets; however, the corresponding mean R2 for predicted versus observed benzene in test sites was 28%. In contrast, mean R2 for benzene models based on 285 sites was 68% and 67% in training and test datasets, respectively. Seasonal and short-term model results will be further discussed.

Conclusion: These results confirm challenges faced by the LUR community in attempting to fit empirical response surfaces to spatially and temporally varying urban pollution levels, and underscore the importance of refining LUR models using AQ modeling tools.

S-30B1-4

Methodological Issues and Statistical Analysis in Land Use Regression Modeling

Gerard Hoek, Rob Beelen, and Bert Brunekreef *University of Utrecht, Utrecht, The Netherlands.*

Background/Aims: Land use regression (LUR) models are increasingly used to provide estimates of spatial variation of outdoor air pollution. LUR models for particulate matter typically are based on monitoring that is not performed simultaneously at all sites, requiring adjustments for temporal variation at references sites using different methods. Traditional LUR models provide relatively crude estimates of traffic impacts, especially within urban areas.

Methods: We will illustrate the improvement of models by characterizing street configuration and height above ground using GIS databases. In the TRAPCA study including 40 sites spread over the Netherlands, we observed that inclusion of street canyon and detailed traffic count data, improved the R2 of prediction of outdoor soot concentrations from 0.81 to 0.94.

Results: We will also discuss the development LUR models (typically based on linear regression) using alternate statistical methods such as universal kriging in cases with significant spatial autocorrelation in the pollution data. In a recent EU-wide LUR model, universal kriging predicted concentrations substantially better than simple linear regression (eg, for urban NO_2 the R2 was 0.51 for universal kriging vs. 0.33 for linear regression). In a recent study on LUR, we further illustrate co-kriging as a method that makes use of (correlated) patterns in different pollutants to improve models for the least intensive measured pollutant.

Conclusion: Significant improvements of LUR models are possible using data that can be obtained with some effort. In large study areas, kriging methods may outperform standard linear regression methods.

S-30B1-5

Challenges and Next Steps for Land-use Regression Models

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Background/Aims: This talk addresses lessons learned, challenges, and next steps in the application of the land-use regression (LUR) model approach for air pollution exposure assessment. Specifically, we will discuss creating national LUR models, developing LUR models for developing countries, and matching the spatial resolution of LUR models with microenvironment location information.

Methods: We developed national LUR models using fixed site monitors for the United States and Canada (obtained from the US Environmental Protection Agency and NAPS respectively), land use characteristics, and satellite pollutant measurements.

Results: For the United States, models were developed for annual average (R^2: 0.78) and seasonal (R^2: 0.73–0.77) concentrations of NO_2. For Canada, models were developed for annual average concentration of particulate matter 2.5 ($PM_{2.5}$) (R^2 = 0.44) and several gases: NO_2, Benzene, Ethyl benzene, and Butadiene (R^2: 0.62–0.69). Within-city variability is predicted reasonably well for the US model, but requires further work for the Canadian model. A second area of current work involves LUR in Delhi, India, for $PM_{2.5}$, black carbon, and particle number concentrations. Preliminary results suggest differing spatial patterns in India compared to typical North American contexts and the need for different predictor variables—for example, in high-density low-income neighborhoods where in-home combustion sources are predominantly solid fuels, $PM_{2.5}$ concentrations may be higher away from a roadway than near a roadway. Our third area of current work is to improve microenvironment location information for exposure estimation. This work builds on prior mobility-based exposure models. CAREX Canada has developed "daytime" location estimates from satellite data at block and dissemination areas, to calculate population exposure estimates using LUR models. Following on earlier work using geocoded activity diaries and logging GPS, we are working with smart-phone GPS technology to estimate individual exposures based on location.

Conclusion: The use of national scale LUR models shows promise. Expanding to developing counties and improving the microenvironment information present a set of challenges to be addressed.

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APPLICATIONS OF EXPOSURE BIOMARKERS AND AGGREGATE EXPOSURE MEASURES IN EPIDEMIOLOGICAL STUDIES

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S-30B2-1

Follow-up of Residents Exposed to Perfluorooctanoic Acid-contaminated Drinking Water in Germany

Jürgen Hölzer,[1] Edna Brede,[1] Johannes Müller,[2] Knut Rauchfuss,[3] Martin Kraft,[3] Rolf Reupert,[3] Peter Kleeschulte,[4] Thomas Göen,[2] and Michael Wilhelm[1] *[1]Department of Hygiene, Social and Environmental Medicine, Ruhr-University, Bochum, Germany; [2]Institute and Outpatient Clinic of Occupational, Social and Environmental Medicine, University Erlangen-Nuremberg, Erlangen, Germany; [3]North Rhine-Westphalia State Agency for Nature, Environment and Consumer Protection, Recklinghausen, Germany; and [4]Public Health Department of the Hochsauerlandkreis, Meschede, Germany.*

Background/Aims: In Arnsberg, Germany, about 40,000 residents have been exposed to perfluorooctanoate (PFOA) (500–640 ng/L)-contaminated drinking water. In 2006, activated charcoal filtering was installed in the waterworks and PFC-concentrations in drinking water were lowered significantly. Human biomonitoring studies were performed in 2006 (immediately after filter-installation), 2007, and 2008. Here, we report on the results of the 2 years follow-up study.

Methods: In all, 90 children (5–6 years old), 164 mothers (23–49 years), and 101 men (18–69 years) took part in the first cross-sectional study 2006, 77% participated in the 2-year follow-up study. Lifestyle factors and drinking water consumption habits were assessed by questionnaire and interview. PFOA, perfluorooctanesulfonate, perfluorohexanoate, perfluorohexanesulfonate, perfluoropentanoate (PFPA), and perfluorobutanesulfonate in blood plasma and PFOA/perfluorooctanesulfonate in drinking water samples were measured by solid phase extraction, HPLC, and MS/MS detection.

Results: In 2006, the PFOA-concentrations in blood plasma of residents living in Arnsberg were 4.4–8.3 times higher compared to the reference population (ratios based on geometric means: children 22.1/4.8 μg/L, mothers 23.4/2.8 μg/L, men 25.3/5.8 μg/L). Two years later, geometric mean concentrations decreased (data for Arnsberg only; geometric means: 13.7 μg/L, mothers 13.8 μg/L, men 20.2 μg/L). These numbers correspond to a decrease of 36% (children), 37% (mothers), and 18% (men), respectively. Based on a first order kinetics/one compartment model PFOA half-lives were estimated from these data (3 years for children and mothers).

Conclusion: This most recent investigation of the German cohort confirms the slow elimination of PFOA in humans. We will also discuss the future application of these biomarkers in ongoing epidemiological studies examining risk of adverse outcomes following PFOA exposure.

S-30B2-2

Serum Dioxin Concentrations and Breast Cancer Risk in the Seveso Women

Marcella Warner,[1] Brenda Eskenazi,[1] Steven Samuels,[2] Larry Needham,[3] Paolo Brambilla,[4] and Paolo Mocarelli[4] *[1]University of California, Berkeley, CA; [2]State University of New York, Albany, NY; [3]Centers for Disease Control and Prevention, Atlanta, GA; and [4]University of Milano-Bicocca, Desio-Milano, Italy.*

Background/Aims: A widespread environmental contaminant 2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD) disrupts multiple endocrine pathways. Impaired mammary gland development has been reported in TCDD-treated mice. Exposure to endocrine-disrupting chemicals, such as TCDD, has been hypothesized to be associated with breast cancer. On 10 July 1976, as a result of a chemical explosion, residents of Seveso, Italy, experienced the highest levels of TCDD in a human population. In 1996, we initiated the Seveso Women Health Study (SWHS), a retrospective cohort study of the reproductive health of the women. We previously reported a significant increased risk for breast cancer incidence with individual serum TCDD level, based on 15 cases, but the cohort averaged only 40 years old in 1996. Herein, we report results from a subsequent follow-up in 2008.

Methods: In 1996, we enrolled 981 women who were 0–40 years in 1976, resided in the most contaminated areas, and had adequate archived sera collected soon after the explosion. A total of 833 women (86%) participated in the 2008 follow-up. TCDD concentrations were measured in the archived serum by high-resolution mass spectrometry. Breast cancer cases were identified during interview and confirmed by medical record. We examined the relation of serum TCDD with breast cancer incidence using Cox proportional hazards model.

Results: By the 2008 follow-up, 32 (3.3%) women had been diagnosed with breast cancer. Most cases were premenopausal. The average age at diagnosis was 47.4 (±8.3) years, and median (range) serum TCDD level was 60.2 (6.7–1960) ppt, lipid-adjusted. The unadjusted hazard ratio for breast cancer associated with a 10-fold increase in serum TCDD levels (logTCDD) was 1.5 (95% confidence interval: 0.9–2.7).

Conclusion: Preliminary analyses suggest individual serum TCDD continues to be positively related with breast cancer incidence in the SWHS cohort, approximately 30 years after exposure. Covariate-adjusted results will be presented.

S-30B2-3

The Impact of Exposure Metric Choice for Cancers Related to Arsenic in Drinking Water in Central Europe

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Background/Aims: Past control of water supplies to reduce arsenic intake is good for public health; however, it complicates the task of accurate reconstruction of past exposures in the service of investigating exposure response relationships between arsenic and cancer. Classifying people based on the current drinking water concentrations would be an unsatisfactory option by ignoring individual differences in patterns of concentrations over time.

Methods: For the ASHRAM study—-a case-control study investigating arsenic in drinking water and cancer, in counties with arsenic exposure in Hungary, Romania, and Slovakia—-the exposure history of each person was constructed taking into account how much water was consumed (as water, in drinks, and in food), sources of drinking water in their various residences over their lifetime and the concentrations of arsenic in the water supply, in many cases measured in the ASHRAM study, or from routine data based on measurements performed by the authorities in each country. Following 4 indices of exposure were calculated: the current concentration of residential drinking water, the time weighted average concentration of residential drinking water, the highest daily dose of As derived from residential drinking water, and the lifetime cumulative dose.

Results: For 1392 participants, the assignment of concentrations to water supplies was very successful with 81% of the population lifetime residential person time being matched to an arsenic concentration. The exposure indices were all log-normally distributed and the median lifetime concentrations were in Hungary 13.3 μg/L, Romania 0.7 μg/L, and Slovakia 0.8 μg/L. Overall, 25% of the population has average concentrations over 10 μg/L and 8% with exposure over 50 μg/L.

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Conclusion: Classifying exposure by current rather than lifetime measures of arsenic exposure leads to an underestimate of the strength of relationship between arsenic and cancer.

S-30B2-5

Cadmium Exposure and Ischemic Heart Disease, Stroke, and Hypertension in the 2005 Korean National Health and Nutrition Examination Survey

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Background/Aims: Limited epidemiologic data are available concerning the cardiovascular effects of cadmium exposure. A recent study suggested an association with myocardial infarction and peripheral arterial disease. We investigated the cross-sectional associations of cadmium exposure with ischemic heart disease (IHD), stroke, and hypertension.

Methods: We used data on blood cadmium in a nationally representative sample of 1908 Korean adults, aged 20 years and older, who participated in the 2005 Korean National Health and Nutrition Examination Survey. We used logistic regression models to estimate the odds ratios related to our targeted outcomes, accounting for the complex sampling design and sampling weights.

Results: The geometric mean of blood cadmium was 1.52 μg/L. After adjusting for potential confounders, an interquartile range increase in blood cadmium level (0.91 μg/L) was associated with an increased risk for IHD (odds ratio [OR]: 2.10, 95% confidence interval [CI]: 1.29–3.43) in both men (OR: 1.88, 95% CI: 0.96–3.69, $P = 0.06$) and women (OR: 2.28, 95% CI: 1.26–4.15). An interquartile range increase in blood cadmium was associated with an elevated risk for hypertension among men (OR: 1.40, 95% CI: 1.09–1.79) but not among women. No association was observed with stroke in both genders.

Conclusion: Cadmium in blood was associated with an increased risk for IHD and hypertension in the general Korean adult population. Further longitudinal studies are needed to better understand and to gain further insights about chronic cadmium exposure and cardiovascular disease.

USE OF TECHNOLOGY IN THE SUPERB STUDY (STUDY OF USE OF PRODUCTS AND EXPOSURE-RELATED BEHAVIORS)

S-30B4-1

Overview of the SUPERB Study

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Background/Aims: The goal of the SUPERB Study is to evaluate new technologies and approaches for data collection to assess environmental exposures in large-scale population-based longitudinal epidemiologic studies, taking into account acceptability and feasibility, as measured by retention, compliance, reliability, and error rates.

Methods: Three data collection modalities address exposure-related behaviors: the traditional annual computer-assisted telephone interview (Tier I); web-technology in a series of 18 monthly self-administered internet-based surveys (Tier II); hand-held device technology to collect passively data through home visits (Tier III). Domains of interest include food, consumer products, and time-activity information, with a special focus on pesticides, metals, phthalates, acrylamide, polycyclic aromatic hydrocarbons, and benzene. The passive measures of exposure in Tier III involve weighing and scanning barcodes of food items, pesticides, and products for cleaning, personal care, and other uses. During this week of monitoring, a video camera in the kitchen records foods prepared, and subjects are asked to wear a GPS and activity monitor, as well as to collect food receipts. Participants are California residents and include young children and their parents, and older adults.

Results: A total of 680 households participated in Tier I, 250 households participated in Tier 2, and 45 households participated in Tier 3. The response rate was higher among older adults for tiers I and III (32%, 75%, and 52% for Tiers I, II, and III) compared to families (26%, 77%, and 34%). Retention in each tier was based on the extent of data completion and was greatest for Tier I older adults (95% had full data completion), Tier I families (87%), and Tier III families (90% vs. 76% among older adults). Tier II had full data completion rates of 60% and 63% for families and older adults, respectively.

Conclusion: Passive monitoring methods and internet survey collection were found to be promising methods for collecting exposure-related behaviors.

S-30B4-2

Use of Bar Code Technology for Assessing Consumer Product Use and Dietary Consumption

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Background/Aims: Determining the use of personal and household care products is of interest, both for use in epidemiology studies as well as in determining exposure for risk assessments. This talk evaluates the feasibility of collecting data by using bar code technology in home visits.

Methods: As part of this study, a novel platform was developed that uses bar codes readily found on consumer products to quickly and reliably determine what products people have in their homes. In addition, we determined the change in mass of the product over a 1-week period to assess the potential magnitude of exposure to these products. This methodology was evaluated in a field study that included 47 California households, 30 with young children and 17 with older adults. We visited households during 4 separate weeks over a period of 16 months in order to also assess temporal variability in product use. Evaluation of the methodology was based on acceptability and feasibility.

Results: Results indicated that 63% of the personal care products and 87% of the household care products had readable barcodes. The distribution of mass used by product category and a comparison between inter- and intra-person variability is also presented. A very low drop-out rate suggests that this methodology can be useful in longitudinal studies of exposure to consumer products.

Conclusion: With some changes to our protocol, this method appears to be very appropriate, acceptable, and useful for gathering information related to potential exposures stemming from the use of consumer products.

S-30B4-4

Longitudinal Variation of Pesticide Use Patterns

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Background/Aims: Pesticide use patterns were examined longitudinally using an internet survey to determine consistency in reporting and to compare results to a one-time phone interview.

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Methods: An initial 182 English-speaking households with young children in northern California participated every 3 months during an 18-month period, with participants completing a varied number of surveys. Questions such as use frequency, pests treated, and area over which pesticide was applied were asked for outdoor sprays, indoor sprays, and indoor foggers, as well as questions on professional applications and pet treatments.

Results: Participants from a total of 74.3% of the households reported pesticide applications at some point during the study period, similar to what we observed in a telephone survey (77%). The percentage of the study population using outdoor spray was higher in the summer/fall than the winter/spring, while for indoor sprays, it was the opposite. The percentage of the population reporting use of outdoor spray significantly declined over time, with season controlled. The average use frequency ranged between 1 and 5 times per 3-month period for different types of pesticide applications. Kruskal-Wallis test detected no significant variation of use frequencies by season or over time among those who used the product. Use frequency from each household at each time point was classified into low, medium, or high; similarly, the average of each household over the longitudinal study was determined. For outdoor sprays and applications on pets, the agreement for each time point with the overall average was over 80%. However, for indoor sprays, agreement was only 65%, suggesting considerable variation over time. The size of the application area varied by application as well.

Conclusion: Results of this study suggest a fair amount of variability in the responses from individual households over an 18-month period, suggesting that longitudinal surveys are required to catch the variability of pesticide usage patterns.

OUTDOOR/INDOOR/ HOME ENVIRONMENT AND CHILDREN'S HEALTH

O-30B5-2

Indoor Air Pollution due to Biomass Fuel Combustion and Acute Respiratory Infection in Children Under 5 in Trichy District of Rural Tamilnadu, India

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Background/Aims: Acute respiratory illness is 1 of the top 5 causes of death in children under 5. In India, up to 444,000 premature deaths in these children are attributable to solid fuel use. We studied the association of indoor air pollution due to biomass fuel combustion with acute respiratory illness in children under 5.

Methods: We enrolled a longitudinal cohort using 25 villages in Tamil Nadu. Data were collected from 1173 children <5 for 1 year. Symptoms of respiratory illness were collected from the primary caregiver. Poisson regression analysis was used to estimate the Incidence Risk Ratio of ARI among children from households using biomass fuels relative to children from households using cleaner fuels. Potential confounding factors were controlled in the analysis.

Results: ARI incidence was higher in male children, children under 2 and children living in households with poor hygiene. The risk of ARI among children in biomass-using households was 1.33 times (95% CI: 1.02–1.73) that of LPG users.

Conclusion: Our findings are similar to results from Guatemala and a prior cross-sectional study from India. Indoor air pollution from household biomass fuels is associated with a significant increase in risk for exposed young children compared to children living in households using cleaner fuels. Identification and control of risk factors is needed to reduce the incidence of ARI and thereby reduce the morbidity and mortality in children below 5. Our data suggest that an important step to prevent illnesses that result from biomass fuel use is likely to be education of the public about these risks and implementation of interventions such as improved stoves.

O-30B5-3

Effect of Perinatal Exposure to Air Pollution on Development of Asthma and Allergic Diseases in Incheon, Korea; A Life-course Approach

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Background/Aims: The purpose of this study was to examine the effect of perinatal exposure to air pollution on development of asthma and allergic diseases in Incheon, Korea by constructing exposure model using GIS.

Methods: This study involved 1229 children and was conducted from 1 November 2008 to 20 December 2008 by the Environmental Health Center, Inha University Hospital. The evaluation of childhood asthma was based on the Korean version of International Study of Asthma and Allergies in Children (ISAAC) questionnaire. Individual exposure to the environmental air pollution concentration was analyzed using geostatistical and interpolation analyses via ArcGIS (ArcMap 9.3, ESRI Inc., California). Statistical analysis was performed using Stata (Version 10.0, StataCorp, Texas). Correlation analysis, χ^2 analysis, logistic regression, multiple logistic regression, and multilevel analysis were used as appropriate to analyze the exposure to air pollution at the birth place and residence.

Results: In univariate analyses, wheezing was significantly associated with the experience of bronchiolitis before 2 years of age. Odds ratio of bronchiolitis for wheezing was 3.45 (95% CI: 2.22–5.36). Odds ratio of parental allergy for wheezing was 1.38 (95% CI: 0.86–2.23). Odds ratio of sex for wheezing was 1.01 (95% CI: 0.99–1.02). Odds ratio of age for wheezing was 0.75 (95% CI: 0.53–1.06). Bronchiolitis was significantly associated with PM_{10} pollution around home at birth. In multivariate analyses, odds ratio of PM_{10} pollution for bronchiolitis was 1.14 (95% CI: 1.01–1.29). Odds ratio of parental allergy for bronchiolitis was 2.09 (95% CI: 1.40–3.13) after controlling for ETS, sex, and age.

Conclusion: Bronchiolitis before 2 years of age was an important risk factor for asthma in children. A bronchiolitis before 2 years of age was significantly associated with PM_{10} pollution around home at birth. Thus, preventive intervention, such as reducing exposure to PM_{10} pollution for children less than 2 years of age, is needed to prevent asthma in children.

O-30B5-4

Place of Birth Interacts With SES, Pest Exposure, and Allergy on Asthma Diagnosis

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Background/Aims: We previously reported that foreign-born children are less likely to have asthma than US-born children.

Methods: We surveyed 233 children at 2 clinics serving Chinese immigrant families. We used tabular analysis (odds ratios and χ^2) and

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logistic regression to assess associations (and possible interaction) between asthma and demographic, clinical, and environmental factors.

Results: Place of birth was weakly associated with asthma (OR = 1.57; $P = 0.23$ comparing foreign-born to US-born). SES was not significantly associated with asthma in the crude data (OR = 2.10; $P = 0.14$; lower vs. higher SES). However, when stratified by place of birth, we found strong evidence that place of birth interacts with SES and asthma. For children born in China, the odds ratio for exposure to household pests was 1.17 ($P = 0.80$). For US-born children, the odds ratio was 2.31 ($P < 0.01$). The Breslow-Day test for interaction was significant ($P < 0.05$). Reported allergy was a significant predictor of asthma for US-born children (OR = 3.40; $P < 0.001$) but was in the opposite direction for children born in China (OR = 0.30; $P = 0.42$). The Breslow-Day test for interaction was significant. Logistic regressions were constructed for US-born and for children born in China. The best US-born model included SES, allergy, and family history of asthma. The best China-born model included only family history and the predicted odds ratio was 16.4 ($P = 0.001$). A sanitation score (based on report of living conditions) did not have a strong correlation with asthma in either descriptive statistics or quantitative assessment.

Conclusion: This data did not show as strong associations between native and foreign born and asthma as did our previous studies. Despite that, we replicated our previous observation that SES and pests were effect modifiers of this association and added allergy as a new effect modifier. Sanitary conditions did not explain these findings.

O-30B5-5

Infant Mortality and Proximity to Industrial Facilities Modification Effect by Neighborhood Socioeconomic Characteristics

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Background/Aims: Evidence of social health inequalities is well established; socioeconomically disadvantaged populations are more strongly affected by health problems. In spite of numerous risk factors already identified, a part of these inequalities remain unexplained. Environmental nuisances are suspected to play a role in this disparity.

Objective: To investigate association between infant mortality and presence of polluting industries and to assess whether the strength of the association is modified by socioeconomic characteristics.

Methods: An ecological study was conducted in Lille (226,000 inhabitants) located in North France. Information on industries' location was drawn from the French database of the European-Pollutants-Emission-Register. We used census data to characterize neighborhood socioeconomic status. Mortality information was obtained at a municipality level. We investigated by logistic regression the association between infant mortality and the presence of polluting industries in the town of residence of the mother, stratified by socioeconomic characteristics.

Results: There were 705 infant mortality cases in Lille between 2000 and 2009 (death rates of 4.2 per 1000 live births). A greater death risk was found in municipalities hosting 1 or more polluting industries (OR = 3.1; $P = 0.043$). The strength of the association was modified by socioeconomic neighborhood characteristics. While there was no association in the subgroup of municipalities with low unemployment or proportion of single-parent families, the risk was increased among municipalities with high unemployment or proportion of single-parent families (OR = 6.6; $P = 0.07$–OR = 8.4; $P = 0.06$).

Conclusion: This observation may result from a greater exposure to industrial pollution due to a greater number of emitting plants in deprived municipalities. It could also stem from a vulnerability phenomenon whereby residents might be more sensitive to the exposure effect because of a poorer health status and lower access to appropriate care. More refined analyses are underway to identify the most plausible explanations and to communicate a public health message to local authorities.

VARIOUS METHODOLOGIES IN ENVIRONMENTAL HEALTH RESEARCH

O-30B7-1

Indoor Activity Patterns in Korea: Implication in Exposure Assessment

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Background/Aims: The information about time spent in microenvironments plays a critical role for personal exposure to environmental pollutants. While there are several large scale activity pattern studies in Western countries, comprehensive time activity pattern research for exposure assessment has not been readily available in Korea.

Methods: We analyzed residential indoor and transportation times of Korean population over the age of 10 years. The population-based study collected time activity pattern of 31,634 Koreans for 2 consecutive days. The residential indoor and transportation times were collected by weekday and weekend. Impact of sociodemographic factors on time activity has been assessed using multiple linear regression models.

Results: The residential indoor times were 14.23 hours in weekday and 16.13 hours in weekend and shorter than those in Western countries. The time spent in residential indoor at 6 PM and 10 PM were about 37% and 75%, respectively. These residential indoor time were different from the results of about 67% (6 PM) and 90% (10 PM) in United States. The finding suggests that Koreans may stay in other indoors after 6 PM. Such indoor environments may include workplace, school classroom, restaurant, and bar. More information about the other indoors is critical for exposure and risk assessment in Korea. The most significant factors on residential indoor time were employment status, age, monthly income, and gender in weekday and employment status and gender in weekend. The factors on transportation were gender, employment status, and monthly income in weekday and gender, employment status, age, and marriage status in weekend.

Conclusion: Determinants of time activity pattern need to be taken into account in exposure assessment, epidemiological analyses, exposure simulations, as well as in the development of preventive strategies. Since there are substantial difference of Korean population activity pattern, this information can be critical for exposure assessment in Korea.

O-30B7-2

Exposure Estimation Technology for Large Environmental Chemical Releases: Feasibility of an Atmospheric Plume Dispersion Model Without Microenvironmental Weather Data

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Background/Aims: The collection of air monitoring data during the emergency response phase of a toxic chemical release is nearly impossible. Plume dispersion modeling is a technological solution which can provide data for use in health studies. We examined the feasibility of using a sophisticated plume dispersion model to estimate personal exposure for quasi-experimental human dose-response study following a large chlorine gas release within a community. The purpose of this study was to test if the absence of micro-environmental weather data significantly reduced model performance.

Methods: A HPAC plume dispersion model was generated for the 60 ton Chlorine spill in Graniteville, South Carolina without any

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microenvironmental weather data. Estimates of mean chlorine concentration (kg-sec/m^3) at each location at 1.5 meters above ground level for each minute during the time period were output from the HPAC model. Archived meteorological surface observations recorded at 12 Remote Automated Weather Stations (RAWS) were collected for the 24-hour period beginning 0:00 hours on the day of the spill. RAWS data were, also, collected from the same 12 stations for 5 nights from 7 January through 12 January (10 January was excluded due to missing data) to compare with readings from the portable microenvironmental meteorological station set up at the incident site late in the morning of the release. Concentration and surface dosage were calculated at 1024 points across a 3 × 3 mile grid with identical source terms using RAWS and microenvironmental weather data separately.

Results: Data from the HPAC plume dispersion model without microenvironmental weather data were highly significantly correlated with the model that included microenvironmental data ($r^2 = 0.98$).

Conclusion: In the United States, the HPAC plume dispersion model can provide valid Chlorine gas exposure estimates of human exposures following a large release in a community even without localized microenvironmental weather data.

O-30B7-3

Estimating Canadians' Exposure to $PM_{2.5}$ and NO_2 Using National Land Use Regression Models: Implications of Scale and Population Location Measures

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Background/Aims: As part of CAREX Canada, national land use regression (LUR) models have been developed previously to estimate exposure to $PM_{2.5}$ and NO_2 in outdoor air. In this paper, we examine the sensitivity of population exposure calculations to the resolution of the pollution estimates derived from LUR models and to the accuracy of population location.

Methods: To examine the influence of scale and population location measures on exposure estimates, LUR models were first used to approximate annual average $PM_{2.5}$ and NO_2 concentrations at centroids of 1412 census tracts (CT), 10,357 dissemination areas (DA), and 41,139 street blocks in Vancouver and Toronto metropolitan areas combined. Also, pollution concentration surfaces were derived at 4 different resolutions (100, 500, 1000, and 2000 m). Exposure estimates were then calculated at each level of population location with the 4 surface resolutions.

Results: Exposure calculations are sensitive both to the geographical units of census aggregation and to the resolution of the pollution estimate. For example: In Vancouver the number of people in the top $PM_{2.5}$ concentration quartile increased from 517,000 to 546,459 to 535,000 when applying the model to block point, DA, and CT centroids. Similarly, in Toronto the numbers decreased from 1,329,000 to 1,271,000 to 1,198,000 when modeling NO_2 exposure at the block point, DA, and CT centroids. Furthermore, in Vancouver the estimates for top NO_2 concentration quartiles varied from 488,000 to 553,000 to 586,000 when calculated using 100, 500, and 2000 m resolution surfaces.

Conclusion: Population exposure calculations are subject to the accuracy of the population location and to the resolution of the pollutant model. Here we demonstrated the importance of the scale of census data and the magnitude of the differences in exposure calculations resulting from a change in the resolution of the concentration surfaces. These changes were not uniform between cities, which has important implications for exposure misclassification.

O-30B7-4

Disease Mapping: Creating a National Atlas for Environment and Health

Linda Beale, Lars Jarup, Fecht Daniela, Abellan Carlos, Fortunato Lea, and Elliott Paul *SAHSU, MRC Centre for Environment and Health, Imperial College London, London, United Kingdom.*

Background/Aims: The development of methods for mapping disease incidence has progressed considerably in recent years largely in response to greater availability of geographical and statistical tools, but also due to greater availability of data. There has been an increasing number of disease atlases published, however, so far, no attempt has been made to map selected diseases, for which environmental factors may play a role, together with maps of such risk factors.

Methods: We have analyzed and mapped health data for 17 health outcomes including 14 major cancers, using 25 years of data held at postcode level (~15 households). Four disease maps, at census ward level (~6000 people) for each health outcome are included, by gender, showing crude incidence/mortality rates (SIR/SMRs), adjusted SIR/SMRs, smoothed SIR/SMRs, and posterior probability maps (to assess uncertainty). Each health outcome is preceded by a general background to the health outcome (both globally and for England and Wales) together with some interpretation of the spatial patterns.

Results: The Small Area Health Statistics Unit has compiled and produced an environmental health atlas for England and Wales, as a basis for informing policy-makers and the public on geographic patterns of disease and potential environmental exposure to pollutants. The atlas comprises 2 sections: the first describing patterns of exposure to environmental hazards and the second describing selected health outcomes.

Conclusion: We will describe the many different epidemiological, spatial, statistical, and cartographic methods used in developing the atlas. Many of the environmental datasets required interpolation—eg, kriging. We include smoothed maps to account for over dispersion caused by sparseness and ran at least 2 chains of simulations with the Bayesian modeling. Map design was carefully considered and a number of methods were used to ensure effective mapping. A number of interesting examples of the maps that have been produced will be shown.

O-30B7-5

Investigating Temporal Variation of Ambient Pollutants at Hsin-Chuang Supersite in Taipei (Taiwan) by Dynamic Factor Analysis

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Background/Aims: Numerous studies have shown that airborne particulate matter (PM) particles are dangerous to human health. Since 1994, Environmental Protection Agency in Taiwan (TWEPA) established air quality monitoring stations throughout entire Taiwan constantly recording the 6 criteria air pollutants. For the purpose of air quality control, it is necessary to understand the underlying mechanism of the genesis of the air pollutants and the composition of the PM. In addition, studies investigating the PM compositions are rapidly emerging recently to reveal direct evidence of the impact to human health rather than only using PM measures. Due to economic and operational reasons, the PM-speciation was only observed at Hsin-Chuang supersite station in Taipei area since 2003.

Methods: We applied dynamic factor analysis to investigate the nonstationary time series of the observations of aerosols in this study which is based upon the state space model which can account for the uncertainty from both the dynamic factor model and observations.

Results: This study investigates the temporal patterns of the observations of ambient pollutants at Hsin-Chuang supersite to obtain the most significant common trends during 2003–2008, which are the trends of a

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group of ambient pollutants. The common trends are uncorrelated to each other and may represent an important contributing mechanism to the local spatiotemporal distribution of air quality.

Conclusion: We demonstrate the capability of dynamic factor analysis to reveal the most significant contributing factors of the ambient pollutants measured at Hsin-Chuang supersite.

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OCCUPATIONAL AND ENVIRONMENTAL CANCER

O-30B8-1

Mesothelioma Mortality and Asbestos Exposure Mapping in Italy

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Background/Aims: The epidemic of asbestos-related disease affects both industrialized countries, where asbestos use is nowadays banned or severely restricted, and emerging countries where asbestos use is allowed by the law. In this frame, there exists general consensus regarding the need to map asbestos exposure and to implement epidemiological surveillance of asbestos-related diseases, so as to estimate its health impact. Pleural mesothelioma is the most specific marker of occupational and environmental asbestos exposure. The identification of clusters of mesothelioma cases has in some instances brought previously unrecognized exposures to light. Objective of this study was to calculate the mortality from malignant pleural neoplasm (ICD code 163.0–163.9, IX revision), which is a valid proxy of mesothelioma incidence at population level.

Methods: The analysis was conducted for all 8100 Italian municipalities (years 1995–2002). The number of observed deaths resident in each municipality was contrasted to the expected number based on national and regional rates.

Results: Significantly increased mortality was found for 202 municipalities, some of which are the sites of large asbestos-cement factories (eg, Casale Monferrato, SMR: 2734; 95% CI: 2351–3161) and naval shipyards (eg, Monfalcone, SMR: 757; 95% CI: 541–1031). Consistently high mortality rates were shown in sites with petrochemical plants (eg, Gela, SMR: 248; 95% CI: 132–424) or textile factories (eg, Prato, SMR: 168; 95% CI: 118–232) and in some metropolitan areas (eg, Turin, SMR: 153; 95% CI: 134–174). The Biancavilla city located on Etna Volcano and characterized by the occurrence of fluoro-edenite fibres also showed an increased risk (SMR: 495; 95% CI: 237–911).

Conclusion: The present results evidence the strong health impact of asbestos exposures on municipality population in areas with certain types of factories, where asbestos manufactured products were present, in metropolitan areas and in an area with natural amphibolic fibres. Analytical studies are required to estimate the role of occupational and environmental exposures in the observed increases.

O-30B8-2

Differences in the Environmental Exposure Pattern Between Peritoneal and Pleural Mesothelioma: Data From the Mesothelioma Lombardy Region Register (Italy)

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Background/Aims: The attributable risk to asbestos exposure (occupational and/or environmental) is somehow different in pleural (PLM) and peritoneal malignant mesothelioma (PEM), with some recent studies suggesting a more limited role of occupational asbestos exposure in the etiology of PEM. A population-based registry of mesothelioma cases has been established in the Lombardy, Italy, since 2000. We compared exposure history and the main characteristics of PEM and PLM cases diagnosed in the period 2000–2007.

Methods: We selected all incident cases in subject residing in Lombardy (period 2000–2007 for PEM, n = 110 and period 2000–2001, n = 515 for PLM). All cases were investigated by an Expert Panel which evaluated clinical records, occupational and residential history, and lifestyle. Differences between PLM and PEM cases were investigated using Fisher exact test.

Results: The proportions of cases with occupational or environmental/familial exposures were similar between PEM and PLM cases (50% occupational and 6% environmental), instead the prevalence of subjects with both occupational and environmental/familial exposure was more than doubled among PEM cases (6.4% vs. 2.7%, $P = 0.059$). PEM cases showed a higher proportion of females (48% vs. 36%) and a higher proportion of subjects with asbestosis and with pleural plaques at the CT scan. No significant differences between PEM and PLM cases were observed regarding age at diagnosis, smoking habits, and level of diagnostic certainty.

Conclusion: Our data suggest that asbestos exposure is the main risk factor not only for PLM but also for PEM, and pointed out the importance of mixed occupational and environmental exposure in etiological pathway leading to such a rare but fatal disease, encouraging any efforts to identify unknown sources of exposure in order to ensure public health.

O-30B8-3

Ingestion of Nitrate and Nitrite and Risk of Stomach Cancer in the NIH-AARP Diet and Health Study

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Background/Aims: Nitrate and nitrite are precursors in the endogenous formation of N-nitroso compounds (NOC), potent animal carcinogens. Ingestion of nitrate in the absence of nitrosation inhibitors (eg, vitamin C) increases endogenous nitrosation in humans. Few cohort studies have evaluated the joint effects of nitrate, nitrite, and nitrosation inhibitors.

Methods: We evaluated intake of nitrate and nitrite in relation to stomach cancer incidence in the NIH-AARP Diet and Health Study, a cohort of 490,194 men and women 50–71 years of age. A total of 658 cases of stomach cancer were identified after 8 years of follow-up. We estimated dietary intake using a 124-item food frequency questionnaire and a database of nitrate and nitrite measurements from the published literature and from recent measurements of nitrite in meats. Potential exposure to nitrate from drinking water sources was determined by linking the census tract of the enrollment address to a United States Geological Survey regional model of nitrate levels in groundwater. Nitrate from drinking water sources was estimated to be low for the cohort; therefore, nitrate exposure estimates are based solely on dietary ingestion. We used Cox proportional hazards models to calculate multivariable adjusted hazard ratios (HR) and 95% confidence intervals (CI).

Results: Overall, nitrate and nitrite ingestion were not associated with stomach cancer risk. Among those with low (<median) intake of vitamin C, we observed increasing stomach cancer risk with increasing ingestion of nitrate (highest vs. lowest quintile HR = 1.40; 95% CI: 0.97–2.01; *P*-trend = 0.056) and nitrite (HR = 1.52; 95% CI: 1.05–2.19; *P*-trend = 0.016). Processed meat sources of nitrite and nitrate were not associated with risk among those with either high or low vitamin C intake.

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Conclusion: Our results suggest that higher nitrate and nitrite ingestion in combination with lower vitamin C intake, a dietary pattern known to increase endogenous formation of NOC, increases the risk of stomach cancer.

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O-30B8-4

Occupational Risks of Esophageal Cancer in Taiwanese Men

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Background/Aims: To explore the relationship between occupation and the risk of esophageal squamous cell carcinoma (ESCC) in Taiwan.

Methods: In a hospital-based case-control study, we collected 326 incident patients with ESCC and 386 matched controls. All subjects completed a questionnaire regarding occupation, substance use and demographic information. Thirty-three different common occupations whose environments are known to present potential exposure to hazards related to cancer development in Taiwan were asked. Relative risks for ESCC were estimated by odds ratios (OR).

Results: Concrete and construction workers and farm and garden workers were found to be at significant risk for ESCC (OR 5.14, 95% CI 2.34–11.33; $P < 0.0001$, respectively). After adjusting for other covariates, it remained significant for farm and garden workers (AOR = 2.18; 95% CI: 1.07– 4.44).

Conclusion: Work in farm and garden, potentially exposed to pesticides, may increase the risk of ESCC in Taiwan.

O-30B8-5

Melatonin and Sex Hormones Among Rotating Shift Nurses

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Background/Aims: The causes of breast cancer are not fully understood. Global discrepancies in breast cancer incidence suggest environmental and societal influences on this disease—long-term shift work was recently classified as a "probable carcinogen" by the International Agency for Research on Cancer. A proposed pathway is from nighttime light exposure, which leads to decreases in melatonin, a cancer-protective hormone. Irregular melatonin levels may influence patterns of sex hormone production that in turn influence breast cancer risk. This study examined relationships between melatonin and sex hormones among shift-working women, with the goals of better understanding this occupational exposure, and ultimately, to minimize health effects.

Methods: A longitudinal study was conducted among 82 premenopausal shift-working nurses. Epidemiological data and biological specimens were collected over 2 time periods (summer/winter). Melatonin metabolite levels were measured in urine, and estradiol, estrone, progesterone, and prolactin concentrations from fasting blood. Information regarding personal, reproductive, and lifestyle factors was collected from questionnaires and physical examinations. We assessed melatonin-sex hormone relationships both cross-sectionally (within each of 2 seasons), and longitudinally (across seasons), to investigate possible latency effects. Multivariate linear regression was used to explore these relationships, with adjustment for confounders including age and body mass index (BMI).

Results: Our sample of premenopausal nurses has a mean age of 35.8($\pm$8.2) and BMI of 27.1 kg/m^2($\pm$6.7), are mostly nonsmokers (85.7%) and nonusers of oral contraceptives (77.1%). Melatonin levels were suggested to be inversely associated with estradiol levels in winter only (regression coefficient, $\beta = -0.16$; $P = 0.07$). No association was observed between melatonin and estrone, progesterone or prolactin. In longitudinal analyses, melatonin in the first season was not associated with sex hormones in the second season.

Conclusion: Our findings suggest, but do not confirm, that melatonin exerts a regulatory influence on estradiol production; thus, shift-work could contribute to increased breast cancer risk via increased estradiol.

PP-30-155

Soluble Mesothelin-related Protein Levels in Subjects With Malignant Mesothelioma

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Background/Aims: Malignant mesothelioma is a highly aggressive tumor associated mostly with asbestos exposure. Soluble mesothelin-related protein (SMRP) is a potential tumor marker for mesothelioma. The aim of this study was to determine the differences in serum SMRP levels at various phases of the disease before and during treatment.

Methods: The study included all 78 subjects with mesothelioma treated at the Institute of Oncology, Ljubljana, between 2007 and 2009. According to the cumulative asbestos exposure, they were divided into 4 groups (nonexposed, low, medium, and high). Serum samples were collected in all subjects before the treatment and/or in different responses to treatment (complete response, partial response, stagnation, progressive disease). Serum SMRP levels were determined by enzyme-linked immunosorbent assay with 2 monoclonal antibodies.

Results: Asbestos exposure was confirmed in 67 (85.9%) subjects. Only occupational exposure was observed in 32 subjects, only environmental in 12 subjects, and both occupational and environmental exposures in 23 subjects. The cumulative asbestos exposure was classified as low in 24, medium in 21, and high in 22 subjects. Mean serum SMRP was 5.75 nM before the treatment, 0.00 nM in complete response, 1.33 nM in partial response, 2.97 nM in stagnation, and 9.67 nM in progressive disease. The SMRP levels were significantly higher before the treatment compared to the stagnation, partial and complete responses to treatment ($t = 2.49$; $P = 0.016$), as well as in the progressive disease if compared to the stagnation, partial and complete responses to treatment (t 5.48; P 0.000).

Conclusion: Asbestos exposure was confirmed in almost 86% of subjects with mesothelioma and among them, the exposure was low in 36% of subjects. As the findings of the study suggest that SMRP might be a useful tumor marker for detecting the progression of mesothelioma and tumor response to treatment, a thorough follow-up of a prospective cohort is needed.

PP-30-156

Role of Genetic Polymorphisms on the Relation Between Carcinogen DNA Adduct in Lung and Blood Mononuclear Cells

Mi-Sun Lee, Li Su, and David Christiani *Department of Environmental Health, Harvard School of Public Health, Boston, MA.*

Background/Aims: Deoxyribonucleic acid (DNA) adducts in blood, used as a surrogate for the target lung tissue, have been used to analyze the association of exposure to environmental carcinogen with lung cancer risk. However, little information is available to assess the effects of genetic polymorphisms in metabolizing genes, GSTs, NAT2, and mEH on the relationship of surrogate marker of carcinogen DNA adducts in blood to target lung tissue.

Methods: DNA adducts were measured in lung and blood mononuclear cells (MNCs) from lung cancer patients using the 32P-postlabeling assay. All of the genotyping was performed using PCR-RFLP techniques. Linear

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regressions were applied to assess the ability of DNA adducts in blood MNCs to predict lung adduct and their modification by polymorphisms in metabolic genes.

Results: The regression coefficient (β) of log DNA adducts in blood MNCs for log DNA adducts in lung was 0.87 ($P < 0.001$). The correlation between DNA adducts in lung and blood was not considerably changed by the GSTs polymorphisms. However, significant differences in regression coefficients were found by NAT2 activity, 1.51 for rapid versus 0.76 for slow ($P = 0.02$). Marginal differences were found by mEH activity, 0.98 for high versus 0.52 for low ($P = 0.07$).

Conclusion: These results suggest that the correlations between DNA adducts in blood MNCs and target lung tissue were modified by NAT2 and mEH activities. These data suggest that genetic factors need to be considered when assessing the association of DNA adducts using surrogate tissue with lung cancer.

PP-30-157

MTHFR Polymorphisms and Carcinogen DNA Damage in the Lung

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Background/Aims: Methylenetetrahydrofolate reductase, MTHFR, is involved in the process of deoxyribonucleic acid (DNA) methylation and DNA synthesis, both implicated in carcinogenesis. Polymorphisms in MTHFR gene, C677T and A1298C, are associated with an elevated and/or decreased cancer risk, yet little is known about DNA damage in target lung tissue in human populations.

Methods: DNA adducts in lung tissue and 5 polymorphic metabolic genotypes (GSTM1, GSTP1, GSTT1, NAT2, and MTHFR) were determined by using 32P-postlabeling assay and PCR techniques from 102 lung cancer patients undergoing resection for stage I-II lung cancer at Massachusetts General Hospital in Boston, MA. The independent effects of MTHFR polymorphisms on DNA lung adduct were assessed using multiple regression analysis, adjusting for covariates and other genotypes.

Results: DNA lung adduct levels significantly increased by 64.4% (95% confidence interval [CI]: 3.0%–162.4%) for the 1298AC+CC genotype versus 1298AA and by 122.4% (95% CI: 1.7%–386.5%) for the combined heterozygous and homozygous variant genotypes versus 1298AA and 677CC, respectively. No association was seen with polymorphism of MTHFR C677T. After adjusting for potential confounders, as well as for other metabolic gene variants, the MTHFR 1298AC+CC had significantly enhanced levels of lung adducts by 109.9% (95% CI: 19.8%–267.8%).

Conclusion: We found an association between increased DNA adduct levels with the MTHFR A1298C gene polymorphism, suggesting a potential effect of DNA methylation via MTHFR on DNA damage in the target lung tissue.

PP-30-159

Comparison of Statistical Methods and Summary Estimates for a Meta-analysis of Occupational Chloroprene Exposure and Liver Cancer

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Background/Aims: Meta-analysis can provide useful summaries of cohort studies for specific occupational situations. We compare statistical methods for estimating the summary standardized mortality ratio (SSMR) for a meta-analysis of occupational chloroprene exposure and liver cancer. We evaluate method-specific SSMR and assess proportional differences in quantitative study weights applied by standard approaches.

Methods: Results were abstracted from mortality studies of 6 occupational cohorts. Positive associations were reported for 3 cohorts whereas negative associations were reported for 3 cohorts. The SSMR was calculated by pooled analysis and by random effects model. Furthermore, stratified SSMR was calculated using inverse variance weighting for the subgroups of positive and negative studies. The relative change in proportional weights for each study-specific SMR was evaluated.

Results: The pooled SSMR was 1.3 (95% CI: 0.9–1.8) for results from the 6 cohorts. The random effects SSMR was 1.9 (95% CI: 0.7–5.2) because of significant evidence of heterogeneity ($P < 0.001$). The SSMR for studies stratified by positive and negative results were 2.5 (95% CI: 1.5–4.4) and 0.9 (95% CI: 0.6–1.3), respectively. Standard statistical approaches to meta-analysis increased the relative proportional weights of positive studies from 6% to 13% after multiplying by increased SMR estimates. For the largest cohort study (SMR = 0.9, 95% CI = 0.6).

Conclusion: Consistent with the conclusion of a recent qualitative review, occupational chloroprene exposure is not significantly associated with liver cancer mortality based on quantitative meta-analysis. Standard statistical methods disproportionately weighted studies that reported positive associations after multiplication by increased study-specific estimates. Relative proportional weights only on the basis of variance contributions could be used to control for this bias.

PP-30-160

Current Trend and Regional Distribution of Lung Cancer Among Koreans: Findings From the Korea National Health Insurance Claims Data 2001–2008

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Background/Aims: Many studies have found a strong exposure-response relationship between particulate matter and cumulative health effects, such as lung cancer. Numerous epidemiologic studies highlighted the role of ambient airborne particulate matter as an important environmental pollutant for lung cancer. The incidence of lung cancer was 27.9 persons per 100,000, ranking the fourth place in 2007. In particular, the overall incidence was second place in men (48.1 persons per 100,000), and it was the highest among persons aged ≥65 years. Moreover the 5-year survival rate was 16.7% in 2003–2007, which was only amounting to 30% of average survival rate (57.1%). Therefore, this study aims to identify the magnitude, trend, and regional distribution of lung cancer for establishing the effective management in Korea.

Methods: Study data were driven from Korean National Health Insurance that covers 96.3% of Korean people. Lung cancer was defined as an inpatient or outpatient for ICD code of C34 and so far more than 300,000 won have been spent on it.

Results: The prevalence of lung cancer was 77 persons in 2006, 87 in 2007, and 85 in 2008 per 100,000 persons. Although the prevalence of men was about 2.5 times higher than that of women, the increasing rate was higher in women (14.3%) than that of men (10.1%) during 2006–2008. In addition, the prevalence of those aged 65 years and older was 16–17 times higher than that of below the age 65 years. The prevalence of Jeonnam was the highest, and Chungnam, Jeonbuk, and Gyongbuk were commonly top 4 areas. Despite the prevalence of Ulsan, Daejeon, and Seoul are relatively low, the increasing rate was fairly high during 2006–2008.

Conclusion: Although Korean government has established the comprehensive planning for the control of air pollution, the higher prevalence together with the continuing increasing trend requires the more intensive management of lung cancer.

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PP-30-161

Mortality Among Ship-breaking Workers—-A Retrospective Cohort Study

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Abstract:

Background/Aims: Taiwan was ever a ship-breaking kingdom. From the late 1960s to the late 1980s, the port city of Kaohsiung witnessed one of the most thriving ship demolition industries in the world. The OSHA agency stated that ship breaking also posed the following dangers: (1) Exposure of hazardous substances as the demolition sometimes released toxic or explosive substances such as asbestos, PCBs, heavy metals, and waste fuel; (2) hazard work activities; and (3) hazard work condition. Among these, there is a need for long-term follow-up study to examine the health risks of exposure of hazardous substances. Hence, the aim of this study was to study the cause of death and standardized mortality ratios in ship-breaking cohort.

Methods: The national mortality data during the years from 1985 to 2008 were obtained from the Office of Statistics of the Department of Health in Taiwan. The death record is defined according to the International Classification of Disease, Injury, and Causes of Death (9th revision). Standardized mortality rates (SMR) for various diseases were calculated on the basis of Taiwan standard population mortality.

Results: The results showed that cause of death of ship-breaking cohort among all cause (SMR = 1.50, 95% CI = 1.41–1.60), cancer (SMR = 1.43, 95% CI = 1.27–1.61), liver cirrhosis (SMR = 10.77, 95% CI = 8.35–13.68), all accidents (SMR = 2.45, 95% CI = 2.09–2.85), and special region cancers as oral and nasopharyngeal (SMR = 2.90, 95% CI = 2.20–3.76), esophagus (SMR = 2.47, 95% CI = 1.44–3.95), liver (SMR = 5.31, 95% CI = 4.12–6.73), and lung (SMR = 1.60, 95% CI = 1.20–2.09) were significantly higher mortality than general Taiwan population.

Conclusion: The studies are providing the reference of health care policy for alive ship-breaking worker in Taiwan and still precede ship-breaking industry in development countries.

PP-30-162

Light, Sleep Duration, and Melatonin Among Rotating Shift Nurses

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Background/Aims: The International Agency for Research on Cancer has classified shift work involving circadian disruption as a probable carcinogen. While the exact biologic mechanism for this relationship is unclear, the main hypothesis involves melatonin, a hormone produced in a pattern following circadian rhythms. The purpose of this research is to examine the influence of light at night exposure on peak melatonin levels among rotating shift nurses.

Methods: One hundred twenty-four nurses at Kingston General Hospital working a rotating shift schedule (2 days, 2 nights, 5 days off) were recruited. Each participation session took place over a 48-hour period, during which nurses were asked to wear a light data logger and provide 2 urine and 4 saliva samples. Melatonin levels were assessed over a 24-hour period that covered either the first day or the second night shift of the rotation pattern, with the morning urine sample in both shift groups used to assess peak urinary melatonin levels. Mean light intensity from 12 AM to 5 AM was assessed from light data loggers during the 24 hours of melatonin assessment.

Results: A total of 118 nurses completed the first 2 data collection periods. Mean light intensity from 12 AM to 5 AM was significantly higher ($P < 0.0001$) when nurses were working a night shift, and mean sleep duration was significantly shorter after the night shift ($P = 0.005$). Pilot work in this population suggested an inverse association between light intensity and melatonin levels. Multivariate analyses will be presented that allow us to characterize the relationship between light exposure and melatonin levels in this population of nurses working rotating shifts.

Conclusion: Our research directly assesses the relationship between light exposure and melatonin, and will contribute evidence regarding the plausibility of melatonin as the biologic pathway linking shift work with cancer.

PP-30-163

The Study of Hearing Loss in Metal Furniture Manufacturing Workers

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Background/Aims: It followed conscious that lift up occupational safety and health and noise problems received respect gradually in working places. The objective is to understand the environment noise of metal furniture manufacturing factory and other related hazards factors on the impact of hearing in workers.

Methods: A metal furniture manufacturing factory workers were 60 as exposed subjects and administrators were 45 as nonexposed subjects. The noise in workplaces and office were estimated by environmental noise spectrum analysis and noise-dosimeters. The pure tone audiometry estimated binaural hearing threshold of workers. Questionnaires assisted results in instruments and conferred reasons that workers had hearing loss.

Results: The highest spectrum analysis value was 84.16 ± 1.15 dB(A) in 500 Hz by exposed group. It affected threshold that the highest hearing loss value was 45.08 ± 14.10 dB(A) in the low-frequency 500 Hz by workers. As to the relative risks (odds ratio: OR) of hearing loss in high-frequency trisection, exposed group as non-exposed group was 12.12 (95% CI: 3.41–43.00) and older than 37 years old was 18.10 (95% CI: 2.80–116.93) and smoking habit was 6.07 (95% CI: 1.18–31.16). Questionnaires showed that age, smoking habit, pre-hypertension, and using hearing protections were significantly associated with the hearing loss

Conclusion: To suggest workers should use hearing protection at work and take audiometry regularly. To ensure health and reduce hearing loss risk for workers.

Policy, Risk Perception, Risk Assessment, Management and Communication (eg, Education, Policy Evaluation)

O-01A2-1

Human Risk Assessment Model Using Biomarker for Consumer Products

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Background/Aims: To solve chemical safety issues, human risk assessment process often requires using exposure assessment and legal limits. However, exposure data used for risk assessment have limitations

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due to various uncertainties involved in analytic methods, representativeness of samples, and exposure assessment methodology. In this study, a newer approach for the risk assessment of the mixture exposure using biomarkers will be introduced. Humans are exposed to the mixture of phthalates in daily life and accurate scientific assessment for human exposure has been needed.

Methods: Exposure to chemicals undergoes toxicokinetics including absorption, distribution, metabolism, and excretion. Therefore, a chemical absorbed in the body will be kinetically changed, time- or dose-dependently, in concentrations. A model phthalate compound DEHP or DBP was used for exposure assessment and a Mathematica program was applied for the development of exposure model for the mixture of DEHP and DBP.

Results: In this study, animal model for the exposure assessment of the mixture of DEHP and DBP was developed, which improved incorrect measurement of single chemical exposure out of multiple exposure situation. To best estimate the exposure levels of DEHP or DBP in a mixture exposure situation, the mathematical exposure model developed using the toxicokinetic relationship between DEHP, DBP, MEHP, MBP, or phthalic acid (PA) in sera and administered doses. Human sera were collected from 300 volunteers who visited a hospital according to the IRB guideline of Korea FDA (KFDA). DEHP, DBP, MEHP, MBP, or PA were analyzed by UPLC/MS/MS and the data were applied to the mathematical exposure model.

Conclusion: A mathematical exposure model for the mixture of DEHP and DBP was developed using biomarkers of DEHP, DBP, MEHP, MBP, and PA based on toxicokinetics. This exposure model might be applicable for human risk assessment of phthalate exposure.

O-01A2-2

Towards New Estimated Daily Intakes for the Canadian Population

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Background/Aims: Health Canada's Contaminated Sites Division is involved in the revision and development of new human health soil quality guidelines (HHSQGs). Part of the HHSQG development process relies on Estimated Daily Intakes (EDIs) which estimate the typical concurrent background exposure to chemicals from all known or suspected sources (air, water, soil, dust, food and consumer products) via all known or suspected routes of exposure (inhalation, ingestion, dermal contact) for the average Canadian. Instead of using a deterministic approach to derive EDIs, a probabilistic one has been developed and will be presented as well as its strengths, limitations and recommended future improvements.

Methods: For each chemical under HHSQG revision or update, an extensive review of all the available Canadian databases covering air, water, soil, dust, and food was performed through grey and scientific literature searches. The scientific validity of all available papers, grey reports, and databases was assessed using a quality score tool developed for this purpose. Then, after final selection of key data, all the environmental concentration distribution parameters and all the physiological distribution parameters involved in the EDI equations were estimated. The Crystal Ball add-in software for excel was used for the Monte-Carlo simulations and probabilistic EDI distributions were obtained for each of the 5 Health Canada human receptor age groups.

Results: Instead of deriving deterministic EDIs, EDI multimedia probabilistic distributions are obtained through a fully transparent and systematic approach. This has already been done for 9 chemicals or species (Barium, Beryllium, Cadmium, Total and Hexavalent Chromium, Lead, Nickel, Vinyl chloride, Zinc).

Conclusion: This is a first step to derive new Canadian EDIs integrating all the pertinent information available. However, through this systematic and transparent process a lot of limitations can be identified (data gaps, methodological limitations, no available correlations between media of exposure, etc). This allows prioritization of future research projects to improve Health Canada EDIs.

O-01A2-3

Pesticide-related Knowledge for Effective Policy Making and Risk Communication: A Study Among Stakeholders in a Farming Community of Tamil Nadu, India

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Background/Aims: Pesticide dealers and government extension officers (sources of information) influence the knowledge of farmers (end-users of information). For effective policy making, it is essential to assess the knowledge of these stakeholders regarding the risks involved in pesticides use. The present study attempts to assess stakeholder's knowledge about pesticide exposure, use of personal protective equipment (PPE), and their views on increasing safe use of pesticides, in the district of Tanjavur in Tamil Nadu (India).

Methods: The results are based on 3 primary surveys among farm owners (n = 126), agricultural daily-wage earners (n = 83), pesticide dealers (n = 53), and government staff (n = 32), conducted during 2007–2008.

Results: Pesticide dealers were the main source of information for the farmer owners (87.3%) and agricultural laborers (88.1%). Extension officers were "accessed" by the farm owners (50.8%) more, when compared to the agricultural laborers (34.5%). The main source of information for the pesticide dealers were the pesticide industry representatives (94.3%). Regarding pesticide-related knowledge, many famers and wage laborers did not know that pesticides can enter the human body (52.9%). Many pesticide dealers did not know that spilling pesticides into bare hands can cause exposure (45.3%), while 75% of government extension officers did not know that dried pesticide on the plants can also be a source of exposure. Concerning PPE-related knowledge, many stakeholders did not recognize the footwear as a form of PPE. Majority of farmers has never been trained for handling pesticide safely. All stakeholders opined that training for using pesticides safely, should be given to farmers. Farmers suggested that they should be given PPE free of cost or at subsidized rates, to encourage use of PPE (84.8%).

Conclusion: Thus, pesticide-related knowledge is not comprehensive among the stakeholders. Policy makers should stress on targeted risk communication and training to help in pesticide risk reduction.

O-01A2-4

Sociodemographic Characteristics and Perception of Risk From Near Highway Pollution

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Background/Aims: Lay perception of environmental risk is based on heuristics influenced by characteristics of risks such as being involuntary or catastrophic; personality traits such as locus of control; and cultural values such as "Individualism/Collectivism" and "Power Distance." Empirical investigation in the United States has found that white men are less concerned about pollution than are white women and minority group members of both sexes. But little is known specifically about people's perception of the risk from automobile emissions in general, much less the

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risk from living near major highways; nor about how risk perception varies according to more detailed sociodemographic categories and cultural values.

Methods: The CAFEH study will survey approximately 600 people age 40 and older from 3 sociodemographically diverse areas along the I-93 corridor in Massachusetts, using area probability sampling augmented by a convenience sample. The study areas include many immigrants; surveys are conducted in all prevalent languages. The instrument includes measures of perceived harm from air pollution and near-highway pollution specifically; cultural values; psychological traits; and detailed sociodemographic data. Biological sampling and exposure assessment are also conducted.

Results: As of this writing, data from 71 respondents are available. Foreign-born respondents (N = 31) perceive near-highway pollution as significantly more harmful than do US born respondents ($P = 0.024$). Lower levels of formal education ($P = 0.002$), and reporting having learned more about local pollution from lay media ($P = 0.03$), are also associated with greater perception of risk. In a multivariate regression, birthplace is not significant but lower education and learning more from lay media remain associated with risk perception ($P = 0.021$ and 0.032, respectively).

Conclusion: As a larger sample is acquired, we will assess the independent relationship of ethnicity, cultural values, and psychological traits to risk perception. The effect of education is a novel finding and calls for further explication.

O-01A2-5

Bringing the Science of Near Source Mobile Pollution and the Risk of Neighborhood Health Impacts to the Attention of Citizens and Policy Leaders

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Background/Aims: Mobile air pollution is intertwined with life in postindustrial societies. Though the US Clean Air Act of 1970 focused on primary emissions such as CO, lead, and TSP, EPA's recent policies have targeted secondary regional ozone and $PM_{2.5}$, with a new emphasis on climate. This leaves a large susceptible population without protection from the effects of pollutants such as ultrafine particles (UFP) and associated toxins. It is our aim to advance science, education, and policies to improve the health of those most exposed to mobile pollutants.

Methods: We have moved from pilot studies of NO_x and UFP to participatory roles in research such as the Community Assessment of Freeway Exposure and Health (CAFEH). CAFEH uses a dedicated mobile lab, stationary monitors, a multilingual field staff, and clinic to investigate highway pollution and cardiovascular biomarkers. We are beginning a HEPA filter intervention study in highway adjacent housing. We also attend development, regulatory, and legislative hearings. We encourage regional discussion and help with Museum of Science "Toxic Traffic" forums. We conducted video interviews of many scientists at ISEE ISES 2008.

Results: We persuaded a local development to decrease highway vehicle dependence in favor of bicycle paths and a privately subsidized subway stop, resulting in a projected 50,000 vehicle per day reduction. We helped secure commitment for over $1 billion of light rail extensions. We helped enact a state "healthy transportation compact" that encourages active transportation and requires review of health impacts of UFP from large highways, diesel rail corridors, ports, and airports. We have failed to help advance EPA policy which could save many lives.

Conclusion: In the absence of effective national oversight of near source mobile pollution, alliances are needed that integrate science, education, and policy at local and state levels. Stronger alliances and better communication could result in large health benefit.

PP-30-166

The Application of Indicator-based Dpseea Model in Air Pollution

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Background/Aims: In Korea, Environmental Health (EH) indicators have been established to support EH-based policy. This is the overview of a pilot study to assess the feasibility of indicators-based DPSEEA model in air pollution.

Methods: The DPSEEA model is a useful tool for illustrating EH indicators, systematically.

Results: In Korea, passenger transport demand by mode of transport, the amount of registered vehicles and road transport fuel consumption could represent driving forces of DPSEEA. From 1980 to 2005, the number of passenger by bus and taxi has steadily declined by an expansion of railroad network and increase of the private car. Since then, transport record showed an immaterial increase by transport policy to promote greater use of public transportation. The number of registered transports increased steadily during 2002 to 2006. Especially, the number of private cars has increased in all areas while bus and freight showed no clear trends. Total transport fuel consumption has been increased during 2000 to 2007.

As a pressure indicator, total annual emissions of air pollutants can be linked to a change in ambient air concentration which leads to a change in exposures and health risk of the population. Total emission of CO, NO_2, SO_2, PM_{10} showed no change or reduction during 1999–2006, while emission of VOCs is still increasing since 1999. For example, total emission of VOCs in 2006 was up by 19.4%, compared to that in 1999.

The prevalence of Asthma cases was rapidly rising. The numbers of cases per 1000 populations in 1998, 2001, 2005 were 11.0, 12.9, and 23.3, respectively. As a result, the disability-adjusted life years (DALY), annual burden of disease, for ages 0 to 9, 10 to 19 were estimated to be 4379 (78.4%), 1226 (42.0%) in 2005. Especially, exposure of numerous environmental factors such as air pollution, environmental tobacco smoke (ETS), increasing number of vehicles contributes to increases of asthma prevalence in children.

Conclusion: The link between air pollution indicators can be applied to improve EH policies. Therefore, the effort to broaden the monitoring these factors is important for future EH policy.

PROBLEMS REGARDING SOCIOECONOMIC STATUS AND VULNERABILITY (EG, POVERTY, RAPID URBANIZATION, DIFFERENCE OF LIFE QUALITY)

PP-30-001

An Epidemiological Study of Canine Distemper in Mumbai: Bridging the Gap Between Human and Animal Health

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Background/Aims: Canine distemper is a disease caused by a *Morbillivirus* that affects numerous species of carnivores. The disease is

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endemic to stray dog populations of developing nations; however, its relationship with human health has been inadequately explored.

This study investigates the mutual influence of human and animal health in the densely populated urban setting of Mumbai. The relationship between case incidence of canine distemper and climatic variation was assessed to inform control programs for the disease.

Methods: An epidemiological study of dogs attended to at the BSPCA Hospital, Mumbai, during a 2-year period (2008–2009) was carried out. A total of 7791 dogs were included in the study, of which 304 were diagnosed with canine distemper. Cases were divided across the administrative wards of the city and compared with the Human Development Index (UNDP, 2009) of those wards. Case occurrence was compared with daily weather conditions to examine the seasonal disease pattern.

Results: The percentage of dogs affected in a ward when compared with its Human Development Index demonstrated high correlation ($r = -0.74$). An increase in cases corresponded to a decrease in temperature and humidity, exhibiting decreasing incidence over the monsoon and an increase during winter.

Conclusion: The strong correlation between disease incidence and quality of life suggests that factors governing the health status of human and animal populations in an area are not mutually exclusive. Maintenance of stray dog population health reduces their susceptibility to infection and may control the spread of zoonotic and vector-borne diseases in human beings. A seasonal rise in the incidence of distemper may be pre-empted by instituting prophylaxis programs corresponding to predicted climatic change. Recent studies have isolated the distemper virus in patients suffering from multiple sclerosis and Paget's disease. Exposure to the virus is highest in developing countries where there is little knowledge of the epidemiology of Paget's disease, thus warranting further study.

PP-30-168

Socioeconomic and Environmental Determinants of Hospitalizations for Childhood and Adult Asthma in Hawaii

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Background/Aims: Asthma has been estimated to affect 17 million people or over 5% of the total population, with 1.9 million emergency room visits, and 466,000 hospital admissions annually in the United States. Approximately 9.7% of children and 6.9% of adults have been diagnosed with asthma in Hawaii. Understanding the disproportionate increase and remarkable disparities in asthma among low socioeconomic status indigenous and ethnic minority population groups may provide insight into the roots of the asthma epidemics and more effective disease management.

Methods: The data on annual asthma hospitalizations for children and adults (ICD-9-CM 493.0–493.9), at sub-county school administrative district level (n = 22), in 2000–2005, was collected from Hawaii Health Information Corporation, and covered the counties of Honolulu, Hawaii, and Maui. The information on socioeconomic status, included socio-behavioral, economic, housing, and environmental characteristics was obtained from Hawaii Behavioral Risk factors Surveillance System and Healthy Hawaii Survey Programs, conducted in 2005. Principal component analysis techniques were employed to reduce the total number of significant area socioeconomic status indicators (n = 18), and to develop the composite area socioeconomic deprivation index for each administrative district as a single predictor of asthma hospital admissions in children and adults. Poisson log-linear regression models were used to estimate the influence of each selected socio-behavioral, economic, housing, and environmental factors on children and adult asthma hospitalization rates. The GIS ArcView 9.2 program was utilized for geospatial data analysis and result representation.

Results: The study results revealed that the number of inactive, adult smokers, overweight and obese people, as well as fast food and other unhealthy food entities in the area were significant predictors of asthma hospitalization rates for both children and adults. Developed composite area socioeconomic deprivation index was a significant predictor of children and adult hospitalization rates for asthma.

Conclusion: The study results support previous empirical findings that severe exacerbations and hospital admissions for asthma are distributed unequally within specific geographical areas and among specific ethnic minority population groups. The socioeconomic deprivation index could be used to explain social, economic, cultural, and environmental disparities in health as a powerful tool to describe social inequalities and also to identify high risk geographical areas and population groups in order to develop more effective disease prevention and health promotion strategies for asthma.

PP-31-175

Low Socioeconomic Status Is Associated With Increased Congenital Heart Malformations' Risk

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Background/Aims: In recent decades, the countries after transition experienced rapid socioeconomic differentiation. Most vulnerable groups appear in lower socioeconomic position, described by lower education, occupation, and income. The objective of our study was to investigate the differences in congenital heart malformations' risk among socioeconomic groups in Kaunas, the second largest city in Lithuania.

Methods: We conducted the population-based case-control study of newborns in Kaunas in 1999–2005. We compared 198 cases of congenital heart malformations with 643 controls with regard to information on socioeconomic status, reproductive and medical history, etc obtained by questionnaire. We performed the logistic regression analysis for the calculations of odds ratio (OR) for families in different socioeconomic positions, estimated by education and occupation, adjusting for age, marital status, medical history, occupational chemical and residential air pollution exposures.

Results: Our results indicated that socioeconomic position described as parental blue-collar occupations and maternal professional comprehensive education, and blue-collar occupations showed the highest risk for congenital heart malformations (adjusted OR = 3.68, 95% confidence interval [CI]: 1.05–12.88) as compared to the socioeconomic position described as parental white-collar occupations, maternal professional comprehensive education, and white-collar occupations. The adjusted OR for socioeconomic position described as parental blue-collar occupations and maternal incomplete and complete secondary education and blue-collar occupations was 2.70, 95% CI: 1.02–7.11. While socioeconomic position described as parental professional occupations and maternal university education and professional occupations showed decreased risk (OR = 0.36, 95% CI: 0.12–1.03).

Conclusion: The risk of congenital heart malformations was associated with socioeconomic position in Lithuania, the country after transition.

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IMPORTANCE OF EXPOSURE ASSESSMENT IN ENVIRONMENTAL EPIDEMIOLOGIC INVESTIGATIONS INVOLVING VULNERABLE POPULATIONS

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S-30B9-1

Investigation of Household Drinking Water Sources and Contaminant Exposures in the Navajo Nation, 2008–2009

Matthew Murphy,[1] Yolanda Barney,[2] Mae-Gilene Begay,[3] Philbert Morgan,[2] Stephanie Kieszak,[1] Kathleen Caldwell,[1] Art Chang,[1] Shannon Graham,[4] Michael McGeehin,[1] and Lauren Lewis[1] *[1]Centers for Disease Control and Prevention, Atlanta, GA; [2]Navajo Nation Environmental Protection Agency, Window Rock, AZ; [3] Navajo Nation Division of Health, Window Rock, AZ; and [4]Agency for Toxic Substances and Disease Registry, Atlanta, GA.*

Background/Aims: Approximately 30% of households on Navajo Nation are currently not connected to a public water system. These households must transport or "haul" drinking water from outside water sources that are often unregulated and may contain dangerous chemical or bacterial contaminants. The objectives of this study were to identify whether Navajo households haul drinking water from contaminated water sources, examine contaminant levels in humans, and define community health risks.

Methods: We conducted a cross-sectional survey of 296 households (with and without access to community water) that were randomly selected from 5 Navajo Nation communities in the state of New Mexico. Questionnaire data were collected regarding water use and hauling practices from selected participants. Laboratory analysis included testing for chemical and bacterial contaminants in drinking water as well as chemical contaminant levels in urine including uranium, arsenic, and cadmium.

Results: Of 296 water samples collected, 33 (11%) samples exceeded safe drinking water standards for arsenic and 6 (2%) samples exceeded safe water standards for uranium. Ninety-four (33%) of the drinking water samples tested positive for total coliform bacteria and 23 (8%) tested positive for *E. coli*. Of the 244 urine samples collected, 93 (39%) had elevated uranium levels (>95% of levels seen in the US population as defined by National Health and Nutrition Examination Survey).

Conclusion: The study population had unusually high urine uranium levels, though only a few water samples exceeded the EPA standard for uranium. Uranium contamination of drinking water sources does not appear to be the primary cause of increased uranium levels found in urine. Bacterial contamination levels were significantly higher in hauled water samples indicating a public health risk.

S-30B9-2

Aflatoxin Exposure in a High Risk Population in Eastern Kenya

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Background/Aims: Aflatoxin contaminates 25% of grain crops worldwide. Since 2004, >450 aflatoxin poisonings from contaminated maize have been documented in Eastern Kenya (case-fatality = 41%). The extent of subclinical aflatoxin exposure in this population is unknown. Maize aflatoxin measurements suggest consumption of highly contaminated food without acute poisoning may be widespread. To assess aflatoxin exposure, we measured human biomarkers in a random sample of households during an aflatoxicosis outbreak in Kenya.

Methods: Households were randomly selected from the region where poisonings were occurring. Interview data and 1 serum sample were obtained per household. Serum was analyzed for aflatoxin B1-lysine albumin adducts (AFB-lys) using HPLC and isotope dilution tandem mass spectrometry. Interview and serum data were analyzed using mixed linear regression.

Results: We collected interview and serum data from 114 households; 82 (72%) serum samples were analyzed for AFB-lys. All 82 had detectable levels of AFB-lys; median concentration was 0.09 ng/mg albumin; range, 0.01–1.06 ng/mg albumin; 3 (4%) of these participants reported jaundice-related symptoms (key indicator of aflatoxin poisoning). Of those 3, 1 had high AFB-lys (>0.25 ng/mg albumin, the level associated with aflatoxicosis in a 2004 case-control study). Of the 79 participants without symptoms, 14 (18%) had AFB-lys >0.25 ng/mg albumin. Those who had received information on prevention of aflatoxin contamination of maize had significantly lower geometric mean AFB-lys compared with those who did not (geomean = 0.06 ng/mg albumin and 0.12 ng/mg albumin, respectively; *t* test $P < 0.05$).

Conclusion: These results suggest that disease surveillance for acute aflatoxin poisoning dramatically underestimates the scope of aflatoxin exposure. The long-term health impact of such high degrees of exposure, as well as lower levels of sustained exposure is not defined but is likely considerable. Education to prevent aflatoxin contamination may be effective in decreasing exposure.

S-30B9-3

Exposure Assessment of the Developing Fetus and Newborn Infants: Methods to Measure Perchlorate and Related Anions in Maternal and Fetal Matrices

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Background/Aims: Perchlorate is a commonly occurring environmental toxicant that may impair iodide transport, and thus compromise development of the fetus and neonate. Therefore, we developed analytical methods for quantifying perchlorate and toxicologically related anions (iodide, nitrate, thiocyanate) in physiological fluids relevant to fetal and neonatal exposure.

Methods: We used ion chromatography coupled with electrospray ionization tandem mass spectrometry to accurately and precisely quantify background levels of perchlorate and related anions in urine and serum from pregnant women; amniotic fluid from the fetus; and cord blood, dried blood spots, and diaper press urine from newborns. Additionally, we validated methods for quantifying perchlorate and related anions in breast milk and infant formula so that perchlorate intake could also be calculated. We found that sample collection materials (eg, diapers and blood spot paper) are potential sources of perchlorate contamination.

Results: Perchlorate was commonly found in maternal, fetal, and newborn matrices. Maternal urinary perchlorate levels were positively correlated with perchlorate levels in amniotic fluid ($r = 0.57$). Maternal serum perchlorate was generally higher than cord serum perchlorate (median ratio 2.4:1 for paired samples); conversely, iodide levels were typically higher in fetal fluids compared to maternal fluids. Perchlorate exposure doses were subsequently estimated for 91 infants based on multiple urine samples collected over the first year of life. The median estimated exposure dose was 0.160 μg/kg/d, with 9% of the estimated doses exceeding the US EPA reference dose of 0.7 μg/kg/d, and breast-fed infants having greater perchlorate exposure than formula-fed infants.

Conclusion: Maternal urine perchlorate is an effective surrogate measure of fetal perchlorate exposure. Perchlorate does not appear to disproportionately accumulate in the fetal compartment; however, infants likely have higher perchlorate exposure doses than adults (medians of 0.160 and 0.064 μg/kg/d, respectively).

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S-30B9-4

Investigation of an Outbreak of Unintentional Acute Pesticide Poisoning: Assessment of Exposure to Carbamate and Organophosphate Insecticides, Rural Bangladesh, 2009

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Background/Aims: In April 2009, a cluster of acute illness occurred in 2 nearby farming villages in rural Bangladesh, resulting in 3 deaths. Unintentional poisoning from a cholinesterase-inhibiting pesticide was suspected to have caused the outbreak.

Methods: Case-patients were children aged 1–10 years who presented to healthcare facilities with at least 2 symptoms characteristic of cholinergic inhibition (ie, difficulty breathing, excessive sweating, frothy discharge, loss of consciousness, convulsions, urinary incontinence, vomiting, weakness in arms or legs) during 2–22 April 2009; controls included asymptomatic children 1–10 years of age. Serial plasma specimens were collected from case-patients for cholinesterase testing. Urine and serum specimens were collected from cases and controls for quantification of carbamates and organophosphates (OPs) and their metabolites using gas chromatography/mass spectrometry and liquid chromatography/mass spectrometry.

Results: In all, 8 case-patients and 18 controls provided at least 1 specimen (plasma, serum, and urine). Three case-patients demonstrated plasma cholinesterase activity within 10 hours of illness onset that was at least 20% lower than specimens tested 30 days after recovery. Serum carbofuran and its metabolite, 3-hydroxy carbofuran, were detected in 2 (of 7) case-patients and in none of the controls; these specimens had been collected within 6 hours of illness onset. Six case-patients had a higher median level of urinary creatinine-corrected carbofuran (3.8 vs. 1.8 μg/g creatinine, Wilcoxon exact $P = 0.090$) and 3-hydroxy carbofuran (579.6 vs. 20.1 μg/g creatinine, Wilcoxon exact $P = 0.006$) than 18 controls. Serum and urinary OP levels were not suggestive of OP poisoning.

Conclusion: Case-patients' symptoms, depressed plasma cholinesterase, and carbofuran and 3-hydroxy carbofuran levels suggest that carbofuran poisoning caused the outbreak. Serum carbofuran for 1 case-patient who survived was higher than a previously reported postmortem suicidal ingestion. Carbofuran use is widespread in Bangladesh; recommendations include improved pesticide regulation, community education regarding safe pesticide usage, and further study to identify exposure routes.

S-30B9-5

US Environmental Protection Agency Tribal Environmental Health Research Program

Maggie Breville *USEPA National Center for Environmental Research, Washington, DC.*

Background/Aims: The Environmental Protection Agency supports research on risks to susceptible populations. Tribal populations are at an increased risk due to unique lifestyle practices, community activities, occupations, customs, and environmental releases. Through its Science to Achieve Results program, the National Center for Environmental Research seeks to explore such environmental risks, particularly through cumulative chemical exposure and global climate change affecting tribes.

Methods: Science to Achieve Results research is funded through Requests for Applications (RFAs) that are derived from Environmental Protection Agency's Office of Research and Development's Strategic Plan. RFAs are prepared in cooperation with other Agency programs and often with partnering agencies.

Results: Seven grants were supported through 2 RFAs:

1. "Lifestyle and cultural practices of tribal populations and risks from toxic substances in the environment."
   - Environmental contaminants in foodstuffs of Siberian Yu'piks from St. Lawrence Island, Alaska.
   - Reducing risks of the Anishinaabe from methylmercury.
   - Risks to northern Alaskan Inupiat: assessing potential effects of oil contamination on subsistence lifestyles, health, and nutrition.
   - Iakotisa'tstentsera:wis Ne Ohontsia: reducing risk by restoring relationships.
   - Lifestyles and cultural practices of tribal populations and risks from toxic substances in the environment.
2. "Issues in tribal environmental research and health promotion."
   - Understanding the cumulative affects of environmental and psycho-social stressors that threaten the Pohlik-lah and Ner-er-ner lifeway: the Yurok Tribe's approach.
   - Impacts of climate change on health benefits of a tribal Alaskan resource: integrating traditional ecological knowledge with risk assessment through local monitoring.

Conclusion: This research provided insight into unique and transferrable Tribal exposure and effects assessment methodologies. Additionally, they helped formulate risk management strategies and/or interventions to reduce these exposures while preserving Tribal practices and traditions. This research identified subsistence resources, sensitive subpopulations within tribal communities, complex chemical exposures from multiple sources and routes, and links between environmental stressors and health outcomes.

AIR QUALITY AND HEALTH IN SOUTHEAST AND EAST ASIA

S-30C1-1

Cobenefits of Air Quality Management and Climate Change Mitigation

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Background/Aims: Greenhouse gases (GHG) such as carbon dioxide, methane, nitrous oxide, hydrocarbons, and ozone are not present as direct air pollutants, in which can be enforced by environmental laws and regulations; however, the synergy between air quality management and GHG reduction plan can be cobenefit toward responding to the global call to mitigate climate change.

Methods: The reduction in air pollutant emission such as sulphur dioxide, nitrogen oxide, and particulate matter that would arise as a result of a reduction in carbon dioxide (CO_2) emission are additional to the benefits from GHG emission. Although, Thailand is not bound to international commitments to reduce GHG emissions but the government has initiated the reduction of GHG emission voluntarily program and promoted the climate change mitigation campaign around the nation.

Results: One of the most important GHG is CO_2. In Thailand, the CO_2 emission increased from 143.4 million ton per year in 1998–188.7 million ton per year in 2006, another word, CO_2 emission increased about 32% within 8 years. Mainly CO_2 emission comes from fuel combustion of power producers, from transportation section and from other industrial sources for 40%, 27%, and 24%.

Conclusion: Mindful that air quality and health issues are transboundary in nature and that globalization has highlighted the climate change with interdependence of nations, communities, and individuals, we emphasis that various efforts are being undertaken by various organizations at the national and regional levels for efficiency, equity, transparency, and accountability measures on reducing GHG and improving air quality as well as health protection.

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S-30C1-2

Characterization of Wintertime Air Pollution Concentrations and Variability in Ulaanbaatar, Mongolia

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Background/Aims: Ulaanbaatar, Mongolia's capital city, has recently undergone dramatic population growth, which has led to substantial increases in air pollution emissions. Major sources include 3 coal-fired power plants, residential wood and coal burning, and vehicles, some of which still use leaded gasoline. Temperature inversions and the surrounding topography lead to high wintertime concentrations.

Methods: We measured air pollution in late February and March, 2010 using 3 measurement platforms to characterize wintertime concentration patterns of relevant pollutants. Daily filter-based particulate matter $(PM)_{2.5}$ and PM_{10} and continuous light scattering were measured at a fixed monitoring station to assess temporal variability, and data on PM_{10}, $PM_{2.5}$, NO_2, and SO_2 were obtained, where available, from government monitoring sites. To characterize spatial gradients in $PM_{2.5}$, mobile monitoring was conducted on 3 consecutive evenings (approximately 20:00–23:00) by driving preselected routes in a vehicle equipped with a GPS and a portable nephelometer. Spatial patterns in NO_2 and SO_2 were assessed with passive Ogawa samplers at 39 locations across the city.

Results: Daily concentrations measured at a centrally located government monitoring site were high for PM_{10} (138 ± 39 $\mu g/m^3$), $PM_{2.5}$ (93 ± 33 $\mu g/m^3$), NO_2 (61 ± 10 $\mu g/m^3$), and SO_2 (69 ± 21 $\mu g/m^3$). Mobile monitoring indicated strong $PM_{2.5}$ spatial gradients and the spatial patterns were consistent across evenings, with highest concentrations in poorer neighborhoods where residential coal and wood burning is common. The highest $PM_{2.5}$ concentrations measured by continuous fixed monitors generally occurred at around 08:00–09:00 and 22:00–0:00, consistent with periods of home heating. Land use regression models will be used to interpolate between the 39 Ogawa NO_2/SO_2 monitoring sites. $PM_{2.5}$ filter samples will be analyzed by inductively coupled plasma mass spectrometry to quantify elemental constituents and infer source contributions.

Conclusion: This work demonstrates the use of current exposure assessment techniques in a developing city and will aid future epidemiologic studies.

S-30C1-3

Exposure to Polycyclic Aromatic Hydrocarbons and Loss of Pulmonary Function in the Elderly

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Background/Aims: Polycyclic aromatic hydrocarbons (PAHs) are reported to cause adverse effects on pulmonary function in occupationally exposed workers such as asphalt workers. However, evidence is lacking on the effect in the general population. We hypothesized that PAH impairs pulmonary function through enhancing oxidative stress, especially in the elderly population.

Methods: A longitudinal panel study of 404 elderly people was performed in South Korea. Repeated spirometric tests were performed up to 3 times on different days for each subject. We also measured urinary concentrations of the metabolites of the PAH (1-hydroxypyrene and 2-naphthol) and markers of oxidative stress (malondialdehyde) on the same day of spirometric tests. A mixed linear regression model was used to evaluate the association among the PAH metabolites, oxidative stress markers, and spirometric tests.

Results: We found that the urinary levels of 1-hydroxypyrene were significantly associated with reduction of FEV1, FEV1/FVC, and FEF25–75 ($P < 0.05$). In addition, the oxidative stress markers were associated with both biomarkers of PAH exposure.

Conclusion: This study suggests that exposure to PAH exerts a harmful effect on pulmonary function by exacerbating oxidative stress in elderly people.

S-30C1-4

Number Concentration of Ambient Ultrafine Particles and Oxidative DNA Damage in Schoolchildren in Korea

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Background/Aims: Recently, ultrafine particles (UFPs) that have an aerodynamic diameter of <0.1 μm have received scientific attention because of its unique small size fraction and potential health effects. Compared with larger particles, UFPs have a higher particle number concentration, and a higher pulmonary deposition efficiency and enhanced capability to increase reactive oxygen species, which can induce oxidative DNA damage. We investigated the association between ambient fine and UFPs and oxidative DNA damage as indicated by urinary 8-OHdG in 3 panels of schoolchildren.

Methods: We performed 3 panel studies that had included repeated measure of urinary 8-hydroxy-2′-deoxyguanosine (8-OHdG) in schoolchildren along with continuous measurement of ambient fine and ultrafine particles during 2 months follow-up periods from 2007 to 2009. The number concentrations of particles in size range of 11.1 to 1083.3 nm were measured with scanning mobility particle size and the hourly averaged mass concentrations of particles were measured by spectrometer. Urinary 8-OHdG levels were determined using ELISA kit.

Results: We found no association between mass concentration of ambient particulate matter, PM_{10}, $PM_{2.5}$, and PM_1 and urinary 8-OHdG level in children. However, increases ultrafine-sized particles were associated with an increased level of urinary 8-OHdG in children with adjusted individual and meteorological confounders. The changes were associated most consistently with short-term exposures to ambient UFPs measured in 2-hour morning periods.

Conclusion: This suggests that the oxidative DNA damage may be more strongly associated with short-term exposure to ambient UFPs than larger particles.

NANO-PARTICLES AND SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCS) IN INDOOR ENVIRONMENTS: THE EFFECT OF INTERACTING SOURCES ON HUMAN EXPOSURES (ISIAQ SYMPOSIUM)

S-30C2-1

Nanoparticles From Hardcopy Devices—Estimation of Exposure From Chamber and Real Room Measurements

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Background/Aims: The emission of ultrafine particles (UFP) from hardcopy devices is currently in the focus of frequent research activities, because the influence of printer configuration, environmental conditions, and composition of consumables on the emission behavior appears to be complex.

Methods: We have analyzed the release of UFP from laser printers and office equipment using a Fast Mobility Particle Sizer and appropriate

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mathematical models. Measurements were carried out in a 1 m^3 chamber, a 24 m^3 chamber in an office room. The time-dependent emission rates were calculated for these environments using a deconvolution model.

Results: The measurements indicate that the emitted particles are mainly generated within the heated fuser unit of a laser printer. Several semi-volatile organic compounds are possible candidates that could lead to nucleation and aerosol formation during the fusing process. The increase in particle number concentration in a real office environment under the same printing conditions is as fast as in the emission test chamber. The most noticeable difference between the measurements in office and emission test chamber is the dissimilar decay in concentration after the emission from the printer stops. Due to the differences in environmental parameters, the particle loss-rate coefficient is larger in the emission test chambers than in the office.

Conclusion: Test chamber experiments under standardized conditions are useful to study the UFP emissions from hardcopy devices, but the influence of the chamber volume on the particle concentration makes this parameter less applicable for the comparison of different printers in different chambers. Moreover, measured chamber concentrations can not directly be used to estimate real-room exposure scenarios. However, the emission behavior of a printer can in general be characterized by the time-dependent emission rate. This parameter can be used for modeling purposes.

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S-30C2-2

Exposure to Polybrominated Diphenyl Ethers in Indoor Environments

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Background/Aims: Polybrominated diphenyl ethers (PBDEs) are a family of semivolatile organic compounds used as additive flame retardants in consumer products at percent levels. PentaBDE was predominantly used in polyurethane foam furniture and DecaBDE in electronics. Typical human exposure in North America is predominantly from indoor sources, although diet may become more important as these products are discarded.

Methods: We have been examining the links between indoor sources, concentrations in indoor dust and air, personal exposure (eg, hand wipes), and internal dose (eg, serum concentrations).

Results: Initial attempts to link PBDEs in dust with counts of products were not successful, but associations improved when products were screened for bromine using X-ray fluorescence: the initial lack of association was due to measurement error that occurred when counting all products, including those with no or little PBDE content. Volatilization from products has been proposed as the primary route from products to the indoor environment, but this did not seem to explain the high concentrations of the relatively non-volatile DecaBDE found in some dust. Using micro-x-ray fluorescence and scanning electron microscopes, we showed that micro-fragmentation of polymer containing flame retardant could provide another transfer mechanism. Correlations between air and dust concentrations of the more volatile PentaBDE were stronger than for DecaBDE. While we had found associations between PBDE body burdens and dust concentrations, this does not distinguish between dust ingestion, dermal absorption following contact with dust (or air-to-skin transfer), or inhalation as routes of exposure. Personal air monitors measured higher concentrations of DecaBDE than the more volatile PentaBDE, suggesting a personal cloud effect, but inhalation still appears minor. We recently found associations between PBDE concentrations in dust, handwipes, and serum (and reduced by handwashing).

Conclusion: Systematic experimental investigation of the source to internal dose provides a powerful approach for understanding exposure and can be applied to other semivolatile organic compounds.

AIR POLLUTION - INDOOR AIR QUALITY AND HEALTH EFFECTS

O-30C3-1

Modeling Personal and Indoor Exposure to Nitrogen Dioxide Among Adults in Eight Swiss Cities in 1993 and 2003

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Background/Aims: There is growing evidence of adverse health effects from traffic-related air pollutants such as NO_2 based on central site data. Since people spend >75% time indoors at home, the associations based on central site/outdoor measurements are prone to exposure misclassification. The major objective of this study is to examine the relationship of personal-indoor-outdoor NO_2 exposures and model it using measured concentrations and home characteristics in 2 different years across the 8 study areas.

Methods: This study was part of the Swiss cohort study on Air Pollution and Lung Diseases in Adults in which 9651 subjects were randomly sampled from 8 areas in Switzerland, with the first health examination in 1991 and a follow-up assessment of 8047 subjects in 2002. Personal, home indoor, and home outdoor passive NO_2 measurements were taken from up to 100 subjects per area over 3 seasons in 1993 and home indoor and outdoor measurements were repeated in 2003. We develop multivariate linear regression models to predict indoor exposure to NO_2 from home outdoor measurements and home indoor sources and ventilation characteristics for the 2 years. Similarly, personal NO_2 exposure models are built for year 1993.

Results: In 1993, mean personal, indoor, and outdoor NO_2 levels were 27 $\pm$ 13 micrg/m^3, 21 $\pm$ 12 micrg/m^3, and 31 $\pm$ 16 micrg/m^3, respectively. In 2003, outdoor NO_2 decreased considerably (25 $\pm$ 12 micrg/m^3), while indoor NO_2 levels were similar (18 $\pm$ 13 micrg/m^3). Highest correlation was between personal and indoor NO_2 (R^2 = 0.51). Preliminary analyses show home outdoor NO_2, gas stove cooking, smoking, regular opening of windows as significant predictors of indoor NO_2 (adjusted R^2 = 0.46, 0.56 for 1993 and 2003, respectively). Model R^2 were observed higher for summer (0.69 and 0.72) than the winter (0.42 and 0.53) for years 1993 and 2003, respectively.

Conclusion: These results show home indoor NO_2 can be reliably modeled using outdoor NO_2 and relevant home characteristics.

O-30C3-2

Measuring the Exposure of Infants and Children to Indoor Air Pollution From Biomass Fuels in the Gambia

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Background/Aims: Smoke from biomass fuels contains multiple gaseous and particulate pollutants, and is a risk factor for pneumonia, the leading cause of child death worldwide. Few studies have assessed the exposure-response relationship for biomass smoke and pneumonia, primarily because measuring children's exposure is difficult, especially for particulate matter (PM). We report on a study which utilized multiple methods to evaluate children's exposure to PM and carbon monoxide (CO) from biomass fuels.

Methods: Seventy-two hours personal CO exposure was measured for 1200 children, with 12%–15% receiving an additional 3–4 CO measurements. In the same subset of children, 72-hours integrated and continuous PM and 72-hours CO were measured in the cookhouse. Personal PM exposure was measured for 20–25 of these children. Usual

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personal exposure to CO is estimated using a random effects model including child- and household-level covariates. Personal exposure of children to PM is estimated using 3 different approaches, as well as a combined model: (1) combining time-location-activity budget with microenvironment PM; (2) estimating PM exposure using CO exposure combined with stationary CO-PM relationship; and (3) direct measurement of personal PM.

Results: Preliminary results show a mean 72-hours CO exposure on children of 1.0 ± 1.3 ppm, with an age distribution of 0.8 ± 0.9 ppm (0–11 months) and 1.1 ± 1.5 ppm (12–59 months). Regression analysis adjusting for child's age, study site, and sex indicates a seasonal pattern for CO exposure, with significantly higher exposure in July, August, and September. Using the CO-PM relationship from a pilot study, estimated average personal $PM_{2.5}$ exposure for these children would be 189 $\mu g/m^3$.

Conclusion: Children's exposure to $PM_{2.5}$ in The Gambia is well above WHO Air Quality Guidelines. The results of multiple measurement methods can be combined to estimate children's personal $PM_{2.5}$ exposure.

O-30C3-3

Impact of Indoor Air Pollution on Maternal and Child Health: A Case Study in India

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Background/Aims: Approximately half of the world's population and up to 95% of households in rural areas in India depend on unprocessed biomass fuels for their basic household energy mainly for cooking and heating. Women are traditionally responsible for cooking, and consequently the exposures are highest for them and for their infants.

Methods: The study evaluated the relationship between exposure to indoor air pollution on mother's health and the occurrence of low birth weight in India. The study population consists of 1372 women and 1505 children in 2 states of eastern India. Birth data were obtained from health cards or from mother's recall. Respiratory health of mothers was evaluated with the help of a questionnaire developed on the pattern of IUATLD. Indoor air monitoring data (CO, CO_2, NO, NO_2, SO_2, O_3, SPM) were collected from household monitoring with the help of portable air quality monitors. General linear model was used to access the relation between household fuel use and birth weight of children with adjustment for confounding factors.

Results: Results of this study suggest that combustion of biomass in traditionally stoves with poorly ventilated homes had a significant impact on indoor air quality and exposures of this smoke is significantly associated with increased incidence of respiratory symptoms of mother (OR = 4.15; 95% CI: 3.21–6.71). Children born to mothers cooking on biomass fuels (n = 870) had the lowest mean birth weight of 2513 g (95% CI: 2185–2733); those using cleaner fuel LPG (n = 635) had the highest mean of 2715 g (95% CI: 2623–2995) ($P < 0.0001$).

Conclusion: The findings from this study have important policy and program implications, in the preventive perspective for sustainable development; there is need for interventions that replace biomass fuels with more processed and cleaner fuels.

O-30C3-4

Modeling Concentrations of Particulate Matter in Solid Fuel Using Households From India

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Background/Aims: Combustion of solid fuels in rural households of developing country has been shown to produce very high concentrations of respirable particulate matter, even few folds above the available guideline. A few studies are available that document such concentrations quantitatively. There is a need to develop models that may predict household level concentrations in relation to the household level determinants which can be easily applicable in exposure and health studies.

The study aimed at developing models to estimate particulate matter concentrations in rural households using datasets that contained measured data on concentrations and survey information on a range of household level determinants.

Methods: We used 24-hour concentrations of $PM_{2.5}$ (measured in the kitchen area) obtained from 600 households along with questionnaire based information on household level variables from 4 states (Tamil Nadu, West Bengal, Madhya Pradesh, and Uttaranchal) in India. First, linear regression models were used to predict kitchen area concentrations by household level variables. Subsequently, the logistic model and "classification and regression trees" (CART) technique were applied by dichotomizing kitchen area concentrations (above or below the median).

Results: The linear regression model that included fuel and kitchen type, kitchen ventilation, state, and cooking duration as significant predictors produced an adjusted R^2 of 0.33. In logistic regression and CART models, the fuel type, kitchen type, and kitchen ventilation were found to be significantly associated with overall prediction powers as 71% and 76%, respectively. Both logistic regression and CART models predicted almost 90% of the high concentration households but only about 30% of the low concentration households correctly.

Conclusion: Although in need of some improvement in prediction power, the models show substantial promise to be able to generate concentration data for solid fuel using households that may be aggregated to estimate population exposures at the state or national level in India.

Conclusion: (This study was supported by National Research Foundation of Korea [2009−0073407]).

O-30C3-6

Relationship Between Personal Exposures and Microenvironmental Concentrations of NO_2 in Korea

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Background/Aims: Personal exposure of air pollutants has been associated with microenvironmental exposures of residential indoor, outdoor, workplace indoor, and others. The purpose of this study is to determine correlation between measured personal exposures and predicted personal exposures of NO_2, and to identify microenvironment affecting personal exposures.

Methods: The personal and microenvironmental concentrations of NO_2 were collected by passive sampler for 5 days. The study subjects for NO_2 measurements were 411 participants from 151 households from 4 cities in Korea and the measurements were repeated in summer and winter. Time activity diary was recorded by each participant and questionnaire was recorded to determine house characteristics and demographic information.

Results: In summer, the mean residential indoor and personal exposures of NO_2 were the highest in Seoul (25.7 ± 7.5, 26.5 ± 8.7 ppb), the lowest in Suncheon (14.3 ± 6.4, 16.2 ± 10.0 ppb), intermediate in Asan and Dae-gu (24.9 ± 7, 24.3 ± 9.0 ppb and 20.3 ± 6.3, 22.6 ± 7.4 ppb). In winter, mean residential indoor and personal exposures of NO_2 were similar in Seoul (25.6 ± 10.1, 24.2 ± 8 ppb), in Suncheon (19.9 ± 11.9, 15.9 ± 8.3 ppb), in Asan (22.9 ± 10.5, 22.3 ± 10.7 ppb), and in Dae-gu (25.1 ± 9.8, 21.7 ± 7.5 ppb). Personal exposure was estimated by microenvironmental concentrations and time spent at each

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microenvironment. The estimated personal exposure of NO_2 using microenvironmental model was significantly correlated and explained about 54% of personal exposures in Seoul and 73% in Suncheon, respectively. The correlation between estimated and measured personal exposure of NO_2 were the lowest in Seoul and the highest in Suncheon. Seoul was the largest city and Suncheon was rural area among the 4 target cities.

Conclusion: The findings suggest that contribution in microenvironmental exposures other than workplace may be significant in metropolitan city. In conclusion, personal exposures of NO_2 can be predicted by microenvironmental concentrations and activity pattern.

HEAVY METAL AND CHILDREN'S HEALTH

O-30C4-1

Lead Exposure and the Onset of Puberty: Birth to Twenty Cohort

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Background/Aims: One of the consequences of lead exposure is the potential to cause pubertal delay. However, this has not been widely researched. The objective of this study is to determine the association between lead exposure and pubertal development in girls in Johannesburg.

Methods: The Birth to Twenty (BT20) Study, a birth cohort study in Johannesburg-Soweto that commenced in 1990 included 1682 girls. At 13 years of age, venous blood samples for lead analyses were taken from 725 Black female participants; however, only 712 participants had menarche data, 684 and 682 participants had pubic hair and breast staging, respectively. A structured questionnaire was interviewer-administered. Pubertal measurement was based on age of menarche and self-reported Tanner staging for pubic hair and breast development.

Results: The mean blood lead level was 4.9 μg/dL. Fifty percent of the sample had blood lead levels <5 and 49% were ≥ 5 μg/dL. One percent (1%) had blood lead levels greater than 10 μg/dL. The average age of menarche was 12.7 years. At 13 years, 4% and 7% had reached Tanner stage 5 for pubic hair and breast development, respectively. Trends in all 3 aspects of pubertal development in association with lead levels showed that as lead levels increased there was a significant delay in puberty ($P < 0.001$). Further analysis showed that anthropometric measures were not significant confounders for the association.

Conclusion: The study has demonstrated that higher blood lead levels were associated with a delay in the onset of puberty after adjustment for confounders. Lead exposure in resource poor countries is generally higher compared to resource rich countries and thus the public and personal health implications of high blood lead levels are important.

O-30C4-2

Modification of Lead Exposure on the Association Between Patterns of Physical Growth and Neuromotor Functions Development

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Background/Aims: The few studies examining the impact of lead exposure on neuromotor development have shown impairments in early childhood among preterm and very low birth weight children. These findings may be due to discordance between somatic and neurologic development during the "catch-up" period of growth in such children. The objective of this study is to examine the relationship between patterns of physical growth and neuromotor function development, and the potential modifying role of postnatal lead exposure among full-term birth (gestational age, >37 weeks) children.

Methods: Subjects were participants in the Early Life Exposure in Mexico to ENvironmental Toxicants (ELEMENT) study in which mother-offspring pairs with relatively high lead exposures were followed in the postnatal period. Repeated blood lead levels and body heights were measured from 67 infants. Bayley Scales Psychomotor Index (PDI) assessments were taken in the offspring at 18 months to 30 months. Height acceleration (change in height velocity between 2 time points) was computed as an indicator of physical "catch-up" growth. Linear regression models were used to quantify the association between changes in motor function and height acceleration, and the modifying effect of lead while adjusting for mother's height, maternal marital status, and maternal education level.

Results: An increase of 1 cm/yr^2 in height acceleration during the 18–30 month age interval was associated with a 0.69, (95% CI: 0.08, 1.29) point increase on PDI. Every 1 μg/dL increase in blood lead at 18 months was associated with a 0.60 (95% CI: -1.07, -0.12) point decrease in PDI. The association between height acceleration and PDI change was modified by lead exposure. The positive effect of height acceleration declined as blood lead concentration at 18-month increased.

Conclusion: This study suggests that postnatal lead exposure may hamper the beneficial effect of physical growth on neuromotor development. This finding deserves further studies with a larger sample size.

O-30C4-3

The German Environmental Survey for Children (GerES IV): Children's Internal Exposure to Nickel

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Background/Aims: The German Environmental Survey for Children (GerES IV) is nation-wide population study conducted from 2003 to 06. Main objectives were to generate representative data on the environmental exposure and on linked health outcomes. GerES IV was performed jointly with the National Health Interview and Examination Survey for Children and Adolescents (KiGGS), conducted by the Robert Koch Institute.

Methods: A total of 1790 children, aged 3–14 years from 150 communities in Germany participated in GerES IV. The investigation comprised of extensive interviews on food and drinking water consumption and other relevant exposure factors. Nickel in urine was quantified by electrothermal AAS. Multivariate regression was used to analyze the associations between various exposure factors and sociodemographic characteristics on the nickel concentration in urine.

Results: Nickel concentrations in urine ranged from <0.5 μg/L (LOQ) to 15 μg/L. The median resulted in 1.3 μg/L, the 95th percentile in 4.5 μg/L. Nickel in urine decreased significantly with age ($P < 0.01$). No significant difference was found between boys and girls. Lower urinary concentrations were observed for children with a high socioeconomic status compared to the other participants (1.11 vs. 1.33 μg/L, $P < 0.001$). Chocolate consumption was associated with the internal exposure to nickel ($P < 0.05$).

Conclusion: GerES IV data describe German children's internal exposure to nickel on a representative basis. Relevant factors associated with nickel in urine were identified. Our findings may help to improve health outcomes in children as the oral exposure to nickel may aggravate nickel-

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induced contact eczemas.

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O-30C4-4

Children's Exposure to Metals in Esperance—A Community Initiated Study

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Background/Aims: In 2007, the shipping of lead and nickel through Esperance Port resulted in contamination of the environment and elevated lead and nickel in blood and urine concentrations of children. A clean up strategy was implemented, focusing on the Port area and individual homes. Little attention was given to nickel exposure or to overall metals exposure of the community.

Methods: In response to community concern about continuing metals exposure a cross-sectional noninvasive exposure study of 39 children aged 1–12 years residing in the Esperance region was undertaken. Children provided a sample of hair, toenails, first morning void urine, drinking water, and residential soil and dust. A questionnaire about lifestyle, activities, and diet was administered.

Results: Concentrations of nickel and lead were low in biological and environmental samples. However other metals were elevated in biological samples, with 4.5% and 18% of participants recording elevated hair aluminium (<DL – 251μg/g) and copper (7–415 μg/g concentrations; and 13.5% of participants had elevated urinary aluminium (<DL-210μg/L), manganese (<DL to 550 μg/L), and copper (<DL to 87 μg/L). Concentrations of nickel in urine, soil, and dust were found to decrease with increasing distance from the participants' residence to the Port, as did soil lead concentrations. Nickel dust concentrations and nickel and copper soil concentrations were found to be significantly higher in properties at a distance of ≤2 km, but exposure concentrations were not. Children who ate home grown produce had higher hair copper concentrations. The elevated urinary and hair manganese and aluminium concentrations were not explained by any other variables collected in this study.

Conclusion: This study was small and restricted to the use of noninvasive samples for metal analysis. However, the results indicate that exposure to both nickel and lead is limited in this group of children but some metals were elevated and require further investigation to determine sources and significance.

O-30C4-5

Research on Total Mercury Levels in Infant Umbilical Cord Blood and Its Influential Factors in Seven Cities of China

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Background/Aims: Mercury is a naturally occurring element that is found in air, water, and soil. Mercury exposure at high levels can harm the brain, heart, kidneys, and other system of people of all ages, especially for the unborn babies and young children, which can harm the developing nervous system. This study aims to investigate the total mercury levels in infants' umbilical cord blood, of different regions of China, and analyze its risk factors, and provide a basis to reduce the exposure.

Methods: One maternal and child health centers or general hospitals was selected in each district. About 200 pairs of mothers and infants born at term (36–42 weeks of gestation) were recruited from September to December 2008 each hospital. The cord blood was collected, of which the concentration of total mercury was detected. Through the mother's questionnaire survey, we analyzed their exposure to risk factors.

Results: A total of 1323 mother-neonate pairs were included in the study. The arithmetic mean and geometric mean of total mercury in cord blood were 2.26 ± 1.19 μg/L and 1.80 ± 1.93 μg/L; and the different levels among the regions were statistically significant (F = 663.961, P = 0.000). Totally, the cord blood mercury risk factors were high maternal family per capita income (OR = 1.496), pregnancy intake poultry (OR = 1.908), fish (OR = 1.685), shellfish (OR = 2.208), and breast milk (OR = 2.322). The protective factors included the high living floors (OR = 0.703), fruits (OR = 0.689) intake during pregnancy. The related factors in different cities were different.

Conclusion: The regional mercury concentrations are at a lower level in comparison with foreign countries; and it differs among regions. Cord blood mercury concentration is not only affected by the family economic and living conditions, but also by the diet during pregnancy. Factors affecting cord blood mercury varied among cities.

HEALTH IMPACT ASSESSMENT OF ATMOSPHERIC POLLUTION AT REGIONAL SCALE AND SUSTAINABLE DEVELOPMENT

S-30C5-1

Sustainable Development: From Economy to Environment and Health. Measuring the Sustainability of Industrialization Patterns Through Ex-Post Sanitary Evaluations: The Petrochemical Areas in Sicily

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Background/Aims: In the second post-war time, under the influence of Perroux "development poles" theory and the Kaldor's manufacturing "growth engine" scheme, Sicily (as well as many "late development" regions in Italy and worldwide) has been interested by several "industrialization plans" aimed to transform the local socioeconomic and productive structure from agricultural to manufacturing. Important examples of this strategy are the petrochemical plants of Gela, Milazzo, Augusta. After 50 years, the "sustainability" of these industrial policy experiences can be assessed both under a socioeconomic and under a health perspective.

Methods: After having briefly discussed the concept of sustainability and the use of health indicators as a measure of sustainability, an intra-regional evaluation of local sustainability is proposed by comparing mortality ratio of Gela residents with people living in a different area of Sicily.

Results: Results show a lesser "sustainability" degree for the Gela's industrialization experiment.

Conclusion: In order to highlight the role of local development model, the choice of the "control population" is not casual; rather, it responds to the criterion of obtaining a proper differentiation of the groups. In the case of Gela, the territory of Trapani has been chosen, given the similarities of economic well-being and territorial morphology, and the differences between the dynamics of local productive structures.

S-30C5-3

Health Impact Assessment for the Lombardia Region (IT)

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Background/Aims: Health Impact Assessment of short-term effect of air pollution at national/regional scale is rarely done. This is relevant whenever we have large areas where the pollution level tends to be homogenous due to orographic and meteorological conditions. Impact evaluation is helpful in planning appropriate program to contrast the phenomenon and setting priorities. However, any impact evaluation has never been extended out of urban area or in small cities where air pollution level and traffic characteristics could be different from those observed in big cities. The present paper presents the main characteristics of a study on health impact assessment in Lombardia (Italy).

Methods: In general, health impact assessment consists of following 3 stages: risk assessment (ie, exposure-response function estimation), exposure assessment, and disease burden evaluation. In the present study, inference on the exposure-response functions describing the relationship between air pollution and mortality/morbidity is based on epidemiological time series analyses. Bayesian hierarchical models are specified to combine first stage effect estimates. Bayesian kriging is performed to predict the continuous surface of exposure levels from a selected subset of monitors. Results from the previous points are combined and attributable number of deaths/hospital admissions are obtained under different reduction scenarios.

Results: Lombardia Region has about 10 millions inhabitants (2001 census). Short-term effects of particulate matter (PM_{10}) (natural mortality: pv 0.26% for 10 μg/cm of pollutant increase) and NO_2 (1.33%) were estimated on 18 areas above 50,000 inhabitants using mortality and morbidity data for the years 2003–2006. Annual average pollutant concentrations for each municipality were obtained by Bayesian kriging (r = 0.88 vs. atmospheric pollution models). Attributable deaths under the scenarios considered in the European Directives showed a large contribution of the metropolitan area of Milan and of peak exposure days of PM_{10} above 50 μg/cm.

Conclusion: The assessment of the impact of air pollution at national/regional level provided useful information to target policies to contrast the phenomenon.

REPRODUCTIVE HEALTH AND ENVIRONMENT

O-30C6-1

Maternal Exposure to Urban Air Pollution During Pregnancy Assessed by a Dispersion Model and Fetal Growth

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Background/Aims: We previously reported that nitrogen dioxide (NO_2) exposures during the first trimester of pregnancy as estimated by a geostatistical model and by the closest monitoring station approach were negatively associated with birth weight (BW) in a cohort of pregnant women from Nancy and Poitiers, France, whereas no clear association was found with particulate matter exposure. Here, our aim was to assess the relationship between maternal exposure to traffic-related air pollution and fetal growth in the same population.

Methods: Women (n = 1236) were recruited during pregnancy, as part of EDEN mother-child cohort. Average ambient levels of NO_2, particulate matter, and benzene during each trimester of pregnancy were estimated by a dispersion model taking into account traffic, industrial, and other local sources (ADMS-Urban software). Associations between trimester-specific exposure levels estimated at the maternal home address and fetal growth were assessed by linear models adjusted for potential confounders and gestational age.

Results: Compared to the lowest exposure tertile, NO2 levels during first trimester of pregnancy in the second and third tertiles were associated with changes in mean BW by −22 g (95% confidence interval [CI]: −81; 36 g) and 3 g (95% CI: −61; 68 g), respectively (P for trend = 0.76). Exposure to PM10 in the second and third tertiles during the same period was associated with BW changes by −14 g (95% CI: −92, 64 g) and −39 g (95% CI: −137; 58 g), respectively (P for trend = 0.37). No clear association was found between urban air pollution levels during the second and third trimesters of pregnancy and fetal growth.

Conclusion: This lack of significant association between exposure to air pollutants assessed with a dispersion model and fetal growth suggests to explore the variability among exposure models and their relevance in estimating exposure of pregnant women to atmospheric pollutants.

O-30C6-2

The ICAPPO Collaboration on Air Pollution and Birth Outcomes: A Meta-analysis of Pilot Data

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Background/Aims: Meta-analysis is a statistical method used to provide a single summary risk estimate based on a set of similar epidemiologic studies. It facilitates comparison and synthesis of analytic results from similar but independent studies on a specific topic. We applied this method to the study of the possible association between exposure to air pollution and adverse birth outcomes.

Methods: Several researchers around the world have examined the possible association between ambient air pollutants concentrations during pregnancy and adverse birth outcomes, using different sets of covariates, different analytic methods, and different study designs. Results of individual studies range from weakly positive to weakly negative, making summarization difficult. To better characterize this possible association, 13 groups of researchers formed the International Collaboration on Air Pollution and Pregnancy Outcomes (ICAPPO) and agreed to undertaken a pilot study to conduct re-analyses of their study data in a consistent manner. A previous report describes the individual study's subjects' characteristics, pilot study methods, and pilot study results qualitatively. This report synthesizes the results quantitatively using meta-analysis, providing a summary estimate of the relative risk of low birth weight (<2500 g) associated with each 10 μg /m^3 increase in the mean PM_{10} concentration.

Results: Results without adjustment for confounders showed a weak but statistically significant association (OR = 1.03; 95% CI: 1.01–1.05). However, the studies were statistically significantly heterogeneous, with 2 studies (California, Newcastle-Upon-Tyne) responsible for more than 50% of the weight. Next, we assessed the impact of socioeconomic status, rerunning the analysis using maternal education as a measure available in most countries and obtained similar results (OR = 1.02; 95% CI: 1.00–1.03).

Conclusion: Evidence supports an association between exposure to air pollution during pregnancy and increased risk of low birth weight. Further research is needed to explain this relationship and the possible role of covariates.

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O-30C6-3

Estimation of the Frequency of Involuntary Infertility on a Nationwide Basis

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Background/Aims: A deterioration of male reproductive health has been reported in several countries, which might impact on the couples' ability to conceive. However, very few studies attempted to describe or monitor the couples' fecundity on a nationwide basis, using approaches which allow including couples who eventually remain infertile. Our aim was to describe the couples' fecundity (involuntary infertility) among the general population living in France.

Methods: Our approach relies on the current-duration design. Through random digit dialing, we contacted 63,181 homes in 2007–2008, which allowed to identify 15,808 women aged 18–44 years. Eligible women (n = 1170) had to have a male partner, to have had an intercourse in the last 2 months, not to be using any method to avoid pregnancy, and not to have delivered in the previous 3 months. Using an approach previously developed, we estimated, from the distribution of the current duration of unprotected intercourse (corresponding to the time elapsed between the start of the pregnancy attempt and the time of inclusion in the study), the distribution of the total duration of unprotected intercourse, until occurrence of a pregnancy or start of an infertility treatment, as if the couples had been followed-up.

Results: Among eligible women, 997 (85%) answered the detailed questionnaire. The estimated proportion of couples not pregnant and still not using a contraceptive method (who had not started an infertility treatment) 12 months after the start of the period of unprotected intercourse was 14% (95% confidence interval [CI]: 4%–21%). The proportion of couples still infertile within 6 and 24 months were 25% (95% CI: 7%–36%) and 7% (95% CI: 2%–10%), respectively.

Conclusion: Our study is one of the first ones to provide a description of the fecundity of a representative sample of couples from the general population, not limited to couples who eventually conceived or to those resorting to medical help.

O-30C6-4

Exposure to Disinfection By-products During Pregnancy

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Background/Aims: Many studies of disinfection by-products (DBPs) in drinking water and adverse birth outcomes have been limited by a lack of individual-level data on water use for exposure assessment, and by potential residual confounding. Uncertainty remains as to the most important factors driving exposure to DBPs, and which factors may be potential confounders. We have investigated these issues whilst performing exposure assessment for a new birth cohort.

Methods: Patterns of water consumption, showering, bathing, and swimming were analyzed for women in the Born in Bradford cohort (n = 4045). These individual-level water use data were collected by questionnaire and validated in a nested study (n = 39), using a 7-day exposure diary. Semi-individual metrics of exposure to trihalomethanes (THMs) during pregnancy were calculated for 2710 women combining individual-level water use data and modeled area-level THM concentrations. Semi-individual exposure metrics were analyzed using ANOVA to assess the contribution of spatial, temporal, and individual components of variability.

Results: Preliminary results show that water consumption, showering, bathing, and swimming differ according to demographic and lifestyle variables (eg, combined showering/bathing per week decreases across increasing age groups, with a difference of almost 2 hours between youngest and oldest age groups), and suggest accuracy of self-reported water use data differs according to employment status. Whilst underlying patterns of spatial and temporal variation in THM concentrations at the tap can be observed in semi-individual THM exposure metrics their contributions to total variability are very small, and it appears the majority (83%–96%) of variability in THM exposure is explained by individual variation in water use behavior.

Conclusion: This study provides important insights into the accuracy of self-reported exposure data and the factors driving DBP exposure amongst pregnant women. The findings are valuable to inform exposure assessment and epidemiological analysis in studies assessing the relationship between DBPs and adverse birth outcomes.

O-30C6-5

Age of Puberty in Relation to Perfluorooctanoic Acid

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Background/Aims: Perfluorooctanoic acid (PFOA, also known as C8) is widespread and has been shown to affect the reproductive cycle in rodents. One small study has reported an association between PFOA exposure and earlier development of pubertal maturation in girls.

Methods: A survey in a group of residents from the Ohio and West Virginia communities with PFOA water contamination was conducted in 2005–2006. Approximately 69,000 participants of all ages who had consumed drinking water for at least 1 year from sources with PFOA contamination, providing demographic information by questionnaire and blood samples. Serum was analyzed for PFOA, PFOS, and many clinical markers, including testosterone and estradiol hormones. The questionnaire included questions on pregnancy and menstruation. In analyses focused on 10—17 year olds, the proportion of teenagers who had reached puberty at each age is estimated by the concentrations of hormones, and for girls, at the onset of menses.

Results: Analyses currently underway are assessing the relationship between the odds of having reached puberty at different ages in relationship to PFOA levels in serum, from which average delay in puberty for unit PFOA increase will be estimated. The principle potential confounder for which we have data is BMI which is included in the models.

Conclusion: As the numbers studied are large and the exposure contrasts very high for PFOA in this population, this study will be very informative on any association between age of puberty and this exposure.

O-30C6-6

Perineal Use of Talcum Powder and Endometrial Cancer Risk

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Background/Aims: Several studies have reported a positive association between perineal use of talcum powder among adult women and ovarian cancer risk. However, the relationship between talcum powder use and other gynecologic malignancies such as endometrial cancer has not been examined, and little information is available on nonhormonal risk factors for endometrial cancer.

Methods: Perineal use of talcum powder was assessed in 1982 in the Nurses' Health Study. Approximately 40% of women who responded to the questions about perineal use of talcum powder reported ever use. Cox proportional hazards models were used to estimate the incidence rate ratio of endometrial cancer and 95% confidence interval (CI), adjusted for body mass index and other potential confounders. We evaluated the relationship among all women and stratified by menopausal status.

Results: Our analysis included 66,028 women with 599 incident cases of invasive endometrial adenocarcinoma diagnosed between 1982 and 2004. Although no association was observed overall, the association varied by menopausal status (P-interaction = 0.02) and a positive association was observed among postmenopausal women; ever use of talcum powder was associated with a 21% increase in risk of endometrial cancer (95% CI: 1.02, 1.44), while regular use (≥once/wk) was associated with a 24% increase in risk (95% CI: 1.03, 1.48). In addition, we observed a statistically significant increase in risk with increasing frequency of use (P-trend = 0.04).

Conclusion: Our results suggest that perineal talcum powder use increases the risk of endometrial cancer, particularly among postmenopausal women. Future and larger studies are needed to confirm this association and investigate potential mechanisms.

PP-30-169

The Impact of Polycyclic Aromatic Hydrocarbons on Pregnancy Outcome

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Background/Aims: There is widespread concern over the impact of polycyclic aromatic hydrocarbons (PAHs) on pregnancy outcome. PAHs are a group of 2 or more fused aromatic rings compounds that are formed as a result of incomplete combustion of organic matter. Sources of environmental contamination can be both industrial and nonindustrial, with the most common sources being cigarette smoke, coal-fired utilities, vehicle exhaust, wood-burning ovens, and smoked food. 1-hydroxypyrene (1-HP) is considered as appropriate surrogate markers of total PAHs exposure. The aim of the study was to examine the impact of PAHs on fetal growth including birth weight, length, head and chest circumference.

Methods: The prospective Polish Mother and Child Cohort Study was carried out in Poland. The study population consisted of 560 women. The women were interviewed 3 times during pregnancy and once after delivery. From all women included into the study, the urine sample was collected 2 times. Concentration of 1-HP in urine was analyzed using high performance liquid chromatography. Smoking status during pregnancy was assessed based on cotinine level in saliva. For the assessment of the PAHs exposure on pregnancy outcome, the linear regression model was applied. The urine 1-HP concentration was log transferred. The model was adjusted for gestational age, gender, education, martial status, BMI.

Results: The mean concentration of 1-HP was 0.6 μg/g creatinine with range 0.03–10.2 μg/g creatinine. Statistically significant association was observed between 1-HP in urine of pregnant women and cotinine level in saliva (P = 0.05).

Conclusion: The findings suggest that transplacental exposure to PAHs from multiple environmental sources may negatively influence fetal development.

PP-30-170

Maternal Smoking and Alcohol Use During Pregnancy, Common Metabolic Polymorphisms, and the Risk of Recurrent Pregnancy Loss

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Background/Aims: A few environmental factors such as cigarette smoking or alcohol use have been shown to affect the pregnancy outcomes. However, gene-environment interaction remains still unclear. The aim of this study is to elucidate the associations between maternal smoking and alcohol use during pregnancy, common metabolic polymorphisms, and the risk of recurrent pregnancy loss (RPL).

Methods: This case-control study of 204 cases with 2 or more RPL and fertile 383 controls was performed in the city of Sapporo, Japan, during the years 2001–2006. The association between cigarette smoking and alcohol use during pregnancy together with common metabolic and pregnancy–associated single nucleotide polymorphisms, namely CYP1A1 rs4646903 (3698T>C), GSTP1 rs1695 (I105V), COMT rs4680 (V158M), NQO1 rs1800566 (P187S), and PAPPA rs7020782 (Y1224S), and RPL was assessed. We performed logistic regression analysis to examine whether there were any associations using SPSS 17.0.

Results: Without consideration of cigarette smoking or alcohol use during pregnancy, the women with homozygotes for the CYP1A1 C allele had a 2.8-fold elevated risk of RPL (95% confidence interval [CI]: 1.5–5.4), while those with homozygotes for the COMT A allele had a 0.4-fold risk of RPL (95% CI: 0.1–1.0). With consideration of smoking, the smokers with homozygotes for the CYP1A1 C allele had a 6.1-fold elevated risk of RPL (95% CI: 1.3–28.6).

Conclusion: Our findings suggested that the risk of RPL might be increased due to gene-environment interaction.

PP-30-172

Exposure to Air Pollutants During Pregnancy and Outcomes at Birth: An Epidemiological Study in Lombardy, Italy, 2004–2008.

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Background/Aims: Preterm delivery and low birth weight have been associated to air pollution during pregnancy, although results across studies are inconsistent, and further research is needed to identify the relevant exposure windows and specific pollutants associated to the effects. For the first time in Southern Europe, we investigated the association between air pollution and pregnancy outcomes in a highly populated area with a large spatial and temporal variability in pollutant levels.

Methods: We obtained birth certificates for all newborns in Lombardy (2004–2008, n = 332519). From ambient monitoring station data, we calculated daily levels of particulate matter (PM_{10}), NO_2, and Ozone within 9 regional zones characterized by homogenous within-area air pollution levels. Each mother was assigned to 1 zone based on her residence. Average maternal exposure was estimated for each pollutant and in different gestational periods. Within each zone, logistic regression models, including main risk factors, were used to estimate the effects of temporal variations of each pollutant (time-series approach). Whole-region risk estimates were obtained using random-effect meta-analysis.

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Results: We observed a mild effect of PM_{10}, measured during the entire pregnancy, on birth weight (−5 g for a 10 $\mu g/m^3$ increase, $P = 0.024$). The effect was more evident in the most polluted urban areas, and was not concentrated in any of the trimesters. NO_2 and ozone did not affect birth weight. No clear adverse effects on preterm delivery were found.

Conclusion: Our results are consistent with recent studies pointing to PM as determining a small but significant adverse effect on birth weight. The small size of the observed effect could be due to exposure misclassification (ambient instead of personal exposure measurements) or to residual confounding of unmeasured risk factors, which could had attenuated risk estimates. Anyhow, given the number of exposed people, if these small effects are indeed causal, their public health impact could be considerable.

PP-30-173

Periodicity and Trends in the Incidence of Congenital Malformations With Regard to Conception Date of Live and Stillbirths Among Jews and Muslims in Israel, 2000–2006

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Background/Aims: Congenital malformations (CM) of male reproductive system, chromosomal aberrations, and secondary sex ratio (SSR) were found to be associated with environmental Endocrine Disruptor Chemicals exposure. The Israeli population is multicultural, consisted of 80% Jews and 18% Muslims. Temporal patterns in birth occurrence and CM incidence rate (IR) were found to differ between them. Therefore, we aimed to investigate and compare trends and periodicity in IR of CM and SSR conceptions of Jews and Muslims in Israel.

Methods: Time-series design based on weekly IR of CM (live and stillbirths) and SSR during 2000–2006. The following CM were considered: male reproductive system—Hypospadias and Cryptorchidism separately and together as part of testicular dysgenesis syndrome (TDS); chromosomal aberrations 21,18,13 trisomies, "other chromosomal" CM, and all chromosomal CM. Data Source—Ministry of Health. Poisson (Trend-Harmonic) models were applied for CM IR to study trends and periodicity of season, half-year, year, and 2-years; a Binomial model was used for SSR.

Results: TRENDS: In Jews, we found significant nonlinear inclining trends for Cryptorchidism, TDS, and all chromosomal CM. In Muslims, we found significant declining trends for TDS and "other chromosomal" CM group. Trends did not differ significantly between the 2 populations. PERIODICITY: In Jews, we found periodicity for Hypospadias, TDS, 18 trisomy, "other chromosomal" CM, and all chromosomal CM. For Muslim, we found periodicity for Hypospadias, TDS, and all chromosomal CM. Comparison between the 2 populations demonstrated significant differences in the 2-year cycle for male CM and "other chromosomal" CM; and in cycles of season and year for all chromosomal CM. For SSR neither trend nor periodicity was significant in both populations.

Conclusion: CM with the same periodicity, found in both populations, may be related to common environmental exposures; further investigation is needed to evaluate a causative relationships.

PP-30-174

Residence Near High-voltage Power Lines and Risk of Birth Defects

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Background/Aims: The adverse effects on human health of electromagnetic fields are still unclear and congenital anomalies are among the outcomes, which have been associated to such exposure. We conducted a case-control study to examine the risk of birth defects associated with maternal exposure to electromagnetic fields from high-voltage power lines during pregnancy in a northern Italy community.

Methods: We identified all cases of congenital malformations diagnosed during the period 1998–2006 in live- and stillbirths and induced abortions to women residing in the city of Reggio Emilia. As a control group, we selected at random a healthy newborn for each case, matched for year of birth, maternal age, and hospital of birth. We geocoded resident address of each mother during the first trimester of pregnancy in a GIS (Geographical Information System) project. We also calculated the cutpoints of magnetic field density of 0.1, 0.2, and 0.4 microtesla (μT) around high-voltage power lines (>132 kV) crossing the municipal territory, inputting the corresponding polylines into the GIS to define exposure corridors. We eventually calculated the relative risk of prevalence of birth defects associated with maternal exposure to magnetic fields from power lines using a conditional logistic regression model and adjusting for some confounding factors.

Results: We identified 256 cases of birth defects and a corresponding number of control births. In all, 2 cases and 5 control mothers had been residing during the first trimester of pregnancy in corridors with magnetic field intensity >0.1 μT. The relative risk of congenital malformations associated with the maternal residence during the first trimester of pregnancy in the corridors with exposure >0.1 μT was 0.4 (95% confidence interval: 0.1–2.3, $P = 0.338$) after adjustment for maternal age and education.

Conclusion: These observations do not suggest that exposure to electromagnetic fields during early pregnancy is associated with teratogenic risk.

PP-30-175

2,4,5-T and Birth Defects in New Zealand

Barry Borman and Deborah Read *Massey University, Wellington, New Zealand.*

Background/Aims: The herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), which contained the dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin as a contaminant, was used extensively in New Zealand to control gorse. Controversy and community concern continues over the possibility of health effects on the local population from its manufacture between 1962 and 1987 at the former Ivon Watkins-Dow chemical plant in Paritutu, New Plymouth. The aims of the current study were to determine whether the prevalence of birth defects in New Plymouth were different from those reported in other New Zealand studies.

Methods: Data from various New Zealand national and local studies of birth defects were compared with data from the Westown Maternity Hospital in New Plymouth and prevalence rates, and 95% confidence intervals calculated.

Results: During 1965–1971, the overall rate of birth defects, and specifically talipes and congenital dislocation of the hips, at the Westown Maternity Hospital was significantly higher than the rates reported from some other studies in New Zealand at that time. An association has been reported between 2,3,7,8-tetrachlorodibenzo-p-dioxin and spina bifida (Institute of Medicine, 2009). However, there was no difference between the rates of neural tube defects, Down syndrome, congenital heart defects, and facial clefts. Data from the New Zealand Birth Defects Monitoring

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Programme showed the rate of birth defects in New Plymouth was consistently higher than the national average and many other areas during 1980–1989. The difference was likely due to an ascertainment bias with exceptionally high rates of congenital dislocation of hips and talipes in New Plymouth.

Conclusion: These data provide no evidence of an effect on the rates of birth defects from an exposure from 2,4,5-T in New Plymouth.

PP-30-176

High Level of Air Pollution Exposure During Pregnancy and Preterm Birth in Taiyuan, Shanxi, People's Republic of China

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Background/Aims: To evaluate the effect of air pollution exposure during pregnancy on the occurrence of preterm birth in a highly air polluted city in China.

Methods: Births data were from Taiyuan Birth Surveillance System, and air pollution data (PM_{10}, SO_2, NO_2, CO) were from local environmental monitoring station. Case-control and Case-Cross-Over design were used to examine the effect of air pollution on preterm birth in a cohort of 53,604 neonates born from November 2005 to December 2008. Air pollution data at 8 air quality monitoring stations were used to create pregnancy period specific exposure estimates according to mother's residence zip code and time of conception or delivery.

Results: Case-control study matching the conception week suggested that after controlling the confounding effects of socioeconomic factors, prenatal care, maternal age, and newborn gender, the odds of preterm birth increased by 85.6% (95% confidence interval [CI]: 38.8%, 148.1%) at high level of exposure to SO_2 during the first month of pregnancy (>4.29 ppm). For the last month of pregnancy, the odds increased by 43.6% (95% CI: 18.7%, 73.8%) and 33.6% (95% CI: 13.7%, 56.9%) at high level of exposure to PM_{10} (>140.88 $\mu g/m^3$) and NO_2 (>1.43 pphm). In Case-Cross-Over study, the exposure window was chosen in the last week of pregnancy for PM_{10} and the last 3 weeks for SO_2. In Bidirectional control model controlling for weather and other pollutants, the significant associations were observed at lag3 for 50 $\mu g/m^3$ increase of PM_{10} (11.2% increase in preterm birth, 95% CI: 0.6%, 23.1%) and at lag11 for 15 ppm increase of SO_2 (95.8% increase in preterm birth, 95% CI: 3.8%, 69.5%).

Conclusion: Results indicate that exposure to PM_{10}, NO_2, SO_2 during pregnancy may have effect on preterm birth.

PP-30-177

Chlorate and Chlorite Exposure Through Drinking Water During Pregnancy and the Risk of Congenital Anomalies

Elena Righi,[1] Petra Bechtold,[1] Daniela Mariosa,[1] Katia Mastroianni,[1] Pierluigi Giacobazzi,[1] Guerrino Predieri,[1] Elisa Calzolari,[3] Gianni Astolfi,[3] Paolo Lauriola,[4] Danila Tortorici,[1] Gugliemina Fantuzzi,[1] and Gabriella Aggazzotti[1] *[1]University of Modena and Reggio Emilia, Modena, Italy; [2]University of Ferrara, Ferrara, Italy; [3]Emilia Romagna Agency of Environmental Health Protection, Modena, Italy; and [4]Regional Agency for Health and Social Care, Emilia-Romagna, Bologna, Italy.*

Background/Aims: Experimental data suggest that chlorite and chlorate, the main disinfection by-products when chlorine dioxide are used, which can be related to the developmental toxicity, however, no epidemiological evidence is available. This study is a part of the international project "HiWate" (Health Impacts of Long-Term Exposure to Disinfection By-Products in Drinking Water), funded under the EU Sixth Framework Programme for Research and Technological Development (FP6), and aimed to evaluate the risk of congenital anomalies related to chlorite and chlorate exposure during pregnancy.

Methods: A case-control study was carried out in a Northern Italy region (Emilia-Romagna). During the study period (2002–2005), newborns with different congenital anomalies (neural tube, cardiovascular, abdominal wall, cleft lip and palate, respiratory, genital organs, and urinary tract defects) or chromosomal anomalies were extracted from the Regional Malformation Registry, whereas controls (newborns without malformations) were randomly selected from the Regional Birth Register. On the basis of each mother's address, the network supplying drinking water during the period of interest (first trimester of pregnancy) was identified: data on disinfection, water quality, and disinfection by-products were linked to each subject.

Results: Chlorite levels were available for 5494 subjects (mean value: 427 ± 184 $\mu g/L$; range: <200–1283 $\mu g/L$); chlorate levels were available for 1178 women (mean value: 283 ± 78 $\mu g/L$; range: <200–1140 $\mu g/L$). In comparison to subjects exposed to levels <200 $\mu g/L$, women exposed to chlorite level >700 $\mu g/L$ resulted, after adjusting for personal, reproductive, and socioeconomic confounders, at higher risk of newborns with renal defects (OR: 3.3; 95% CI: 1.4–8.1), abdominal wall defects (OR: 6.9; 95% CI: 1.7–28), cleft palate (OR: 4.1; 95% CI: 0.98–16.8); whereas women exposed to chlorate level >200 $\mu g/L$ resulted at higher risk of newborns with obstructive urinary defects (OR: 2.9; 95% CI: 1.1–7.6) and spina bifida (OR: 4.94; 95% CI: 1.1–22).

Conclusion: This was the first epidemiological study evaluating the relationship between chlorite and chlorate exposure and congenital anomalies, however, despite of the ecological exposure assessment, significant increased risks were observed, mainly for urinary tract defects.

PP-30-178

A Case-control Study on Congenital Anomalies and Trihalomethanes Exposure in Emilia Romagna (Northern Italy)

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Background/Aims: Epidemiological studies suggest that exposure during pregnancy to disinfection by-products, mainly trihalomethanes (THMs), can increase the risk of congenital malformations; however, evidence is not conclusive. This study, funded under the EU Sixth Framework Programme for Research and Technological Development (FP6) ("HiWate" project), aimed to assess congenital anomalies risk associated with exposure to THMs during pregnancy.

Methods: A retrospective register-based case-control study was carried out in Emilia-Romagna region (Northern Italy). Data on chromosomal anomalies and different congenital anomalies (neural tube, cardiovascular, abdominal wall, cleft lip and palate, respiratory, genital organs, and urinary tract defects) occurred in the period 2002–2005 were extracted from the Regional Malformation Registry. Four Controls (newborns without malformations) were randomly selected form the Regional Birth Register and frequency matched to cases according to pregnancy period. The network supplying drinking water during the first trimester of pregnancy was identified on the basis of mother's address: THMs data, technical, and structural information (disinfection treatment, water type and quality) were linked to each subject.

Results: A total of 6140 subjects; 1242 cases and 4984 controls, were included in the study: age, reproductive history, and zonal deprivation index distribution (Caranci index) resulted significantly different in mothers of cases and controls. Both total brominated-THMs and total THMs levels appeared very low: mean values were 3.8 (±3.6) and 3.2 (±2.6) $\mu g/L$, respectively and maximum values were 22.8 and 19.7 $\mu g/L$, respectively. No significant increased risks for the different congenital

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anomalies included in the study were observed, also after adjusting for potential confounders, in mother exposed to levels >10 μg/L of total brominated THMs or total THMs in comparison with mothers exposed to levels lower than 5 μg/L.

Conclusion: The low levels of THMs observed in drinking water in the study area did not appear to be associated with a significant increase in the risk of selected congenital malformation.

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PP-30-179

Chlorination Disinfection By-products and Risk of Stillbirths in England and Wales

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Background/Aims: We investigated the association between trihalomethane (THM) concentrations in drinking water and stillbirths across a large population residing in 12 regions of England and Wales. THM concentrations in drinking water are routinely measured by the water companies; therefore, they are often used in epidemiological studies as a marker for disinfection by-products. The study comprises 2.79 million births during the period 1993–2001, of which 14,265 were all-cause stillbirths. Additionally, we investigated 2 cause-specific subgroups of stillbirths, as defined by Wigglesworth codes.

Methods: A hierarchical mixture model was used to model routinely collected THM data from each water company. For the third trimester of pregnancy, the modeled concentrations for total THMs and individual THM species were categorized into predefined low, medium, and high exposure categories and linked, through postcode of the maternal address at birth, to the birth outcome data. Logistic regression was performed adjusting for potential confounding by maternal age (split into 5 categories), and socioeconomic status (as measured by quintiles of the Carstairs Index). Fifteen company/period specific analyses were carried out for each disease endpoint and THM exposure combination, and then company/period specific results were combined through meta-analysis.

Results: Mean total THM concentrations ranged from 16.5 μg/L in the low exposure category to 71.9 μg/L in the high exposure category. Prevalence rates of all-cause and cause-specific stillbirths differed according to maternal age category and according to socioeconomic status (trend of increasing prevalence rates from least to most deprived group). Meta-analysis results were suggestive of a small excess risk of stillbirth associated with chloroform, but not with total THMs or the other individual THM species examined.

Conclusion: There was no evidence to support an association of stillbirth or cause-specific stillbirth with total THMs; however, there was evidence suggestive of a small excess risk of stillbirth with levels of chloroform.

PP-30-181

Epigenomic and Gene Expression Changes in Testicular Cells From Exposure to Phthalates

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Background/Aims: Epigenetic changes disrupting the regulation of gene expression are a common process in the development of cancer. Testicular germ cell tumor (TGCT) is the most common malignancy in young males, and its incidence has been rising in recent years. Epigenetic mechanisms have been known to be associated with gene silencing in TGCT. DNA hypermethylation can cause gene silencing, including the inactivation of tumor suppressor genes. Many tumor suppressor genes have been found to be silenced in TGCT following DNA hypermethylation. Phthalates are endocrine disruptors and are abundantly used as industrial plasticizers. Di-2-(ethylhexyl) phthalate (DEHP) is the most common phthalate found in consumer products and has been reported to be associated with hypermethylation. After exposure, Di-2-(ethylhexyl) phthalate is rapidly hydrolyzed into its active form, mono-(2-ethylhexyl) phthalate (MEHP), a testicular toxicant. The purpose of this study is to examine gene promoter-region methylation in testicular cells and assess the relationship between exposure to phthalates and expression and methylation status of tumor suppressor genes: *Testisin* and *RASSF1A*. Alteration of gene expression of xenobiotic metabolizing enzymes is also known to be associated with TGCT, thus genes, such as *GSTP1* and *CYP1A2*, will also be studied.

Methods: Promoter hypermethylation and gene expression was examined for each genes in testicular germ cells exposed to MEHP in a dose- and time-dependent manner at concentrations of 10 nM, 1 μM, 10 μM, 100 μM, and 1 mM at 24-, 48,- 72-, and 96-hour points, respectively. The methylation status of the tumor suppressor genes *Testisin*, *RASSF1A*, and xenbiotic metabolizing enzyme genes: *GSTP1* and *CYP1A2* were assessed by methylation specific (MSP)-PCR and gene expression by qRT-PCR.

Results: Exposures inversely increased cell proliferation, cell viability and methylation, and decreased gene expression. The results indicative of an association between DNA methylation and gene expression following exposure to phthalate will be presented and discussed.

Conclusion: The findings of this study will allow for a better understanding of the role phthalates play in DNA methylation and the subsequent expression of methylated genes in testicular germ cells.

CHEMICALS AND ENVIRONMENTAL HEALTH ISSUES: PHTHALATE EXPOSURE

O-30C7-1

Associations Between Maternal Prenatal Phthalate Urinary Metabolite Concentrations and Child Mental and Motor Development at Age 3 Years

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Background/Aims: Recent epidemiologic research has shown inverse associations between prenatal and postnatal phthalate urinary metabolite concentrations and child IQ and executive function.

Methods: We have evaluated relationships between maternal prenatal urinary metabolite concentrations and child age 3 Mental Development Index (MDI) and Psychomotor Development Index (PDI) on the Bayley Scales of Infant Development II among 315 mothers and children in New York City. Metabolites were mono-n-butyl phthalate (MnBP), mono-benzyl phthalate, monoisobutyl phthalate (MiBP), and 4 di-2-ethylhexyl phthalate (DEHP) metabolites: mono-2-ethylhexyl phthalate (MEHP), mono-2-ethyl-5-hydroxyhexyl phthalate, mono-2-ethyl-5-oxohexyl phthalate, and mono-2-ethyl-5-carboxypentyl phthalate (MECPP). Concentrations were adjusted for specific gravity and log-transformed. Models controlled for race/ethnicity, child gender, gestational age, maternal education, material hardship, prenatal environmental tobacco smoke, and quality of the home environment. Chlorpyrifos levels were low with little variability. Prenatal polycyclic aromatic hydrocarbons did not improve model fit. Thus, neither was included in the models.

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Results: None of the metabolites were significantly associated with child MDI. However, MEHP/sum of the 4 DEHP metabolites × 100 (%MEHP, thought to be a biomarker of susceptibility) was inversely associated with MDI (B = −0.22; 95% CI: 01, −0.46; P = 0.06). Child PDI scores decreased with increasing concentrations of (ln)MnBP (B = −2.4; 95% CI: −0.7, −4.1; P = 0.007) and (ln)MiBP (B = −2.0; 95% CI: −0.4, −3.6; P = 0.01) and the odds ratio for risk of motor delay increased significantly (1.5; 95% CI: 1.0, 2.2; P = 0.04 and 1.8; 95% CI: 1.2, 2.6; P = 0.004 for (ln)MnBP and (ln)MiBP). In contrast (ln) MECPP was positively associated with child PDI scores (B = 1.9; 95% CI: 0.4, 3.5; P = 0.01) but did not modulate risk of motor delay (P = 0.5).

Conclusion: Prenatal exposure to some phthalates may modulate child development. However, these are among the first reports of effects on mental and motor development and should be interpreted with caution. Additional research is warranted to explore these hypotheses.

O-30C7-2

Maternal Exposure to Phthalates and Phenols and Fetal Growth Among Male Newborns

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Background/Aims: A previous study in humans reported possible sex-specific effects of some phthalates and phenols on fetal growth. The aim of this study was to assess the relation between prenatal exposures to phthalates and phenols and birthweight among male newborns.

Methods: We conducted a case-control study nested in 2 mother-child cohorts. Pregnant women were recruited before 24 gestational weeks and followed-up until delivery. We selected all cases of cryptorchidism and hypospadias (detected at birth in the 2 cohorts) and matched them with 3 male controls. We measured in maternal urine samples collected between the fourth and 27th gestational weeks the concentrations of 9 phenols (n = 195) and 11 phthalates metabolites (n = 291). We examined birthweight by a weighted linear regression adjusted for potential confounders, gestational duration, and creatinine level. The weighting approach was used to account for the fact that we used data from a case-control study based on another health outcome to study birthweight.

Results: Birthweight varied by −67 g for an increase by 1 in log-transformed concentrations of 2,4-dichlorophenol (DCP) (95% confidence interval [CI[: −115 to −18 g) and by −36 g for an increase by 1 in log-transformed 2,5-DCP (95% CI: −70 to −3 g). An increase by 1 in log-transformed benzophenone-3 (BP3) levels was associated with an average increase by 30 g in birthweight (95% CI: 0 to 59 g). This relation was not monotonous: compared to the lowest exposure tertile, birth weight varied by −111 g (95% CI: −264 to 41 g) and +108 g (95% CI: −33 to 250 g) in the second and third exposure tertiles, respectively. A nonlinear relation was observed between several high molecular weight phthalate metabolites and birthweight.

Conclusion: Among male newborns, 2,4-DCP and 2,5-DCP were monotonously associated with birthweight decreases, whereas BP3 tended to be positively associated with birthweight. The 2,5-DCP and BP3 results were in agreement with those reported before among newborns from New York.

O-30C7-3

Phthalate Exposure Predicts Social and Attention Problems in Children

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Background/Aims: Previous studies on phthalate exposure to children have shown that phthalate concentration was adversely associated verbal IQ and symptoms of ADHD in school-aged children. They have investigated a relatively limited range of variables. In this study, we extended the investigation to parents-rated behavioral problem by phthalate exposure using path analysis.

Methods: A total of 1089 school aged children(mean age = 9.05 ± 0.7) has been enrolled in this study from 2008 to 2009 in 5 cities. Children's urine was collected and analyzed for phthalate metabolites. Mono-2-ethylheyl phthalate (MEHP) and mono-2-ethyl-5-oxohexylphthalate (MEOP) and mono-n-butyl phthalate (MNBP) were measured in urine samples. Children were assessed for the intellectual functioning and inattention/hyperactivity-impulsivity symptoms using the continuous performance test (CPT). Children's parent evaluated their child's behaviors using Children's Behavioral Check List (CBCL). Path analysis was used to determine the relationship between variables.

Results: In multivariate adjusted models, increased log concentrations of MNHP and MNOP were associated with poorer scores on the verbal IQ (beta [SE] = −0.568 [0.253] P = 0.025), the score of Commission error on CPT (beta [SE] = 2.595 [1.01] P = 0.01), and higher scores of social problems and attention problems on CBCL were associated with increased MNHP and MNOP concentrations. (beta [SE] = 0.807 [0.243] P = 0.001, beta [SE] = 0.403 [0.204] P = 0.048). Path analysis models revealed differences in the variables predicting behavioral problems of Children. Increased phthalate concentrations had strong direct negative effects on Verbal IQ and Commission error on CPT. Specifically, increased phthalate concentrations measures mediated the role of verbal IQ, commission error on CPT in predicting behavioral problems on CBCL. Phthalate had an indirect effect on Behavioral Problems (Social problems, Attention problems). This result provided an excellent fit to the data. (NFI = 0.945, CFI = 0.950, RMSEA = 0.089)

Conclusion: This study suggests that phthalate exposure may be associated social and attention problems mediated by poorer verbal IQ and higher scores of commission error on test.

O-30C7-4

Phthalate Exposure May Affect Girl Puberty Via Stimulation of Kisspeptin-54 Secretion

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Background/Aims: Central precocious puberty (CPP) is a complex problem with hypothalamic-pituitary-gonadal (HPG) axis for children development. This research is aimed to investigate the relationship and effect mechanism between phthalate exposure and girl puberty.

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Methods: This case-control study was conducted from 2007 to 2009. Twenty-six CPP girls were recruited from the polyclinic of Pediatric Endocrinology in National Cheng Kung University Hospital, and 11 normal and similar age ranged girls were recruited as control group from elementary school. Informed consents were obtained from all participants and their parents. Basic clinical diagnostic, luteinizing hormone, follicle-stimulating hormone, estradiol, 7 urinary phthalate metabolites, and kisspeptin-54 levels were evaluated in each participant. The concentration of kisspeptin-54 was measured using kisspeptin-54 radioimmunoassay kit. Seven urinary phthalate metabolites including MMP, MEP, MBP, MBzP, MEHP, MEOHP, and MEHHP were analyzed by LC-MS/MS.

Results: Kisspeptin-54 levels of CPP girls were significantly higher than those of control group (2.23 pmol/L V.S. 1.95 pmol/L; $P = 0.01$). We further divided CPP girls into 2 groups: treatment with Leupline and nontreatment with Leupline. The results showed a significantly increasing trend of kisspeptin-54 among 3 groups (trend test, $P = 0.003$). Levels of urinary phthalate metabolites also revealed a significant difference ($P < 0.05$) among 3 groups on MMP, MBP, MBzP, MEOHP, MEHHP. Significantly positive correlation between kisspeptin-54 secretion and urinary MBP levels in girls were found ($R^2 = 0.288$; $P = 0.001$).

Conclusion: In this study, we found MBP may affect puberty onset in girls by stimulating kisspeptin-54 secretion. Future researches are needed to elucidate the mechanism of action and to investigate whether any other factors related to DBP exposure alter the kisspeptin-54 secretion.

O-30C7-5

Hierarchical Bayesian Regression for Multiple Correlated Exposures: An Application to Prenatal Phthalate Metabolites and Length of Gestation

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Background/Aims: In previous results, several metabolites of Di(2-ethylhexyl) phthalate (DEHP) measured in prenatal urine were found individually and as a molar sum to be associated with shortened length of gestation in an inner-city pregnancy cohort. The high multicollinearity of exposure to some phthalate metabolites (Pearson correlation on log-transformed concentrations >0.9) poses a challenge in modeling multiple exposures simultaneously. Shrinkage methods such as ridge regression and hierarchical Bayesian models, which may reduce variance driven by multicollinearity, have not been widely applied to biomonitoring data. We predict that without known relative weighting, hierarchical Bayesian models can be used to estimate effects of phthalate mixtures.

Methods: We used ridge regression with generalized cross-validation to select an optimal shrinkage parameter value and then drew Markov Chain Monte Carlo samples from the equivalent posterior distribution of Bayesian models using WinBUGS software. Three covariates from the prior analysis were retained (smoking during pregnancy, premature rupture of the membrane, pre-planned C-section).

Results: Shrinkage estimates using single DEHP metabolites were consistent with our prior findings. The largest effect size was likewise MEHHP, a secondary oxidative metabolite of DEHP (−0.18 weeks gestation for a 1 SD increase in the log concentration of MEHHP, 95% credible interval −0.31 to −0.05, n = 267). After adjusting for other metabolites of DEHP, the 95% credible interval included 0. In contrast, the 95% CI of an indicator for the proportion of DEHP metabolites made up of the primary metabolite, MEHP, proposed by others as a crude phenotype for phthalate metabolism, was negative and did not include 0. The addition of metabolites of other phthalates besides DEHP did not substantially reduce the deviance indicating that they may not be associated with our outcome.

Conclusion: These preliminary results indicate the potential importance of the metabolism of phthalates in modeling epidemiologic effects. Future analysis will work to model metabolism more explicitly.

LONG-TERM HEALTH IMPACT OF CHEMICAL EXPOSURE (OIL SPILL AND DIOXIN)

S-30C8-1

Evaluation of the Persistence of Respiratory Health Effects in Clean-up Workers of the Prestige Oil Spill

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Background/Aims: The wreckage of the oil tanker Prestige in 2002 heavily contaminated the coast of Galicia (Spain). We have previously reported an increased prevalence of respiratory symptoms and bronchial hyperresponsiveness (BHR), and increased levels of the oxidative stress marker 8-isoprostane in exhaled breath condensate of non-smoking fishermen 2 years after having participated in clean-up work. In 2008, we evaluated the persistence of these effects 4 years later in 158 highly exposed and 57 non-exposed lifetime nonsmoking fishermen.

Methods: An interview included questions on respiratory symptoms. Forced spirometry and methacholine challenge testing was performed again and BHR was defined as a 20% fall in FEV1 associated with a methacholine dose of 2 mg or less. Exhaled breath condensate samples were obtained and 8-isoprostane was determined using an enzyme immunoassay. Associations between participation in clean-up work and respiratory health outcomes were assessed using multivariable logistic or linear regression models adjusting for sex and age.

Results: There were no differences in symptom prevalence (odds ratio: 1.0; 95% confidence interval: 0.5–2.0), BHR (odds ratio: 0.5; 0.3–1.1) and annual decline of FEV1 ($P = 0.41$) or FVC ($P = 0.96$) between exposed and non-exposed. Geometric mean levels of 8-isoprostane were 18 and 21 pg/mL in exposed and non-exposed, respectively ($P = 0.24$), and not associated with respiratory symptoms.

Conclusion: These findings provide no evidence for persistent respiratory health effects in nonsmoking fishermen 6 years after having participated in clean-up activities of the Prestige oil spill. This may suggest that the previously observed effects 2 years after exposure could have been reversible.

S-30C8-2

Long-term Health Effects of Hebei Spirit Oil Spill on Cleanup Workers

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Background/Aims: Our objective was to examine and evaluate the health effect of the residents who participated in cleanup works in the area near Hebei-Spirit oil spill site and to overview some factors associated with the results 2 years after the accident.

Methods: A survey was conducted from February 2009 to August 2009. The number of participants was 9242 adults and 457 students of the

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elementary school in contaminated coastal area. The symptom of allergic disease and multiple chemical sensitivity (MCS) as well as the information of demographic characteristics, smoking habit, alcohol consumption, number of clean-up working days were investigated using a constructed questionnaire and the oxidative stress markers, eg, 8-hydroxydeoxyguanosine and malondialdehyde were measured. The environmental exposure direct assessment was used by simulation and direct measurement of residual contaminants in water, food, soil, and air was performed and the indirect assessment used by the days of clean-up working and residential area.

Results: The prevalence of asthma among children attending school in high contaminated area was 27.2% by the questionnaire and 16.8% by metacholine provocation test, which were higher compared with those among children with similar ages in similar areas but not contaminated (16.0%, 6.4%). In adults, the odds ratio of the various symptoms of the allergic disease and MCS were increased according to increasing cleanup working days and decreasing distance to coastline contaminated by oil spill. We found the dose-response relationship between clean-up work days and 8-hydroxydeoxyguanosine and malondialdehyde.

Conclusion: Residents and children in oil spill area showed increasing symptoms of allergic disease, MCS, and higher level of oxidative stress biomarkers according to increasing indices of oil spill exposure, while there were hardly found the residual oil contaminants in various environmental media.

S-30C8-3

Environmental Metabolomics in Health Effects Investigation of Oil Spill Exposure

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Background/Aims: Environmental metabolomics is an emerging technology for examining metabolic profiles in biological systems exposed to environmental stress using mass spectrometry, which provides a blend of sensitive, rapid, and selective qualitative and quantitative analyses with the ability to metabolites. It involves the application of advanced analytical and statistical tools to profile changes in levels of endo- and exogenous metabolites in tissues and biofluids result from disease onset, stress, or chemical exposure.

Methods: In this study, we performed a pattern analysis using UPLC-QTOF/MS in urine of residents who exposed to toxicant chemicals, and then we investigated a steroids profile in urine using the GC-MS.

Results: To visualize differences between the metabolite signatures between low- and high-exposure to chemical substances, both PLS-DA and supervised hierarchical clustering analysis (based on Pearson correlation coefficients) were the good discrimination between groups. We were searched histidine metabolism for upregulated, and glutathione and steroid metabolism for down-regulated metabolites from library. For targeted metabolic profiling, androgen steroids metabolites were decreased in high-exposure group, while estrogen steroids were increased. The alterations in circulating steroids levels usually lead to compensatory adaptation of the production rate and the rate of degradation and excretion.

Conclusion: Our results mean toxicant-induced estrogenic and antiandrogenic effect. The present metabolomic approaches will provide the most comprehensive molecular description of organisms in the environment and could be a useful tool in investigation of health effect and biomonitoring.

S-30C8-4

Long-term Effects in the Population Exposed to Dioxin After the "Seveso Accident"

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Background/Aims: The 1976 Seveso, accident caused the contamination of a large inhabited area by 2,3,7,8-tetrachlorodibenzodioxin. Three zones with decreasing soil 2,3,7,8-tetrachlorodibenzodioxin levels were delimited: zone A (very high), zone B (high), and R (low). A surrounding non-contaminated area was adopted as reference area. All subjects living in the Seveso area were followed up, blind of their exposure status, to evaluate long-term health effects through mortality and cancer incidence studies. The main finding of the mortality study (1976–2001) was an increase in lymphatic and hematopoietic cancers among both genders in the most polluted zones (A and B). The cancer incidence had already been investigated for the years 1977–1991. We report the results of the extension of the study to 1996 (20 years after the accident).

Methods: Gender-, age-, and period-adjusted rate ratios (RR) and 95% confidence intervals (95% CI) were calculated by using Poisson regression for subjects aged 0–74 years.

Results: All cancer incidence did not differ from expectations in any of the contaminated zones. An excess of lymphatic and hematopoietic tissue neoplasms was observed in zones A (4 cases; RR, 1.39; 95% CI, 0.52–3.71) and B (29 cases; RR, 1.56; 95% CI, 1.07–2.27). An increased risk of breast cancer was detected in zone A females after 15 years since the accident (5 cases, RR, 2.57; 95% CI, 1.07–6.20). No cases of soft tissue sarcomas occurred in the most exposed zones. No cancer cases were detected among subjects with chloracne.

Conclusion: The extension of the Seveso cancer incidence study confirmed an excess risk of lymphatic and hematopoietic tissue neoplasms in the most exposed zones. No clear pattern by time since the accident and zones was evident partly because of the low number of cases. The elevated risk of breast cancer in zone A females after 15 years since the accident deserves further and thorough investigation.

S-30C8-5

Cardiovascular Disease Risk Linked to Insulin Resistance in Persons Exposed to Moderate-to-high Levels of Dioxin

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Background/Aims: Epidemiologic research has linked insulin resistance to increased risk for cardiovascular disease (CVD). Dioxins cause cardiovascular toxicity in experimental animals. In the large worldwide burden of CVD, it is necessary to identify the high-risk candidates for CVD to facilitate the most efficient use of healthcare resources and make the reduction of CVD risk. We aimed to investigate and clarify the integrated effects of moderate-to-high exposure to dioxins and insulin resistance on the risk of CVD.

Methods: This cross-sectional study investigated 1920 residents without CVD near a deserted pentachlorophenol factory. Insulin resistance syndrome and CVD-related factors were measured to examine associations with serum dioxin. We also investigated associations between insulin resistance (HOMA-IR $>$ 75th percentile), serum dioxins, and the Framingham risk score.

Results: After adjusting for confounding factors, we found that general cardiovascular risk increased both with serum dioxin levels and with insulin resistance ($\beta = 0.010$, $P < 0.001$ for dioxins; $\beta = 0.002$, $P < 0.001$ for HOMA-IR). Moreover, we found that participants with higher serum dioxins or insulin resistance levels had a significantly increased

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cardiovascular risk ($P < 0.001$, χ^2 test for the trend). The joint highest tertile of serum dioxins and insulin resistance was associated with a >20% risk of CVD at 63 times the odds of the joint lowest tertile (AOR, 63.30; 95% CI: 33.23, 128.60).

Conclusion: We hypothesize that serum dioxins and insulin resistance are associated with the risk of CVD.

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S-30C8-6

Chronic Kidney Disease and Its Related Factors in an Endemic Area of Dioxin Exposure in Southern Taiwan

Chien-Yuan Huang,[1,2] Jin-Shang Wu,[3] Cheng-Long Wu,[1,2] Jung-Wei Chang,[1] Ching-Chang Lee,[1] Ying-Jan Wang,[1] Yau-Chang Guo,[4,5] Yi-Ching Yang,[3] and How-Ran Guo[1,4,5] *[1]Department of Environmental and Occupational Health, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [2]Tainan Science Park Clinic, Chi-Mei Medical Center, Tainan, Taiwan; [3]Department of Family Medicine, College of Medicine, National Cheng Kung University, Tainan, Taiwan; [4]Department of Occupational and Environmental Medicine, National Cheng Kung University Hospital, Tainan, Taiwan; and [5]Department of Occupational and Environmental Medicine, College of Medicine, National Cheng Kung University, Tainan, Taiwan.*

Background/Aims: Metabolic syndrome (MS) has been found to be related to chronic kidney disease (CKD) in normal population. MS was also found to be correlated to dioxin levels in an area of Tainan, Taiwan where residents were exposed to dioxin released from a factory from 1965 to 1979. As CKD was prevalent in this endemic area of dioxin exposure, we conducted a study to assess the association between MS and CKD and its related factors among the residents.

Methods: We recruited residents with high levels of dioxin, defined as >64 pg WHO98-TEQDF/g lipid and performed health examination between 1 October 2008 and 31 December 2009. CKD was defined as an estimated glomerular filtration rate <60 mL/min/1.73 m^2. MS was defined as meeting 3 of the following criteria: fasting glucose 126 mg/dL, waist circumference >90 cm in men and >80 cm in women, triglycerides >150 mg/dL, HDL <40 mg/dL in men and<50 mg/dL in women, and blood pressures 130/85 mm Hg. The results were compared to a group of residents whose blood dioxin levels were below 64 pg WHO98-TEQDF/g lipid.

Results: Of the 2933 participants in this study, 319 had high exposure levels. We observed positive associations between CKD and dioxin exposure, gender, insulin, uric acid, and MS (all with $P < 0.01$). After adjusting for other factors, we found high dioxin exposure (adjusted odds ratio [AOR] = 2.28, 95% confidence interval [CI]: 1.50–3.46), female gender (AOR = 1.95, 95% CI: 1.36–2.79), high insulin (AOR = 1.74, 95% CI: 1.04–2.79), high uric acid (AOR = 3.41, 95% CI: 2.36–4.95), and MS (AOR = 2.99, 95% CI: 2.12–4.21) were independent predictors of CKD.

Conclusion: CKD is correlated with high dioxin levels in southern Taiwan. It is also related to the gender, insulin, uric acid, and MS.

AIR POLLUTION - SAND DUST AND COARSE PARTICLES

O-31A1-1

Effects of Asian Dust Events on Daily Mortality in Nagasaki, Japan

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Background/Aims: Asian dust, called "kosa" in Japan, is the long-range transport of atmospheric pollutants originating from the desert areas of China and Mongolia. We aimed to quantify the potential effects of Asian dust on daily mortality in Nagasaki, Japan.

Methods: We used the definition of Japan Meteorological Agency for an Asian dust event. Information on the day of death, sex, age at death, cause of death, chronic disease status, smoking habit for all deaths between 1990 and 2006 in the Atomic Bomb Survivors living in Nagasaki city were retrieved. Time-series analysis of all cause deaths and deaths resulting from circulatory and respiratory diseases were performed using a generalized linear Poisson regression model adjusting for suspended particulate matters (SPM), O_x, SO_2, and NO_2. Effects for single-day lags of 0, 1, and 2 days were examined.

Results: There were 20,822 deaths in the study period and more than 95% of the deaths were 60 years or older. Thirty-three percent of the deaths were due to circulatory diseases and 17% were due to respiratory diseases. Never smoker consists 24% and the person treated for diabetes and hypertension were 5% and 14%, respectively. Concentrations of SPM and O_x in March–May were significantly higher in the day of Asian dust than in non-Asian dust day. All cause, circulatory and respiratory daily mortality were 0.5% (95% CI: −10.0, 12.2), 8.8% (95% CI: −10.0, 31.5) and −12.6% (95% CI: −33.7, 15.3) higher on days of Asian dust compared to other days.

Conclusion: We found little evidence of the effects of Asian dust on daily mortality in Nagasaki.

O-31A1-2

Health Effects of Coarse Particulate Matter: A Time-series Analysis in Hong Kong

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Background/Aims: Many epidemiologic studies linked daily counts of hospital admissions to PM_{10} and $PM_{2.5}$. Fewer studies have investigated the relationship of hospital admissions with coarse particles (PMc: particulate matter between 2.5 and 10 μm in aerodynamic diameter), to estimate the health effects of PMc on hospital admissions of cardiovascular and respiratory diseases in Hong Kong after controlling for $PM_{2.5}$.

Methods: Daily time series data from January 2000 to December 2005 included city-wide hospital admission counts for cardiovascular and respiratory outcomes, daily mean temperature and humidity, $PM_{2.5}$, and PMc concentrations. PMc concentrations were estimated by subtracting $PM_{2.5}$ from PM_{10} measurements. Generalized additive model with log link allowing Poisson autoregression and overdispersion was used to model the relationship between particulate matter and hospital admissions. The results were reported as the excess risk (ER%) for admissions per 10 $\mu g/m^3$ increase in the concentration of PM.

Results: The average concentrations of $PM_{2.5}$ and PMc were 39.45 $\mu g/m^3$ and 16.62 $\mu g/m^3$, respectively. A 10 $\mu g/m^3$ increase in the 4-day moving average (lag 03) concentration of PMc corresponded to 1.33% (95% CI: 0.57%, 2.10%) and 1.78% (95% CI: 1.14%, 2.42%) increases of emergency cardiovascular and respiratory admissions, respectively. Parameter estimates for PMc were generally higher than those for $PM_{2.5}$. After controlling for $PM_{2.5}$ in the 2-pollutant model, the effect of PMc on respiratory admissions was attenuated but remained statistically significant while its effect on cardiovascular admissions decreased largely and lost statistical significance.

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Conclusion: Elevated PMc levels were associated with increased hospital admissions of respiratory diseases in Hong Kong. The effect of PMc on cardiovascular admissions was uncertain.

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O-31A1-3

Temporal Distribution of Short-term Effects of Coarse and Fine Particles on Daily Mortality in Nine French Cities

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Background/Aims: Short-term effects of airborne particulate matter (PM_{10}) on mortality have been consistently reported, especially for fine particles ($PM_{2.5}$), which are thought to contain the more harmful components of PM_{10}. However, recent evidences have put new insight into the adverse effects of coarse particles ($PM_{10-2.5}$). In order to further explore the relative role of the 2 size fractions, we investigated the temporal pattern of their effects on short-term mortality in 9 French cities during the 2000–2004 period.

Methods: Data from background monitoring stations measuring both PM_{10} and $PM_{2.5}$ levels were used to compute daily mean levels of $PM_{2.5}$ and $PM_{10-2.5}$. For each city, the temporal distribution of the effects of both fractions of PM_{10} on daily number of deaths (for nontraumatic, cardiovascular and cardiac causes) up to 15 days following exposure was estimated using polynomial distributed lag within Poisson regression models. City-specific results were combined using random effects models.

Results: The temporal patterns of the effect of the 2 size fractions were clearly different: the effect of $PM_{2.5}$ decreased slowly from the day of exposure to 5 days after exposure. No excess risk was observed after then. For $PM_{10-2.5}$, the decrease was sharper, and risks became negative between lags 5 and 10, showing some evidence of mortality displacement. Overall, the excess risks of mortality associated with $PM_{2.5}$ doubled when considering the cumulated effect over the 15 days following exposure compared to the average effect over the 2 days following exposure, whereas the cumulated effect of $PM_{10-2.5}$ was lower than the effects at lags 0–1.

Conclusion: Our results suggest that, while the levels of both fine and coarse particles are associated with very short-term increases in mortality, the effect of $PM_{2.5}$ persists over 15 days, while the effect of $PM_{10-2.5}$ appears to be attenuated. Chemical composition and pathways of both fractions could explain those differences.

O-31A1-4

Long-range Transported Air Pollution From Wild-fires and Mortality

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Background/Aims: Massive amounts of particulate air pollution (PM) are emitted yearly from wild-fires around the globe. However, the effects of exposure to PM from wild-fires on mortality are poorly known. Our objective was to evaluate the association between episodes of long-range transported wild-fire smoke and cardiorespiratory mortality in the Helsinki Metropolitan Area, Finland.

Methods: Data on respiratory and cardiovascular mortality was obtained for the Helsinki Metropolitan Area (around 1 million inhabitants) from the national death registry. Outdoor $PM_{2.5}$ was measured at an urban background and a rural measurement station. Days when $PM_{2.5}$ levels were simultaneously elevated at both stations were categorized as episode days of long-range transportation. Episodes were further divided between episodes from wild-fires and other sources based on backward air mass trajectories, remote sensing of fire hot spots, and dispersion modeling of smoke. Poisson regression adjusting for temperature, relative humidity, coarse particles, and influenza was used to associate wild-fire episode days with mortality. Corresponding non-episode days (i.e. 1 per year for each episode day) were used as control days.

Results: There were 9 days with abundant wild-fire smoke in 2001–2006. The smoke typically originated from large fires in Eastern Europe. Daily mean $PM_{2.5}$ concentrations were 8.7 and 27.1 $\mu g/m^3$ during nonepisode and episode days, respectively. During the episodes, respiratory and cardiovascular mortality were increased by 60% and 26%, respectively.

Conclusion: Long-range transported air pollution from open biomass-burning increases both respiratory and cardiovascular mortality. Adverse health effects of wild-fires on populations are not limited to the immediate vicinity of fire areas.

O-31A1-5

The Feature Analysis for the Metal Components of Ambient $PM_{2.5}$ and PM_{10} During Sand Dust Weather

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Background/Aims: To study the basic distribution of chemical component of $PM_{2.5}$ and PM_{10} during the sand dust weather.

Methods: The method included sampling the ambient particulate matter at Beijing and Alashan area during the sand dust weather of the spring season; and measuring the daily concentration of $PM_{2.5}$ and PM_{10} with the Gravimetric analysis and the chemical component of $PM_{2.5}$ and PM_{10}, especially for heavy metals, with Atomic Absorption Spectrum and X Fluorescence analysis.

Results: The concentration of both $PM_{2.5}$ and PM_{10} have obviously peak values when sand dust weather happens. The time trends for the level of $PM_{2.5}$ and PM_{10} are basically similar in Beijing and Alashan area during the study time. The concentration of constant elements (K, Ca, Na, Mg) and heavy metal elements (Pb, Cr, Cd, As) of PM_{10} were higher in the sand dust weather than that in non-sand dust weather ($P < 0.05$). Method of enrichment factor (EF) was used to express the distribution of the chemical components in the PM. The elements of $1 < EF < 10$ were K, Na, Mg, and Cr; ones of $EF > 10$ were Ca, Pb, As. The EF of Pb, Cr, As in $PM_{2.5}$ were higher than that in PM_{10}, while the EF of K, Ca, Na, Mg were higher in PM_{10}. The results also show that the EF of Pb, Cr, As both in $PM_{2.5}$ and PM_{10} were higher in Beijing than that in Alashan.

Conclusion: Not only the concentration of both $PM_{2.5}$ and PM_{10}, but also the concentration of both constant elements and heavy mental elements in the sand dust weather were higher than that in the non-sand dust day. It suggests that as a result of the heavy traffic and the developing industrialization, the environmental pollution in Beijing is severer than that in Alashan.

O-31A1-6

The Study on Changes of Chemical Component in $PM_{2.5}$ and PM_{10} During the Sand-dust Weather in Beijing

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Background/Aims: The study on health effects of Asian dust has been one of the hotspot in research in northeast Asian area. The aim of the

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study is to analyze the changes of chemical component in $PM_{2.5}$ and PM_{10} during sand-dust weather in Beijing.
Methods: Sampling the particles of PM_{10} and $PM_{2.5}$ for 30 days continuously on May to June of 2007 and measuring the chemical components of the particles by using atomic absorption spectrometry, fluorescence analysis, and X-ray ICP-MS. Meteorological data from local weather authority SPSS 11.5 software was used for statistical analysis.
Results: The concentration of Al, Mn, Sr, Ti, Ni, Ca, Si, Fe, and Mg in $PM_{2.5}$ and the concentration of Al, Mn, Ti, Ca, Si, Fe and Mg in PM_{10} in Beijing were lower than that in Alxa League. The concentration of Cu, Zn, Pb, As, Zr, Mo, Cd, K and B in $PM_{2.5}$ and the concentration of Cu, Zn, Pb, As, Zr, Mo, Cd, K, Ba, and Hg in PM_{10} in Beijing were higher than that in Alxa League. In Alxa League, the concentration of Zr, Mo, Cd, Hg, Pb, Cu, and Zn in $PM_{2.5}$ and the concentration of Zr, Mo, Cd, Hg, Pb, and B in PM_{10} in sand-dust weather were as same as them in the weather without sand and dust. On the contrary, the concentration of other elements were increased. When the sand-dust weather happened, the concentration of some metal element in Beijing increased.
Conclusion: The level of some hazardous heavy metals in the PM are higher in Beijing during sand-dust weather, which may come from the vehicle exhaust pollution of Beijing.

ASSESSMENT METHODOLOGY FOR NEWLY EMERGING EXPOSURES IN ENVIRONMENTAL EPIDEMIOLOGY

S-31A2-1

Assessment Methodology for Newly Emerging Exposures in Environmental Epidemiology

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Background/Aims: Accurate assignment of exposures, which can be evaluated in relation to health outcomes is the cornerstone of successful environmental epidemiologic studies. Current methods of exposure assessment include both direct and indirect measures including internal dose (ie, biomarkers); self-reported exposure based on diet or consumption/use of products; personal monitoring; assignment of exposure based on occupation or residence that may rely on environmental measures. Each method has strengths and weaknesses. Cost, feasibility, and possible misclassification must all be considered when choosing the exposure assessment method for an epidemiologic study.
Methods: Emerging environmental exposures of concern such as polybrominated diphenyl ethers, polyfluoroalkyl compounds, phthalates, and bisphenol A require focused attention for exposure assessment due to issues related to multiple sources of exposure, unknown exposure sources, and temporal representation of the available biomarkers. This symposium will explore selected examples of exposure assessment that have been/can be used in environmental epidemiologic studies and will include a period of discussion on the pros and cons of direct and indirect environmental exposure assessment approaches.
Results: The presentations will include advantages, limitations, and challenges associated with accurate measurement of air pollutants in both outdoor and indoor environments, as well as personal exposures; the possibilities and limitations of biological monitoring using examples of exposures to endocrine disruptors such as phthalates and bisphenol A, and exposure to a well-known carcinogen, environmental tobacco smoke; and a comprehensive presentation on the advantages and disadvantages of various exposure assessments used for polybrominated diphenyl ethers.
Conclusion: This symposium takes a unique cross-society approach by bringing together exposure scientists and environmental epidemiologists through an exploration of the methodological issues related to emerging environmental exposures.

S-31A2-4

Passive Air Sampling: Advantages, Limitations, and Challenges

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Background/Aims: Accurate measurement of air pollutants in outdoor, indoor, and or personal air is critical for assessing exposure to air pollution and potential health effects. Passive sampler is becoming more and more an effective alternative for conventional active sampler in exposure and health effects studies, given its simplicity and low cost. Also, many passive samplers are capable of providing comparable performance to active samplers in terms of sensitivity and reproducibility.
Methods: A variety types of passive samplers with different adsorption media, trapping principles, geometric designs, and the techniques used for the release of the trapped analytes and their final determination techniques have been developed to measure different air pollutants, including single pollutant, such as O_3 and SO_2, and a group of chemicals, such as Volatile organic compounds, carbonyls, semi-volatile organic compounds (such as polycyclic aromatic hydrocarbons and polybrominated diphenyl ethers). Those samplers have been widely used in exposure and epidemiological studies and found very desirable in many situations, such as monitoring of small children, senior people, and pregnant women, as well as synchronic monitoring air pollutants at multiple locations and microenvironments in community exposure studies. However, limitations still exist for passive samplers.
Results: Many samplers are subject to effects of temperature, sampling duration, wind speed, and air concentrations. Also, a long sampling time is often required in order to get enough mass for detection. Further, it is a challenge to measure non-volatile species by passive sampler due to the low diffusion of particle to the adsorption medium. Thus, there is a need to develop a sensitive, reliable, inexpensive, and friendly use passive sampler for the species primarily distributed in particle phase.
Conclusion: Last, a suitable and simple validation system needs to be developed for the evaluation of passive samplers performances for semi-volatile organic compounds and particles.

S-31A2-3

Significance of Biomarkers in the Exposure-disease-continuum

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Background/Aims: Human biomonitoring or the measurement of specific biomarkers in body tissues/fluids is one of several tools to assess exposure to chemical substances. With the aid of biological monitoring internal exposures (biomarkers of exposure), biochemical and biological effects can be evaluated.
Methods: Unlike ambient monitoring, exposure models or questionnaire data, human biomonitoring provides a measure of the amount of substance that has actually been taken up by the human body. Thus, human biomonitoring data permit a reliable approach to exposure assessment even when the extent and nature of external exposures pathways (eg, via foodstuff, air, dust water, cosmetics, lifestyle) are multiple, unknown, or difficult to evaluate. Biomonitoring can also provide data to verify or calibrate (probabilistic) exposure models. An important prerequisite for human biomonitoring is some knowledge on the metabolism and kinetics of the target biomarker and its metabolites. Depending on the characteristics of the respective biomarkers, biomonitoring data can capture exposures over the past 24 hours, a couple of weeks or even several months in the past. Further assumptions, worst case scenarios or evaluation of the contribution exposure routes are not essential, because

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biomonitoring data represent an integral measure of all sources and routes of exposure. Finally, biomonitoring data can also provide critical information to accurately evaluate and communicate health risks, and to develop and monitor measures for reducing exposures.

Results: The possibilities and limitations of biological monitoring will be shown using examples of emerging environmental exposures of concern to endocrine disruptors such as phthalates and bisphenol A (BPA), and exposure to a well-known carcinogen, environmental tobacco smoke. In the case of tobacco smoke exposure, the usefulness of reaction products of carcinogenic substances with hemoglobin, the so called Hb-adducts, as exposure biomarkers will be discussed. Last, biomonitoring data trends of exposure over the last few years will be shown (for phthalates and BPA), as well as comparisons of exposures between Europe and the United States. Biomonitoring data trends of exposure over the last few years will be shown (for phthalates and BPA), as well as comparisons of exposures between Europe and the United States.

Conclusion: Biomonitoring is an excellent tool that can add valuable information on exposures to chemical substances. It does not replace other measures of external exposure or model estimates.

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S-31A2-2

Contrasting Approaches to Exposure Assessment: The Polybrominated Diphenyl Ethers Example

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Background/Aims: Polybrominated diphenyl ethers (PBDEs) are brominated flame retardants added to foam furniture and electronics at percent levels. The current high interest in these compounds was triggered by biomarker research: the discovery in 1998 of exponentially rising concentrations over time in people.

Methods: Research over the last decade into PBDE exposure has used following 4 main approaches: (1) extrapolation from other related compounds (eg, polychlorinated biphenyls); (2) exposure factors: measure PBDEs in environmental media (eg, dust) and multiply by an exposure factor (eg, dust ingestion per day); (3) pharmacokinetic modeling: estimate exposure from body burden data using simple pharmacokinetic models; (4) an epidemiologic approach: examine associations between measured concentrations at various steps along the pathways from sources (eg, concentrations in products) to microenvironments (eg, dust concentration) to personal exposure (eg, handwipes) to absorbed dose (eg, serum concentration). For example, studies have examined associations of PBDE serum levels with dust concentrations or diet (as reported by questionnaire or duplicate diet); further back on the pathway, other studies examined associations between PBDE concentrations in dust and putative sources.

Results: Each approach has its advantages and disadvantages. The extrapolation approach is a very simple first step but risky. The exposure factor approach can be reasonably straightforward, but important issues include the representativeness of the environmental samples and our knowledge of the exposure factor. For example, the exposure factor for incidental ingestion of dust by adults is particularly uncertain. The pharmacokinetic approach is also easy, but an important weakness is the poorly known halflives for most PBDEs. The epidemiologic approach has the advantage of using epidemiologic principles to design internally valid studies and to consider chance, bias (including measurement error), and confounding (as well as generalizability). A disadvantage is the generally high cost and effort needed.

Conclusion: In sum, the various approaches can provide complementary ways of examining problems.

INTERACTION OF ENVIRONMENTAL AND GENETIC FACTORS IN HEALTH AND DEVELOPMENT

O-31A3-1

Influence of Proinflammatory Cytokines Polymorphisms on the Incidence of Bronchial Hyperresponsiveness After Early Occupational Exposure Among Hairdressing, Bakery, and Pastry-making Apprentices

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Background/Aims: Occupational asthma (OA) is a good model for studying the natural history of adult onset asthma, and for investigating gene-workplace exposure interactions. Most studies on genetic polymorphisms involved in this disease were conducted among workers, none dealt with apprentices. Our aim is to assess whether polymorphisms of interleukins (IL) (1, 4, 5, 13) and tumor necrosis factor-alpha (TNFA), play a role in the incidence of bronchial hyperresponsiveness (BHR) among bakery and hairdressing apprentices, 2 populations at high risk of OA.

Methods: A nested case-control study was conducted within a cohort study conducted in 6 vocational schools. Three follow-up visits were scheduled every 6 months after an inclusion examination. Cases were subjects with BHR determined by a metacholine challenge test that was conducted at every visit (V1–V4). DNA was extracted from the nasal lavage fluid. Polymorphisms (IL-1(alpha, beta) IL-13 Arg130Gln, IL-4R Ser478Pro and Gln551Arg, IL-5C-703T and TNFA-308G>A) were evaluated by real-time PCR (Light-Cycler, Roche).

Results: Altogether, 387 subjects had at least 3 visits, including V1 and V4. The mean age at inclusion was 16.9. Most hairdressers were females (92.8%) while most bakery and pastry cooks were males (87.4%). At the end of the follow-up, 71 cases (18.35%) showed an incident BHR. Host factors associated with this incidence differ across the training tracks. Atopy is a determinant among subjects exposed to flour dust ($P = 0.01$). The genotype TNFA-308GG was significantly associated with BHR ($P = 0.03$), with effect in nonatopic subjects. Also, significant interactions between these polymorphisms differ between the training track among the nonatopic subjects. Indeed an increased risk of BHR was observed among hairdressers displaying the combined genotypes TNFA-3086GG/IL1-alpha-TT ($P = 0.03$) and subjects exposed to flour dust displaying the combined genotypes TNF-308GG/IL5-TT ($P = 0.04$) and IL1-beta-TT/IL-13-GA ($P = 0.01$).

Conclusion: This study shows an interaction between early occupational exposure and genetic predisposition, on the risk of BHR.

O-31A3-2

Epigene-environment Interactions and Fibrinogen in an Elderly Cohort: Veterans Administration Normative Aging Study

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Background/Aims: In a previous study, we observed positive effects of traffic-related pollutants (PN, BC, NO_2, and CO) on fibrinogen. Epigenetics refers to potentially mutable marks on the chromosome that influence gene expression, including DNA methylation. These methylation patterns have been shown to influence disease. This is the first study to investigate an epigene-environment interaction for the effects of air

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pollution on levels of fibrinogen, a key player in the clotting cascade, in the elderly, a suspected risk group.

Methods: Using the 75th percentile of the baseline LINE-1 methylation distribution as a cut-off point, we created 2 categories (low vs. high LINE-1 methylation). We fit separate mixed models with random intercepts stratified by these 2 levels. We adjusted for age, seasonality, body mass index, day of the week, temperature, relative humidity, smoking status, statin use, and diabetes, percent neutrophil in differential blood count, and batch for DNA methylation analysis. We investigated whether global LINE-1 methylation modifies the effect of air pollution on fibrinogen levels in 705 elderly men participating in the Veterans Administration Normative Aging Study (2000–2008). We evaluated differences of fibrinogen increase (δ_low vs. high) per 1 interquartile range increase of pollutant between the 2 groups and computed a test of significance of that difference.

Results: In all subjects, we observed significant associations of 3 and 7 days moving average (MA3 and MA7) black carbon levels with fibrinogen ($P = 0.021$ and $P = 0.029$, respectively). Among participants with low LINE-1 methylation, we also found that the effect of black carbon on fibrinogen was significantly greater compared to subjects with higher LINE-1 DNA methylation (δ low vs high = 5.0%, P interaction = 0.035 for MA3 and δ low vs. high = 5.7%, P interaction = 0.036 for MA7).

Conclusion: We observed greater effects of air pollutants on fibrinogen levels among subjects with lower LINE-1 methylation, indicating that epigenetic status can convey susceptibility to air pollution.

O-31A3-3

Association Between Air Pollution and SDNN is Modified by SNPs Involved in Cardiac Rhythm in Individuals With Diabetes or Impaired Glucose Tolerance

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Background/Aims: Epidemiological studies have revealed association between ambient particles and cardiovascular events and heart rate variability (HRV). We investigated the association between air pollution and the standard deviation of NN-intervals (SDNN) and effect modifications by single nucleotide polymorphisms (SNP) in possibly susceptible participants.

Methods: Between March 2007 and December 2008 patients with type 2 diabetes mellitus and impaired glucose tolerance participated in a panel study in Augsburg, Germany. In total, 207 ECGs with an average duration of 5.6 hours were repeatedly measured in up to 4 visits in 61 patients. Particulate matter (PM) was acquired from a fixed monitoring site on an hourly basis. Associations between 1 hour averages of PM and SDNN were analyzed using additive mixed models. Genotypes of 84 SNPs supposed to be involved in cardiac rhythm were identified in the literature. Using regression trees for longitudinal data, SNPs associated with 1 hour intervals of SDNN were determined and included as potential effect modifiers for effects of PM.

Results: A 12.5μg/m^3 increase in PM with an aerodynamic diameter$\leq$ 2.5μm ($PM_{2.5}$) led to an immediate decrease in SDNN (percent change: −3.9%, 95% confidence interval: [−6.7%; −1.1%]) which persisted up to 6 hours. With the tree-based method, we identified the SNPs rs11153730 near the PLN gene and rs333229 in the CHT1 gene. For both SNPs, participants with at least 1 minor allele showed a stronger association with PM2.5. In patients with one or two risk alleles of rs11153730, we observed an immediately decreased SDNN (−5.6 [−8.8%; −2.4%] and −9.6% [−15.6%; −3.6%], respectively). Participants with two risk alleles of rs333229 showed a 2 hours delayed decrease of −10.3% [minus]18.1, −2.6%] in SDNN. Similar results were observed for PM10 and the non-volatile fractions of PM.

Conclusion: We identified persons with a genetic predisposition making them potentially more susceptible to PM with regard to HRV, a possible precursor of cardiac adverse events.

O-31A3-4

A Gene Environment Study of Mercury in The Michigan Dental Association Cohort

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Background/Aims: Mercury (Hg) is a potent neurotoxicant of concern to the general public. Recent studies suggest that several genes that mediates mercury metabolism are polymorphic in humans. We hypothesize that single nucleotide polymorphisms (SNPs) in genes for Metallothionein (MT), Glutathione S-transferase, and Selenoprotein P may underlie interindividual differences in mercury metabolism.

Methods: Dental professionals (n = 232) were recruited during the 153rd Michigan Dental Association Annual Convention. Samples of urine, hair, and buccal swabs were collected for inorganic/organic mercury levels and genotyping (18 SNPs), respectively. Questionnaires were administrated for demographics and dietary fish consumption. Linear regressions were used.

Results: The mean mercury levels in urine and hair and the average mercury intake from fish were 1.11 μg/L, 0.55 μg/g, and 0.082 μg/kg/d, respectively. A weekly average of 10.2 and 9.4 mercury amalgams were removed and placed, respectively, and the average number of personal amalgams was 4.6. Genotype frequencies of all SNPs were in Hardy-Weinberg equilibrium. Models show that the number of personal amalgams and amalgams removed are significant predictors of urine Hg level along with age; Hg intake from fish is a significant predictor of hair Hg level along with gender and age. When the associations between mercury intakes and biomarkers were analyzed with respect to SNPs, gene-environment interactions were found. The minor homozygote of MT2A (rs10636) had a significant positive interaction with mercury intake from fish on hair mercury levels (an increase of 0.13 μg/g compared to the major homozygote for every increment of 0.01 μg/kg/d in fish Hg intake). Minor homozygotes of MT1A (rs11640851), MT1M (rs2270837), and GCLM-588 (rs41303970) were associated with a decrease of 0.017, 0.27, and 0.16 μg/L, respectively in urine Hg compared to the respective major homozygotes for each personal amalgam.

Conclusion: The findings suggest that gene-environment factors may significantly influence mercury biomarkers and this may improve our ability to assess the health risks of mercury.

PP-31-167

Modulation of the Arseniasis Risk by Indoor Exposure and Host Factors in a Multiethnic Village

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Background/Aims: Arseniasis due to contaminated drinking water is a serious problem in some Asian countries. Over 2000 patients in Southwest Guizhou, China have been identified as a unique case of arseniasis related with indoor combustion of high arsenic coal.
Methods: A field investigation in 2 ethnic clans (Han and Hmong), which have been living in the same village for generations was launched. A set of the polymorphic loci, which might be related with the toxic consequence of arsenic exposure were genotyped.
Results: The data showed arseniasis prevalence was associated with subject's ethnicity and the clan consanguinity. The ethnic Han farmers suffered much more frequently from arseniasis, compared with their Hmong neighbors (OR: 15.18, 95% CI: 3.45–67.35). However, analyses of the environmental samples indicated that Hmong clan members were exposed to even higher level of arsenic via inhalation and food ingestion. A higher arsenic body burden in Hmong individuals was also observed. The duration of indoor burning of high arsenic coal proved to be quite similar. The significant higher presentations of genotypes or alleles have been found in diagnosed arseniasis patients than in asymptomatic fellow villagers at the loci GSTO1 C/C10629; CYP19/AS3MT T/C14215; XPD/ERCC2 A/A 35931; and GSTP1 G/G1578 + A/G1578. If all the "risk" genotypes were put into an overall consideration, the carriers of GSTO1C/C10629—AS3MT T/C14215—XPD A/A 35931—GSTP1 G/G1578 + A/G1578, would face even greater risks. Interestingly, the population frequency of "risk" genotypes or "risk" alleles was proved to be significant lower in "less susceptible" Hmong individuals than in their Han neighbors. All the combined "risk" genotype carriers detected were of ethnic Han origin.
Conclusion: The ethnicity or clan consanguinity may play a role in the modulation of arseniasis risk under this unique exposure scenario. The ethnic Hmong villagers seemed less susceptible to arsenic-related skin lesions.

PP-31-168

Association of 5,10-Methylenetetrahydrofolate Reductase Polymorphisms, Arsenic Metabolism, and Arsenic Skin Lesions in Residents Chronically Exposed to Arsenic in Drinking Water

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Background/Aims: This study was conducted to investigate the relationship between 5,10-methylenetetrahydrofolate reductase (MTHFR) genetic polymorphism, arsenic metabolism, and arsenic skin lesions in residents chronically exposed to arsenic in drinking water (≥0.05 mg/L).
Methods: In all, 50 subjects with skin lesions and 35 subjects without skin lesions recruited from an endemic arsenic poisoning area of Shanxi Province, China. Urinary inorganic and methylated arsenic was specified by high performance liquid chromatography combined with hydride generation atomic fluorescence spectrometry. MTHFRC677 polymorphism was determined by polymerase chain reaction-restriction fragment length polymorphism. Micronuclei assay was conducted to evaluate the genetic toxicity of arsenic.
Results: The frequencies of TT genotype and T allele in case group were 34.0% and 56.0%, respectively, and were not significantly different from those in the controls (34.3% and 52.9%). MTHFR 677 polymorphism was significantly associated with arsenic methylation. Subjects with the genotype of CT/TT had the increased percentage of urinary As3+ (P = 0.029) and decreased percentage of urinary dimethylarsinic acid (P = 0.033). No associations were observed between arsenic methylation capacity and skin lesions or micronuclei frequency.
Conclusion: MTHFRC677 polymorphism was significantly associated with arsenic methylation. We did not find the associations between genetic polymorphism of MTHFR(677C-T) and skin lesions or micronuclei frequency.

PP-31-169

Home Dampness, Tumor Necrosis Factor G-308a Genotype, and Childhood Asthma

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Background/Aims: Indoor exposures at home, like dampness, have inversely effects on respiratory outcomes. However, little studies showed that the association between dampness and genetic polymorphisms on childhood asthma.
Methods: We investigated 3810 7-grade schoolchildren in Taiwan Children Health Study from 14 Taiwanese communities. Children's exposure and disease status were measured from questionnaire by parents. Multiple logistic regression models were fitted to estimate the effects of home dampness exposures and TNF-α on the prevalence of asthma and wheeze.
Results: Mildew odor at home was significantly associated with increased prevalence of ever wheeze. The effects of water stamp on the wall at home were associated with increased risk of ever wheeze (Odds ratio [OR] = 1.29, 95% Confidence Interval [CI]: = 1.03–1.62), and it showed an increasing trend (P for trend = 0.01). Joint exposure to mildew odor and TNF G-308A polymorphism showed a significant effect on ever asthma (OR = 2.20, 95% CI: = 1.27–3.82, P for interaction = 0.01) and ever wheeze (OR = 1.69, 95% CI: = 1.02–2.80). Water stamp on the wall at home with TNF-308 GA or AA has more risk on ever asthma (OR = 1.86, 95% CI: = 1.17–2.95), active asthma (OR = 2.47, 95% CI: = 1.37–4.47), and ever wheeze (OR = 1.86, 95% CI: = 1.26–2.74, P for interaction = 0.04). Under stratification by TNF G-308A, the frequency of water stamp on the wall was associated with increasing risk of all asthma subcategories and ever wheeze among TNF-308 GA or AA genotype (P for trend < 0.05).
Conclusion: Home dampness is a risk factor for asthma and wheeze, especially among children with TNF-308 GA or AA genotype.

PP-31-171

IQ and Blood Lead Levels: Effect Modification By ALAD Amongst Children in Chennai, India

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Background/Aims: Exposure to lead is known to be causally associated with deficits in intelligence quotient (IQ) among children. However, little is known about genetic factors that affect neurocognitive susceptibility to lead. The effect of lead on the body has been known to vary across the aminolevulinate delta-dehydratase (ALAD) genotype among adults, but there are few studies examining the association in children. This study tests the hypothesis that the ALAD polymorphism modifies the association between lead and IQ among school-age children in Chennai, India.
Methods: A total of 756 children, aged 3 to 7 years, were recruited from 12 schools in Chennai, India. Blood lead levels (BLL) were measured using the LeadCare Analyzer. The Binet–Kamat intelligence test was administered to ascertain IQ. ALAD genotype, for 695 children, was determined using the MassARRAY iPLEXTM. Stratified and interaction generalized linear models were used to explore modification of the lead

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and IQ association by ALAD genotype (1/1 vs. 1/2 + 2/2 genotypes) after adjusting for age, socioeconomic status, mother's and father's education, and hemoglobin.

Results: The distribution of the ALAD 1/1, ALAD 1/2, and ALAD 2/2 genotype in this population was 73.4%, 23.2%, and 3.4%, respectively. The mean BLL for the whole population was 11.5 μg/dL. Children with the ALAD 1/1 genotype experienced a 3.11 reduction in IQ points with every 10 μg/dL increase in blood lead levels ($P = 0.022$). Children with the ALAD 1/2 or 2/2 genotype experienced a 1.72 drop in IQ points with every 10 μg/dL increase in BLLs ($P = 0.4603$). In the interaction model, IQ decreased by 0.698 points between the ALAD groups, with every 10 μg/dL increase in blood lead levels ($P = 0.788$).

Conclusion: This study did not find significant effect modification of the lead and IQ association by ALAD genotype.

PP-31-172

Functional STK15 Phe31Ile and p53 Pro72arg Polymorphism and Bladder Cancer in Southwestern Taiwan

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Background/Aims: To evaluate whether arsenic exposure and functional STK15 (Aurora A) Phe31Ile and p53 Pro72Arg polymorphisms are associated with the risk of bladder cancer in southwestern Taiwan.

Methods: We conducted a hospital-based case-control study and recruited bladder cancer patients as cases and noncancer patients as controls. All the participants were interviewed using a standard questionnaire to collect relevant data. The genotypes were determined using polymerase chain reaction-restricted fragment length polymorphism.

Results: We recruited 59 bladder cancer patients and 201 controls. We found that male gender, lower educational level, and cigarette smoking were associated with a higher risk of bladder cancers. In addition, we found that drinking well water over 15 years and in southwestern Taiwan with high arsenic concentration were also risk factors of bladder cancer. In the gene polymorphism analysis, we found that both STK15 Phe31Ile (T > A) mutant type (AA) and mutant allele (A) associated with a higher risk of bladder cancer (OR = 2.1, 95% CI: 0.8–5.5, $P = 0.39$) and (OR = 1.7, 95% CI: 0.7–4.4, $P = 0.17$), but the increases were not statistically significant. p53 Pro72Arg (C > G) with one mutant allele (GC) was associated with a higher risk of bladder cancer (OR: 1.4, 95% CI: 0.7–2.7, $P = 0.54$), but the increase was not statistically significant, either. Regardless of genotypes, an increase in arsenic exposure was associated with a significant higher risk of bladder cancers.

Conclusion: Arsenic exposure was associated with a higher risk of bladder cancers, but the effects of STK15 Phe31Ile and p53 Pro72Arg polymorphisms on bladder cancer were not statistically significant.

PP-31-173

Arsenic Ingestion, Polo-like Kinase 2 Gene Polymorphism, and Skin Cancer

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Background/Aims: Arsenic is a well-documented human carcinogen. The cutaneous effects, including skin cancer, of chronic exposure to arsenic in drinking water have been demonstrated by epidemiological studies conducted in Taiwan. However, the mechanism of arsenic as a carcinogen is unclear. Polo-like kinase 2 (PLK2) is a protein from PLK family which is related serine-threonine kinase and regulates both normal cell cycle progression and the cellular response to DNA damage. Recent studies found that calcipotriol affected proliferation of keratinocytes by decreasing the expression of PLK2, and the gene polymorphism of the protein regulates those functions and is related to the individual variability regarding susceptibility to skin cancer. To evaluate the relationship of arsenic exposure and PLK2 gene polymorphism to skin cancer, we conducted a case-control study.

Methods: We recruited skin cancer patients and cancer-free controls at a teaching hospital in Tainan, Taiwan. Each participant completed a behavioral and demographic questionnaire, which included questions related to gender, age, education, family history, and smoking habit, and provided a blood sample for genotyping analysis. We evaluated the differences in characteristics between the cases and controls by using the *t* test for continuous data and the chi-square test for categorical data. In addition, we evaluated the associations between PLK2 genetic polymorphism and arsenic-related skin cancer by using logistic regression.

Results: We found that participants were less educated and had high exposure levels of arsenic in drinking water. Through logistic regression analysis, we found that individuals who were exposed to arsenic had a more than 6-fold increased risk of developing skin cancer as compared with those who had never been exposed to arsenic.

Conclusion: Being exposed to arsenic affects the odds of skin cancer in individuals. The evaluation of the effects of PLK2 genetic polymorphism on skin cancer is inconclusive.

PP-31-174

ATR1 Gene Polymorphism and Blood Pressure Response to Outdoor Temperature

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Background/Aims: Temperature-related variations of blood pressure has been considered to play a role in excess cardiovascular mortality in extreme temperature. The aim of this study is to evaluate the role of Renin-Angiotensin-Aldosterone (RAA) genotypes on temperature dependent blood pressure (BP) response in Korean population.

Methods: Data including meteorological information, RAA genotypes, and BP were collected for 4998 subjects from February 2003 to August 2004 in a university hospital. The generalized linear models were used to examine the association between the temperature and BP response by RAA genotypes.

Results: The inverse association between temperature and systolic BP (SBP) and diastolic BP (DBP) were observed regardless of polymorphisms of ACE (II + ID/DD) and AGT (TT/MT + MM) genes. In the subjects with ATR1 AA genotype, the similar temperature

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dependent BP responses were noticed (SBP; $\beta = -0.148$, $P < 0.001$), whereas in those with ATR1 AC+CC genotype, those associations were not significant ($\beta = -0.038$, $P = 0.6592$, $\beta = -0.039$, $P = 0.4837$). The younger (age, <10th, 10–50th, 50–90th,90th), ATR1 polymorphism gave larger effect on blood pressure than age in temperature above 90th (25.2°C) percentile while age gave larger effect than ATR1 polymorphism below 20.2°C.

Conclusion: The study suggests a role of ATR1 gene polymorphism for modification of the relationship between temperature and BP in hot temperature (25.2°C).

PROBLEMS REGARDING SOCIOECONOMIC STATUS AND VULNERABILITY (EG, POVERTY, RAPID URBANIZATION, DIFFERENCE OF LIFE QUALITY)

PP-30-182

Association of Maternal Folate and Vitamin B6 and Serum C-reactive Protein Levels With Gestational Age at delivery: Mothers and Children's Environmental Health

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Background/Aims: C-reactive protein (CRP) is the most extensively studied inflammatory risk marker, and elevated serum CRP levels in pregnant women are known to be associated with subsequent development of preeclampsia and preterm delivery. Several studies have suggested that folate intake may help control the inflammation process. The current study examined whether folate nutrition modifies the relationship between serum CRP level and gestational age at delivery.

Methods: Serum folate and CRP concentrations were analyzed in 865 pregnant women between 12 and 28 weeks of gestation. Dietary intake data for usual intake over a 1-year period before pregnancy were collected using a semiquantitative food frequency questionnaire, and 24-hour dietary recalls were used to determine the intake on the day before blood samples were collected. The subjects' serum folate and CRP levels were analyzed by radioimmunoassay and latex agglutination tests, respectively.

Results: Multiple regression analysis after adjustment for covariates revealed that maternal CRP levels at mid- and late-pregnancy were negatively associated with gestational age at delivery; these negative associations were only found when folate intake at mid-pregnancy was below the median, but not when folate intake was above the median. Significant interactions between maternal CRP level at late-pregnancy and folate intakes at pre- ($P = 0.0435$) and mid-pregnancy ($P = 0.0079$) were found on gestational age at delivery. Similar results were obtained for maternal vitamin B6 intake.

Conclusion: In conclusion, we found that adequate maternal folate and vitamin B6 intake at pre- and mid-pregnancy may play a beneficial role against a decrease in gestational age at delivery, which is associated with increased serum CRP levels at late-pregnancy in pregnant women. The findings of this study suggest a potential relationship between folate metabolism and the observed inverse association between CRP level and gestational age at delivery. Thus, further studies are warranted to explore this mechanism.

PP-31-176

Family Interaction Patterns and Risk of Adolescent Internet Addiction in Shanghai, China

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Background/Aims: The quality of parent-adolescent relationships may be associated with the prevalence of internet use and internet addiction in adolescents. The aims of this study were to determine the prevalence of adolescent internet use and internet addiction in Shanghai, and to examine the association of that use and addiction with parent-adolescent relationships in different Chinese family patterns.

Methods: A total of 5135 middle-school students (11.33–20.42 years of age) in Shanghai were studied in 2007. Anonymous questionnaires consisting of the DRM 52 Scale of Internet-use and a Basic Information Questionnaire were completed in order to quantify internet use and characterize the quality of parent-adolescent relationships.

Results: Of total, 450 adolescents met the criteria for internet addiction, and 291 never used the internet. Most parents had an educational attainment beyond junior middle school level (over 97%), had a nuclear family (65.97%) or 3 generation family structure (20.9%), and both parents had harmonious relationships with their children (45.93%). Adolescents with parents who were farmers had the lowest level of internet use, and adolescents with fathers working as doctors or with mothers working as financial professionals were more likely to develop internet addiction. Adolescents from married-but-separated families had the highest prevalence of internet addiction. Left-behind adolescents, adolescents from single-parent families, and those whose mothers had high educational attainment were also at high risk. Poor parent-adolescent relationships strongly predicted adolescent internet addiction.

Conclusion: The quality of parent-adolescent relationships had important effects on adolescent internet addiction, and maternal factors played a central role in the guidance of appropriate adolescent internet use. Adolescents from married-but-separated families or single-parent families, and left-behind adolescents require particular attention.

SCIENCE AS SUPPORT FOR EU POLICY DEVELOPMENT IN ENVIRONMENTAL HEALTH

S-31A4-2

Environmental Health Impacts of European Policies for Mitigation of and Adaptation to Climate Change—A Case Study for Integrated Health Assessment Using the INTARESE/HEIMTSA Methodology

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Background/Aims: Policies and measures for mitigation of and adaption to climate change are usually assessed with only a few criteria, ie, reduction of CO2-eq. emissions (mitigation), reduction of climate change impacts (adaptation), and costs and distribution of costs (who pays how much). However, there are relevant side benefits or side detriments, in particular environmental health impacts, which also should be taken into account when considering decisions about climate policies. Examples are the production and burning of biomass, which causes more pesticide use and more emissions of particulate matter and other pollutants, or the use of renewables instead of coal and gas for electricity production, which reduces the emissions of particulate matter, NOx, and others. Thus, the following question is addressed: What is the (negative or positive) environmental health impact of EU mitigation options (policies and resulting measures) to reduce greenhouse gas emissions and of EU

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adaptation options (policies and resulting measures) to reduce impacts of climate change on human health worldwide?
Methods: Health impacts in scenarios with and without climate policies are estimated using the full chain or impact pathway approach and then compared.
Results: Results show that in general climate policies reduce significantly the population's exposure to environmental pollutants and their associated health impacts. It is shown that, in monetary terms, the "ordinary" environmental health benefits of many mitigation measures are about as important as or sometimes more important than the climate effects. However, some mitigation or adaptation measures cause significant negative environmental health impacts, eg, the burning of wood in smaller stoves, increased air conditioning or the insulation of houses without taking care of sufficient ventilation.
Conclusion: Such measures should be ranked lower than they currently are in the order of priority of climate change policies and they should be accompanied by measures (eg, obligatory dust filters) to reduce the negative environmental health impacts.

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S-31A4-3

Open Collaboration in Environment and Health Policy Support

Jouni Tuomisto,[1] Mikko Pohjola,[1] and No Body[2] [1]*National Institute for Health and Welfare, Kuopio, Finland; and* [2]*University of Eastern Finland, Kuopio, Finland.*

Background/Aims: Issues of environment and health form complex networks of natural and societal phenomena. Good policy-making needs due assessment of these networks. These assessments necessarily require consideration of both knowledge and values from multiple sources representing plural views. Several actors are involved in making important decisions relevant to environment and health. In scientific literature, environment and health assessments are usually considered as tightly interlinked with policy making. Importance of stakeholder and public participation is emphasized. The practice, however, most often is that assessment and policy making are clearly distinct processes. Participation is treated rather as a compulsory add-on to these fundamentally closed processes, more often in relation to policy making than assessment. Also, the use of assessment output is rarely considered during design and making of assessments.
Methods: Recently, we have seen encouraging examples of successful mass collaboration, eg, Linux, Wikipedia, and the human genome project, and recent developments in theories of collaborative learning. Therefore, we tested a new approach to environment and health policy-support: open collaboration. In this approach assessments, engage policy makers, experts, stakeholders, and citizens, ie, anyone interested, to cogenerate sound solutions to practical societal problems by means of science. They are open processes of collective knowledge creation through codevelopment of shared information objects. Based on these starting points, we designed a web workspace that offers functionalities for this kind of work.
Results: Open assessment (http://en.opasnet.org/w/Open_assessment) is a method for open collaboration in environment and health policy support. Opasnet (http://en.opasnet.org) is a web workspace for carrying out open assessments. Open collaboration has been successfully performed in several environmental health assessments and research projects. It has been functional in organizing scientific information. However, researchers have been reluctant to participate. Experience on open collaboration among policy-makers is limited.
Conclusion: Scientific information can be organized using open collaboration methods. Practical experience from different users is urgently needed.

SPATIAL EPIDEMIOLOGY

O-31A5-1

Socioecological Changes and Dengue Fever Transmission in Queensland, Australia: A Spatial Bayesian Approach

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Background/Aims: This study examined the impact of socioecologic factors on the transmission of dengue fever (DF) and assessed the difference in the potential predictors of DF between locally and overseas-acquired cases, Queensland, Australia.
Methods: We obtained data from the Queensland Health on numbers of notified DF cases by local government area (LGA) in Queensland for the period 1 January 2002–31 December 2005. The data on weather and socioeconomic index for areas (SEIFA) and overseas visitors were obtained from the Australian Bureau of Meteorology and the Australian Bureau of Statistics. A Bayesian spatial conditional autoregressive (CAR) model was used to quantify the relationship between variation of DF and socioecologic factors and to determine spatial patterns of DF.
Results: Our results show that the average increase of locally acquired DF was 6% (95% credible interval [CI]: 2%–11%) and 61% (95% CI: 2%–241%) for a 1-mm increase in average monthly rainfall and a 1°C increase in average monthly maximum temperature between 2002 and 2005, respectively. The average increase of overseas-acquired DF cases was 1% (95% CI: 0%–3%) and 1% (95% CI: 0%–2%) for a 1-mm increase in average rainfall and a 1 unit increase in SEIFA. No significant association between numbers of overseas travellers, SEIFA, and DF was found for locally acquired DF cases. For overseas-acquired cases, DF had no significant associations with temperature and numbers of overseas travellers.
Conclusion: The results of this study indicated that socioecological factors may have played a significant role in the transmission of DF. Socioecological drivers of locally and overseas-acquired DF appear to differ in Queensland, Australia.

O-31A5-2

Childhood Type 1 Diabetes Mapping Using Routinely Collected Hospital Data

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Background/Aims: Childhood onset insulin-dependant (type 1) diabetes mellitus shows spatial trends in incidence at the European and UK regional level. In lieu of a dedicated diabetes register for England, hospital records were used to create a surrogate of a national childhood diabetes register for use in epidemiological studies. This hospital records based proxy register validated well against regional registry data, especially for younger children (aged, 0–9 years) and for more recent years (from 2000). Our aim was to use this surrogate register to map childhood diabetes incidence at the small area level across England, to explore spatial trends in risk, and investigate demographic and social variables that may be associated with diabetes risk.
Methods: Incidence of type 1 diabetes in children aged 0–9 years over the period 2000 to 2006 was mapped at the district level to explore spatial patterns in disease risk. Diabetes incidence was explored in relation to

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population density, urban/rural status, area-level socioeconomic status (Carstairs index 2001), overcrowding, and social class.

Results: There was substantial variation in diabetes incidence by district across England. Diabetes incidence rate was 10% higher in rural than urban districts ($P = 0.02$); 22% higher in districts in the lowest population density quintile compared to the highest quintile ($P = 0.01$); and 18% higher in districts in the lowest social class quintile (measured as the highest percentage of persons with a semiskilled/unskilled manual worker as household head) compared to the highest social class quintile ($P < 0.01$). Incidence did not significantly differ with respect to overcrowding or Carstairs index.

Conclusion: Incidence of childhood type 1 diabetes shows spatial variation across England. In keeping with previous studies, higher diabetes incidence was associated with rurality and lower population density. The associations between these social and demographic variables and diabetes risk, and the mechanisms by which they operate require further investigation.

O-31A5-4

On the Use of Satellite Data to Estimate Spatially Referenced Health Risk of Air Pollution

Denis Sarigiannis,[1] Alberto Gotti,[1] Fausto Manes,[2] Guido Incerti,[2] Elisabetta Salvatori,[2] and Pavlos Kalabokas[3] *[1]European Commission-Joint Research Centre, Institute for Health and Consumer Protection, Ispra, Italy; [2]Sapienza University of Rome, Rome, Italy; and [3]Academy of Athens, Athens, Greece.*

Background/Aims: The state of the art in air quality assessment comprises information and data processing tools using only data from ground-based measurement and atmospheric modeling. Ground measurements of air pollutants are not taken from dense enough monitoring networks around the world to permit a satisfactory analysis of the actual influence of fine urban aerosol and ozone on the health of vulnerable population groups, such as the elderly, children under the age of 15, asthmatics, people with cardiovascular problems. Introduction of information derived from Earth Observation satellite data can be used to bridge the gap between models simulating the transport and chemical transformation of ambient air pollutants, and analytical observations.

Methods: A data and model fusion methodology has been developed to integrate the 3 information data sources (i.e., Earth Observation [EO], ground-based information and atmospheric modeling) to derive PM_{10}, $PM_{2.5}$ and ozone loading at the ground level. The resulting pollution maps are coupled to epidemiologically derived exposure-response functions and population data, resulting in high resolution morbidity and mortality indicator maps. Comparison of these maps with actual health outcome statistics reveals new insight into the spatial link between air pollution exposure and public health risk.

Results: The data assimilation methodology was applied in Athens, Greece and Rome, Italy, 2 of the largest capitals in Southern Europe, characterized by increased photochemical pollution and long-range transport of PM. Results showed that the proposed methodology improved significantly the spatial accuracy of health risk estimates. Given the scalar nature of the approach, refined risk estimates can be made in areas populated by susceptible sub-groups taking into account risk modifiers such as the existence of urban vegetation and socioeconomic condition.

Conclusion: Satellite-based atmosphere observation can be a key contributor to the determination of the spatial relationship between air pollution and public health risk. Efficient data and model fusion is the optimal way to achieving this.

O-31A5-5

Comparison of Remote Sensing, Land-use Regression, and Fixed-site Monitoring Approaches for Estimating Exposure to Ambient Air Pollution Within a Canadian Population-based Study of Respiratory and Cardiovascular Health

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Background/Aims: Remote sensing (RS) has emerged as a cutting edge approach for estimating ground-level concentrations of ambient air pollution. While the validity of RS has been demonstrated through comparisons to values obtained from fixed-site monitoring, no previous epidemiological studies have investigated the implications of using RS to characterize health risks. We examined respiratory and cardiovascular health outcomes associated with longer -term exposure measures of air pollution in a national population-based survey ($N = 125{,}574$), using estimates of annual average based on RS, land-use regression (LUR) models, and measured concentrations at the nearest fixed site monitor station.

Methods: RS estimates of NO_2 and $PM_{2.5}$ were derived using satellite measurements from OMI, MODIS, and MISR. Multi-city LUR estimates were based on spatial models incorporating land-use characteristics such as traffic and industrial sources. Measured concentrations at the nearest regulatory continuous monitoring site were obtained from the National Air Pollution Surveillance Network. Self-reported health outcomes including diagnosis, age of onset, symptoms, and medication use for: asthma, bronchitis, COPD, heart disease, hypertension, congestive heart failure, angina, heart attack, and diabetes were collected through the Canadian Community Health Survey, a representative sample of Canadians 12 years of age and older.

Results: RS estimates of $PM_{2.5}$ and NO_2 were highly correlated with ground-based measurements in North America ($R = 0.9$ and 0.8, respectively). Long-term exposures to ambient NO_2 and $PM_{2.5}$ were significantly associated with respiratory and cardiovascular health outcomes (OR = 1.1–1.4, $P < 0.05$) adjusting for age, sex, socioeconomic status, smoking status, and second-hand smoke. Effect estimates for RS were similar to those obtained using LUR and nearest fixed site monitor.

Conclusion: These results suggest that RS can provide useful estimates of individual long-term exposure to ambient air pollution in epidemiologic studies, particularly in remote and rural areas for which monitoring and modeled air quality data are unavailable.

PP-31-177

Spatial Disparities in Potential Access to Food Environments in Rural Texas

Daikwon Han, Joseph Sharkey, and Scott Horel *Texas A & M School of Public Health, College Station, TX.*

Background/Aims: Spatial disparities in access to food environments have emerged as important issues in public health. Of particular interest is further methodological improvement of the measures that incorporate spatial nature of the data. Spatially correlated access measures and/or indicators of neighborhood characteristics have not been adequately addressed in previous studies of food access. In this study, we explored

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the use of multiple spatial analysis methods that consider the spatial nature/limitations.

Methods: We used data from the Brazos Valley Food Environment Project, which included direct observation and on-site GPS identification of all traditional and nontraditional food stores and comprehensive in-store observational survey of the presence and variety of fruits and vegetables in all food stores in 6 rural counties. GIS-based exploratory spatial analysis methods, including global and local measures of spatial autocorrelation (LISA), and kernel density estimation method, were used to examine spatial disparities in potential access, based on measures including distance, coverage, and the ratio of food stores to population.

Results: Overall, we observed both global and local associations in access measures; spatial data are frequently characterized by positive spatial autocorrelation, and we found evidence of highly positive spatial autocorrelation across a set of food stores with different types and varying options of food availability. Kernel density surfaces depicting variations in potential access, adjusting for population density, were used to compare local associations in access measures, and LISA maps to identify those geographic areas with better or poor potential access. Results also indicate that access measures were associated with neighborhood characteristics, thus control of spatially correlated measures may be necessary in estimating the relationships between access and neighborhood characteristics.

Conclusion: To reduce the potential bias and errors associated with spatial characteristics of neighborhood and food environment data, this study illustrates the need for methodological considerations in further ecologic studies of spatial disparities in potential access to food environments.

PP-31-178

Which Postcodes Are Most Vulnerable to Hot Weather in Melbourne? A Spatial Analysis of Human Vulnerability to Heat Events

Margaret Loughnan, Neville Nicholls, Nigel Tapper, and Shobhit Chandra
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Background/Aims: The Intergovernmental Panel on Climate Change has clearly stated that climate change is occurring, and temperature extremes and heat waves will be more frequent. In Melbourne, this may include a 10% to 40% increase in heat wave days by 2030. Published data have identified the elderly population, infirmed, and the very young population as being most susceptible to heat wave conditions. We need to locate groups within our population who are most vulnerable to adverse health outcomes associated with extremely hot weather to develop effective adaptation and mitigation strategies.

Methods: This project used multiple social, health, and environmental sources of information to create an index of vulnerability for Melbourne. This index was mapped to create a spatial representation of vulnerability in Melbourne. The index was tested using daily numbers of deaths and hospitalizations and meteorological data for predefined temperature thresholds to assess its effectiveness in identifying the location of populations susceptible to heat events.

Results: The vulnerability map indicated a clear picture of increased vulnerability in the urban areas around Melbourne along a northwest to southeast axis. There was also a clear relationship between the night-time urban heat island and increased vulnerability. The main factors contributing to population vulnerability were the following: age, ethnicity, urban design, and older people living alone.

Conclusion: By providing information about population vulnerability to heat exposure from a social, demographic, health, and environmental perspective, this study created the opportunity to target behavioral adaptation, public health responses to heat events, and specific information about health risk for urban planners. The research tool itself is not Melbourne-specific and can easily be transferred to other Australian cities.

PP-31-179

Association of Traffic-related Air Pollution and Biomarker in the Elderly Cohort

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Background/Aims: Particulate air pollution in the urban environment has been associated with an increased risk in human mortality and morbidity, especially that caused by cardiopulmonary diseases (Dockery et al, 1993; Peters et al, 2001; Pope et al, 2002). One of the proposed mechanisms is increased oxidative stress. The purpose of this study is to determine association between traffic-related variables and biomarkers in elderly.

Methods: The study population was 411 elderly living in a district (Sungbuk-gu) in Seoul, Korea. The subjects were recruited in local clinics and elderly welfare center. Urine samples were collected 3 times over a year. Average age was 70.5 years and 318 subjects were female. Smoking prevalence was 24% for male and 1.3% for female. The elderly subjects were classified into 4 groups by ambient air pollution data and GIS. Ambient air pollution data for 2 years were used to establish pollution gradient by intrapolation method. Traffic-related variable was established by distance from residence to traffic road and total length of road within 200 m radius. Urine samples were analyzed for MDA.

Results: The highest exposure group showed higher urinary MDA levels than 3 lower groups in all 3 visits. Differences of urinary MDA level between the highest and 3 low exposure groups were statistically significant in second and third visits ($P < 0.01$).

Conclusion: The results suggest that oxidative stress may be associated with air pollution-related with traffic. However, the weak association may be due to relatively small target area and less diverse air pollution level.

PP-31-181

On the Use of Satellite Data for Spatial Health Risk Assessment of Urban Air Pollutants

Denis Sarigiannis,[1] Alberto Gotti,[1] Pavlos Kalabokas,[2] Fausto Manes,[3] Guido Incerti,[3] Elisabetta Salvatori,[3] and Giuseppe La Torre[4] *[1]European Commission, Joint Research Centre, Institute for Health and Consumer Protection, Ispra, Italy; [2]Academy of Athens, Research Centre for Atmospheric Physics and Climatology, Athens, Greece; [3]Department of Plant Biology, Sapienza University of Rome, Rome, Italy; and [4]Department of Experimental Medicine, Sapienza University of Rome, Rome, Italy.*

Background/Aims: The state of the art in air quality assessment comprises information and data processing tools using only data from ground-based measurement and atmospheric modelling. Ground measurements are not taken from dense enough monitoring networks around the world to permit a satisfactory analysis of the influence of air pollution on the health of vulnerable population groups. Attempts to improve our estimation of atmospheric pollutant concentrations at the urban and regional scale from combining ground data with numerical modeling are hampered by the need for high quality and up-to-date emissions inventories, as well as accurate estimates of initial and boundary conditions of the models. Information derived from earth observation satellites can bridge the gap between models, simulating the transport and chemical transformation of atmospheric pollutants and analytical observations.

Methods: A data fusion methodology was developed to integrate satellite data with ground-based information and atmospheric modeling to derive particulate matter and ozone loading at the ground level. Physical properties of tropospheric aerosol and ozone are linked with the

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atmospheric physical–chemical processes that determine the total mass concentration and size distribution of particulate matter and the concentration of ozone. Coupling these with spatially explicitly exposure–response functions and population data, it results in refined maps of health risk attributable to air pollution.

Results: The methodology was implemented in Athens, Greece and Rome, Italy, 2 capitals characterized by intense photochemical pollution and long-range transport of dust. Maps of health risk were produced. The spatially scalar nature of the approach allowed us to evaluate the impact of risk modifiers such as the existence of urban vegetation and population susceptibility.

Conclusion: Satellite data can be used efficiently to improve the spatial link between environmental pollution and human health. The data fusion method proposed in the present study opens the way toward the enhanced use of this valuable information in spatial epidemiology and environmental health science.

CONSUMER PRODUCT EXPOSURE ASSESSMENT IN ASIA/PACIFIC REGION

PP-29-192

Quantitative Risk Assessment Methods to Evaluate the Safety of Menstrual Protection Products

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Background/Aims: Modern superabsorbent feminine care menstrual protection products are sophisticated, well-engineered products that provide many benefits including convenience, comfort, exceptional leakage protection, improved hygiene, and skin care benefits compared with conventional home-made cloth products. Safety assurance is an integral part of the product development process with the ultimate goal of ensuring safety of the product for the user.

Methods: A systematic, stepwise approach to product safety assessment encompasses a thorough evaluation of new design features and materials, and (using principles of quantitative risk assessment) habits and practices (usage) data, along with information from controlled trials to assess clinical endpoints, and independent scientific review of existing and newly generated safety data. The majority of menstrual protection product materials are polymers that enjoy a very safe toxicological profile and do not present inherent toxicity concerns. Trace amounts of nonpolymeric materials, such as colorants, and other materials, like glues, are assessed based on their skin contact potential.

Results: New materials or design features are introduced in marketed products only if they have been shown to be safe under the conditions of recommended or foreseeable use. Product safety continues to be confirmed after product launch by means of in-market monitoring.

Conclusion: This presentation provides a broad overview of human safety quantitative risk assessment methods that are used to ensure that female consumers continue to receive well-designed and safe menstrual protection products.

PP-29-193

Conducting Consumer Product Exposure Assessments: Methods, Data, and Future Directions

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Abstract: Methods and the data required to assess exposure from consumer products are still underdevelopment. Consumers' use of products can be quite variable among consumers. For example, the range of products a consumer can use or come into contact with is quite wide, ranging from personal cleansing products such as hand soap, to cleaning products, to home use pesticides, to clothing and furniture. Furthermore, for any given consumer product, individual consumers can handle these products in very different ways. Finally, some consumers use a product regularly while others never use the product in their lifetime. This variability can lead to quite different exposures to products for individual consumers and makes understanding and estimating this exposure difficult.

Despite this wide range of issues and questions related to how to estimate consumer exposure, there is a need under existing and emerging regulations to generate estimates of these exposures to evaluate whether chemicals used in these types of products are safe. To meet this need, industry has been developing and publishing habits and practices data for various types of consumer products.

This presentation will discuss the methods used to obtain data to understand and quantify how consumers handle products and how these could potentially vary with age, ethnicity, and sex. The strengths and limitations of these various approaches are discussed and the public sources for these data described.

PP-29-194

Consumer Product Safety: Coherent Exposure Assessment for Multiple Products Containing Same Chemical Ingredients—Defining Exposure Opportunities for Different Consumer Types

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Background/Aims: Regulatory agencies in Canada, Europe, and United States wish to assess risks to human health when exposed to a multitude of substances in consumer products. Canada's Environmental Protection Act and Europe's REACh provide some frameworks for the identification, prioritization, and assessment of existing substances and for the control or management of those considered to pose a risk. The United States may strengthen the Toxics Substances Control Act in a similar manner. All of these require exposure assessment strategies sensitive to the chemical's properties and use of the products in which they occur. Divergent consumer types and multiple exposure opportunities per person from multiple products present a dilemma, which could lead to oversimplification and overestimation of exposure for groups of products.

Methods: Using the activity profile generator and community-based assessment software models, exposure profiles were constructed for a series of consumer products including personal care products containing common ingredients. The activity profiles were inserted to the exposure model to yield aggregated exposure assessments as distributed over the population under different exposure durations. The same process was used for each product type individually. Critical contribution assessments were conducted for each age group and duration period to find key drivers of high exposure situations in this proof of concept analysis using the aggregate assessment versus a simple post-analysis combination of individual product types.

Results: Overall contributions by different product types differed by age group, gender, and other parameters. The simple post-analysis combination of individual product types greatly overestimated exposure for all exposure durations and population groups. Aggregated assessments revealed significant exposure drivers for each age group.

Conclusion: Aggregated exposure assessments over multiple consumer product groupings is possible with existing technologies and provides more realistic exposure estimates than combining simple product by product assessments. Within age groups, product use scenarios creating highest exposure opportunities are visible.

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PP-29-195

An Exposure-based Risk Assessment Approach to Safety Evaluation of Laundry Detergent Products

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Background/Aims: Manufacturers of laundry detergent products are responsible for ensuring the safety of new ingredients and products before their introduction into the market place. A risk assessment-based approach has been applied to safety evaluation of the ingredients and finished product formulations using a 4-step process: hazard identification, dose-response assessment, exposure assessment, and risk characterization. A dermal sensitization quantitative risk assessment (QRA) for a detergent ingredient of concern was conducted by incorporating different consumer habits and practices (H&P).

Methods: Extensive consumer studies were conducted to understand consumer H&P for laundry detergent products in prospective market places to estimate consumer exposure to the product ingredients of safety concern though a product-specific route of exposure. Specific parameters include but are not limited to the following: machine-wash use, hand-wash use, bleach co-use habits, the product concentrations in wash solution, and period of hand-washing laundry. A dermal sensitization QRA was conducted for a detergent ingredient of concern based on consumer H&P data in prospective markets.

Results: Recent P&G H&P data showed that consumers in certain developing markets co-use bleach with laundry detergent products for their hand-washing of fabrics which may affect overall risk assessment for the product. In this presentation, we described the following: (1) comprehensive H&P data for consumers' bleach co-use habits for hand-washing laundry in developing markets and (2) a dermal sensitization QRA for a representative ingredient, taking into consideration different regional H&P for laundry detergent products.

Conclusion: A risk assessment-based approach has been successfully used to ensure safety of a detergent ingredient taking into account of different consumer H&P for detergent products in prospective market places.

PP-29-196

Dermal Sensitization Quantitative Risk Assessment for Fragrance Ingredients

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Background/Aims: Some of the chemicals in common use today may have the potential to cause dermal sensitization. However, the fact that a chemical is a skin sensitizer does not mean it cannot be formulated into consumer products at safe levels. This is the case for fragrance ingredients. Based on advances in our understanding of a range of factors associated with the induction of dermal sensitization, it is possible to conduct an exposure-based quantitative risk assessment (QRA) for induction of dermal sensitization to determine safe levels of fragrance ingredients in different consumer product types.

Methods: Key steps of the quantitative risk assessment process are determination of benchmarks (No Expected Sensitization Induction Level or NESIL); application of sensitization assessment factors (SAF) and calculation of consumer exposure (CE) through product use. As fragrances are used in a wide diversity of product types, it is necessary to determine specific SAF and CE for each of these. Using these parameters, an acceptable exposure level (AEL) can be calculated and compared with the consumer exposure level (CEL). The ratio of the AEL to CEL must be favorable to support the safe use of the skin sensitizer. This ratio must be calculated for the skin sensitizer in each product type.

Results: This methodology is now used to determine global fragrance industry product management practices (IFRA Standards) for fragrance ingredients that are potential dermal sensitizers, limiting the use of the materials for 11 individual product categories. The first group of 4 IFRA Standards that implemented this methodology was in May 2006; since then an additional 58 IFRA Standards are based on this methodology.

Conclusion: This poster provides an overview of the principles of exposure-based QRA as applied to fragrance ingredients and provides a practical example using a fragrance ingredient in different product types.

S-31A7-1

Human Risk Assessment Using Biomarkers for Consumer Products

ByungMu Lee *Sungkyunkwan University, Suwon, Republic of Korea.*

Background/Aims: Human risk assessment process often requires exposure assessment data and legal limits to determine safety levels for chemicals. However, exposure data used for risk assessment have limitations due to various uncertainties involved in analytic methods, representativeness of sample, and exposure assessment methodology. In this study, a newer approach for risk assessment of mixture chemicals using biomarkers was studied.

Methods: Chemicals exposed to humans undergo toxicokinetics including absorption, distribution, metabolism, and excretion. Therefore, a chemical absorbed in the body will be kinetically changed time- or dose-dependently in concentrations. A model phthalate compound DEHP or disinfection byproduct (DBP) was used for exposure assessment, and a Mathematica program was applied for the development of exposure model.

Results: In this study, animal model for the exposure assessment of the mixture of DEHP and DBP was developed, which improved incorrect measurement of single chemical exposure out of multiple exposure situation. To best estimate the mixture exposure levels of DEHP or DBP, the mathematical exposure model developed using the toxicokinetic relationship between DEHP, DBP, MEHP, MBP, or phthalic acid (PA) in sera and administered doses. Human sera were collected from 300 volunteers who visited a hospital according to the IRB guideline of Korea FDA (KFDA). DEHP, DBP, MEHP, MBP, or PA were analyzed by UPLC/MS/MS, and the data were applied to the mathematical exposure model.

Conclusion: A mathematical exposure model for the mixture of DEHP and DBP was developed using biomarkers of DEHP, DBP, MEHP, MBP, and PA based on toxicokinetics. This exposure model might be applicable for human risk assessment of phthalate exposure.

This work was supported by a grant from Korea Food and Drug Administration [KFDA].

S-31A7-2

An Exposure-based Risk Assessment Approach to Safety Evaluation of Consumer Products

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Background/Aims: Manufacturers of consumer products are responsible for ensuring the safety of new ingredients and products prior to their introduction into the market place. An exposure-based risk assessment approach is currently applied to safety evaluation of the ingredients and finished product formulations. This presentation is to provide consumer habits and practices (H and P) data for consumer products as an integral part of the risk assessment.

Methods: It is well recognized that consumer H and P on how consumers use of products may be variable across the world. Thus, consumer H and P data for a specific product type in the regions where the product is sold have been collected to conduct the exposure assessment for an ingredient of concern under real consumer product conditions for that region.

Results: Procter and Gamble has collected comprehensive consumer H and P information for a variety of consumer products, which is used to incorporate regional differences in exposure assessments for a certain product type in its risk assessment. This presentation will describe the exposure-based risk assessment approach to safety evaluation of consumer products and demonstrate how different regional H and P data for a product affects its overall risk assessment.

Conclusion: A thorough understanding of consumer H and P for consumer products in prospective market places is essential to estimate consumer exposure to the product ingredients of safety concern via a product-specific route of exposure.

S-31A7-3

Margin of Exposure for Ethyl Carbamate in High Wine Consumption Group in Republic of Korea

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Background/Aims: Ethyl carbamate occurs naturally in fermented foods and alcoholic beverages such as bread, soy sauce, yogurt, wine, beer, and spirits. A number of precursors present in foods and beverages such as hydrocyanic acid, urea, and ethanol can lead to the formation of ethyl carbamate during food processing and storage. Ethyl carbamate is a multisite carcinogen and genotoxic in animals and probably carcinogenic in human.

Methods: The exposure level to ethyl carbamate was calculated on the basis of mean ethyl carbamate level (0–15 μg/L) in wine and 95th percentile consumption level (432 g/d) in adult group. A risk characterization was performed using the Margin of Exposure (MOE) approach which compared a BMDL 10 derived from animal cancer study with exposure level to ethyl carbamate. A MOE value of 10,000 and above was considered to be of low concern for public health.

Results: The estimated exposure level to ethyl carbamate was about 70–104 ng/kg bw/d for a 60 kg person and the exposure level including exposure from other foods was about 87–120 ng/kg bw/d. The MOEs were calculated on the basis of the estimated intake of ethyl carbamate and the BMDL 10 value of 0.3 mg/kg bw/d, and this BMDL 10 value is a corresponding dose to 10% incidence of alveolar and bronchiolar neoplasm in both male and female mice.

Conclusion: The MOEs for high wine consumption group including exposure from other foods were 2493–3440. If the exposure from a variety of alcoholic beverages was considered, the MOEs could be even lower. This indicated that ALARA (As Low As Reasonably Achievable) principle should be considered to reduce and prevent the formation of ethyl carbamate in wine.

SUSTAINABILITY: THE CASE OF BUILDINGS IN THE SHADOW OF CLIMATE CHANGE (ISIAQ SYMPOSIUM)

S-31A8-1

Is Epidemiology Important For Environmental Sustainability?

Julian D. Marshall *University of Minnesota, Minneapolis, MN.*

Background/Aims: Usage of the word "sustainability" is widespread and incorporates a plethora of meanings.

Methods: I review 4 extant sustainability frameworks (The Natural Step, Triple Bottom Line, Ecological Footprint, and Sustainable Emissions and Resource Usage), then add a new one: a Sustainability Hierarchy.

Results: The Sustainability Hierarchy structures a broad array of issues associated with sustainability. These issues vary widely in their urgency, severity, and uncertainty of consequences, and temporal and spatial dimensions. The hierarchy categorizes actions some view as unsustainable based on their direct or indirect potential to (i) endanger the survival of humans; (ii) impair human health; (iii) cause species extinction or violate human rights; or (iv) reduce quality of life or have consequences that are inconsistent with other values, beliefs, or aesthetic preferences.

Conclusion: This presentation discusses whether indoor air pollution, exposure analysis, and environmental epidemiology are relevant in the context of current sustainability theory.

S-31A8-2

Challenge to Sustainability: Climate Change and Indoor Climate

Hal Levin *Building Ecology Research Group, Santa Cruz, CA.*

Background/Aims: Addressing impending global warming (often described within a broader label, climate change) is arguably the most urgent need to move toward a sustainable society. Both the effects of climate on health including but not limited to the indoor environment, and the control of the indoor environment to provide healthy indoor climate are increasingly urgent matters.

Methods: Identification of connections and interactions between climate change and indoor climate as they affect environmental health.

Results: Connections between indoor climate and climate change are strong, but not generally recognized. Climate change impacts local and regional atmospheric conditions including air quality and thermal conditions. Building climate control systems must respond to local climate and air quality to protect human health and support buildings' functional uses. Good indoor climate protects humans against local air pollution and the severe consequences of climate change. Technologies to control indoor climate requiring fossil fuel energy increase pollutant emissions including greenhouse gases; thus, indoor climate control impacts indoor and ambient air quality as well as global climate.

Conclusion: Protecting humans and other living systems from the impacts of climate change involves adaptation and mitigation of the local and regional effects. Understanding and considering impacts of indoor climate control on regional air quality and global climate can reduce the negative impacts of building technology on building occupants as well as the entire global environment. The very definition of sustainability requires understanding the trade-offs among priorities among human and ecosystem effects of climate change and the built environment.

S-31A8-3

Climate Change and Indoor Environments

John Spengler *Harvard School of Public Health, Boston, MA.*

Background/Aims: Extreme variability in weather is a consequence of global warming. To a great extent, the built environment reflects human response and adaptation to long-term climatic conditions. Trends in

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atmospheric measurements reveal rapid changes over the past 30 years in patterns of precipitation, storm intensities, and heat waves. The aim of this presentation is to elucidate the possible implications of climate change (directly or mediated by mitigation efforts) to indoor environments.

Methods: Plausible pathways for climate change impacting indoor environments will be discussed.

Results: There are several scenarios where storm damage, heat waves, increase in ambient ozone, and altered vegetation and ecosystems impact buildings through water damage, thermal stress, emission rates, indoor air chemistry, and infestations. These climate-imposed changes along with deliberate efforts to save energy could influence the chemical, biological, and physical conditions indoors, which have implications to human health and comfort.

Conclusion: Indoor environments may be altered as a result of climate change. While efforts to mitigate carbon from energy sources might bring a reduction of exposures to biomass fuel emissions in the developing world, efforts to shed energy loads in climate-controlled buildings may actually increase risks associated with moisture as well as alter exposures. Clearly, the risks and benefits will not be homogeneously distributed across building types or populations. There will be infrastructure that will be more susceptible to weather extremes and populations more vulnerable to disruption of indoor conditions imposed by climate change.

EMERGING INFECTIOUS DISEASE AND ENVIRONMENTAL FACTORS

O-31A9-1

Possible Aerosol Transmission of Influenza in a Hospital Ward

Ignatius Tak Sun Yu,[1] Hong Qiu,[1] Bonnie C. K. Wong,[2] Nelson Lee,[2] Yuguo Li,[3] Paul Kay Sheung Chan,[4] Zhiwen Luo,[3] Raymond W. M. Lai,[4] and Kin Wing Choi[2] *[1]School of Public Health and Primary Care, The Chinese University of Hong Kong, Shatin, Hong Kong, China; [2]Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Shatin, Hong Kong, China; [3]Department of Mechanical Engineering, The University of Hong Kong, Pokfulam, Hong Kong, China; and [4]Department of Microbiology, The Chinese University of Hong Kong, Shatin, Hong Kong, China.*

Background/Aims: We describe an outbreak of influenza A in a hospital ward in Hong Kong and explore the possible role of aerosol transmission.

Methods: Epidemiological data were collected during the investigation of a nosocomial outbreak in the hospital ward. Spatiotemporal analyses were performed to examine the risk of infection among hospitalized patients in the ward during the infectious period of the index case. Detailed airflow measurements were carried out, and the distribution of a hypothetical virus-laden aerosol source from the index patient at different locations of the ward was estimated using computational fluid dynamics modeling.

Results: The overall attack rate of influenza among inpatients was 15.3% (9/59). It was 23.8%, 22.2%, and 0% in the same, adjacent, and distant cubicles, respectively ($P = 0.022$). Staying in the same and adjacent cubicles on the day when the index case was put on noninvasive ventilation support was independently associated with increased risk of acquiring influenza (odds ratio = 17.0; 95% CI: 2.0, 147.7; $P = 0.01$). The supply air velocities of the air purifier unit placed next to the index patient was found to dominate the airflow pattern, causing a directional airflow in the ward. Computation fluid dynamics modeling suggested that dispersal of the hypothetical virus-laden aerosols into the same and adjacent cubicles corresponded to the locations of affected inpatients.

Conclusion: Results of the study suggest a role of aerosol transmission of influenza virus in the hospital outbreak. Cautious use of aerosol-generating devices and controlling airflow patterns in the hospital wards may need to be implemented.

O-31A9-2

Cooking, Mosquitoes and Malaria: Is There a Relationship?

Shelby Yamamoto,[1] Valérie Louis,[1] Ali Sié,[2] and Rainer Sauerborn[1] *[1]University of Heidelberg, Heidelberg, Germany; and [2]Centre de Recherche en Santé de Nouna, Nouna, Burkina Faso.*

Background/Aims: Most of sub-Saharan Africa uses some form of biomass solid fuel for cooking. This can lead to high exposures and adverse health effects. However, biomass smoke may offer some protection against malaria by creating environments that are inhospitable for mosquitoes, which could impact the transmission and incidence of malaria. In this study, we investigated whether biomass cooking smoke affected the number of mosquitoes in sleeping rooms and the risk of malaria.

Methods: This case-control study examined particulate matter (PM_{10}) concentrations and exposures in the kitchens and sleeping rooms of 55 women (15–45 years) and 283 children (≤9 years) in conjunction with malaria incidence in Nouna, Burkina Faso. Light trap and pyrethrum spray captures were performed in participants' sleeping rooms to assess mosquito abundance.

Results: Sleeping room and kitchen PM_{10} concentrations were not found to be correlated. Higher sleeping room PM_{10} exposures but not concentrations were associated with a lowered risk of malaria among the children in the study (OR = 0.46; 95% CI: 0.22–0.94). No significant correlation was found between the total number of *Anopheles gambiae* mosquitoes captured and PM_{10} concentrations or exposures in sleeping rooms. Higher counts of *A. gambiae* mosquitoes were associated with a lower risk of clinical malaria.

Conclusion: These results suggest that biomass smoke may be protective for children against malaria, although sources of PM_{10} other than cooking fuels might be affecting overall sleeping room concentrations. The lack of a significant correlation between An. gambiae counts and PM_{10} concentrations could be a consequence of the low number of An. gambiae mosquitoes captured, which may have affected the statistical power of the study. The finding of protective effects against malaria with greater mosquito counts may be related to the use of bed nets in the region. Prospective studies may provide a clearer picture of the nature of this relationship.

O-31A9-3

Effectiveness of Aedes Index and Breteau Index in Predicting Dengue Outbreaks in Selangor, Malaysia

Shamsul Azhar Shah and Jamiatul Aida Sani *Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia.*

Background/Aims: Dengue is the most important vector borne disease in Malaysia and globally due to its increasing incidence over the years. Climate changes coupled with rapid urban development result in increasing the breeding and survival of Aedes mosquitoes, the vector for dengue, hence the success of dengue virus transmission. This study aims to identify the relationship between Aedes indices (Aedes Index [AI] and Breteau Index [BI]) and dengue outbreak and study the effectiveness of using Aedes indices to predict dengue outbreaks.

Methods: A cross-sectional study using secondary data on dengue cases notified to Sepang District Health Office 2004 to 2007 was performed.

Results: This study found an increase in dengue incidence over the years in Sepang. Most dengue cases occur among males (62.3%), age group 21–30 years and Malays with upward trend in foreigners. Almost all dengue notifications came from hospital, 68% of cases were confirmed by lab. Majority of dengue outbreaks occurred in localities with low Aedes indices, although significant relationships between Aedes indices and dengue outbreak were found (AI: >5% and outbreaks in 2007 [$P < 0.001$], BI: 20 and outbreaks in 2007) p1% and outbreaks in 2006 ($P =$

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0.029), in 2007 ($P < 0.001$) and BI 5 and outbreaks in 2007 ($P < 0.001$). On further analysis, Aedes indices were shown not to be effective in predicting dengue outbreaks (AUC for AI 0.572, AUC for BI 0.571).
Conclusion: This study concluded that Aedes and Breteau indices are not effective in predicting dengue outbreaks.

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PP-29-111

Health Risks, Methodological Approaches, and Proposals for Action According to Recent Studies on the Health of Travelers

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Background/Aims: The aims of this study were to identify problems related to health and travel, and public policy approaches and proposals in scientific studies.
Methods: A total of 41 articles were selected for review and analyzed according to the place of study, health problems investigated, objectives and methodologies, research location (travel origin or destination), period (pre-travel, during, or post-travel), traveler typologies, and policies and proposed actions.
Results: The most frequent health problems were vector-transmitted diseases, waterborne and foodborne diseases, and respiratory diseases. Studies at the origin and post-travel predominated using surveys of events notified with reduced capacity for intervention on these problems.
Conclusion: The travelers' health is seen primary as individual aspect and secondarily as impact on public health in the interaction of travelers with new environments and rise emerging diseases. The conclusions highlight the need for action about information and risk communication, and the development of surveillance systems, which consider the traveler and their specific mobility and risk.

PP-29-112

A Case-control Study of the Association Between Human Exposure to Selected Chlorinated Pesticides and Primary Hepatocellular Carcinoma

Benhua Zhao,[1] Feng Liu,[2] Sheng Liu,[1] Janjun Niu,[3] Fei Guo,[1] Xueli Sun,[4] and Heqing Shen[2] *[1]Medical College of Xiamen University, Xiamen, People's Republic of China; [2]Key Lab of Urban Environment and Health, Institute of Urban Environment, Chinese Academy of Sciences, Xiamen, People's Republic of China; [3]Xiamen Center for Disease Control and Prevention, Xiamen, People's Republic of China; and [4]Zhangzhou Center for Disease Control and Prevention, Xiamen, People's Republic of China.*

Background/Aims: Although it is well accepted that hepatitis B virus infections are the major risk factors for HCC especially in China, studies have showed that chlorinated pesticide exposure can increase the risk of carcinoma in human (Landau-Ossondo et al, 2009).We designed a case-control study to investigate the possible association between human exposure to chlorinated pesticides and HCC.
Methods: A total of 100 patients and 100 healthy control subjects were personally interviewed for several HCC risk factors. The risk factors like carcinoma and chronic hepatitis of family members, hepatitis B surface antigen and chronic liver diseases are controlled, environmental factors such as drink unclear water, hair coloring, alcohol, smoking, salted vegetable, and tea are also controlled in the design. The serum samples were collected and stored under −20°C until exposure analysis. The sample preparation was modified from the US Environmental Protection Agency method (Sundberg et al, 2006) and measured by Gas Chromatograph-Mass Spectrometer.
Results: The primary statistic results showed that the age and sex of case and control group is nearly normal distributed and matched. Hexachlorobenzene, β-, γ-hexachlorocyclohexane, aldrin, p,p′-DDE, and p,p′-DDD are detectable in most of the samples with average levels 0.32, 2.40, 1.12, 0.14, 8.01, and 0.38 ng/mL.
Conclusion: The further analysis will mine the association of pollutant levels to HCC outcome.

PP-29-113

Integrating Exposure and Epidemiologic Models to Select Nonpharmaceutical Interventions for Influenza

Rachael Jones and Elodie Goodman *University of Illinois at Chicago, Chicago, IL.*

Background/Aims: Traditionally, the effectiveness of hygiene interventions—-hand washing, respirator use, and cough etiquette—-have been explored through mechanistic exposure models within a quantitative risk assessment framework; whereas the effectiveness of social distancing interventions has been explored using epidemiologic models. We present an approach, inspired by Larson (2007), in which the transition from Susceptible to Infected group in the SIR epidemiologic model is based on infection probabilities determined by exposure/risk models, rather than a reproductive number.
Methods: Monte Carlo simulation of a Markov model of influenza exposure and infection risk provides estimates of infection probabilities for selected contact scenarios. Hygiene interventions are included in the exposure/risk model, altering the infection probabilities. The infection probabilities define the transition from Susceptible to Infection in the standardized incidence ratios epidemiologic model. For illustration purposes, we use 2 population strata, with high and low contact rates, respectively; and model the impact of social distancing interventions by modifying the number of people in each strata, and their contact rates. Given repeated model simulation, the epidemic dynamics resulting from different interventions and compliance rates, the can be compared to select the intervention(s) which minimize costs and maximize health risks, given uncertainties about influenza exposure and infection risk.
Results: This new methodological approach will be illustrated using a simple scenario.
Conclusion: The advantages of this approach are the direct comparison of hygiene and social distancing interventions, and explicit treatment of influenza as an environmentally mediated disease, for which the risk of infection is highly dependent upon the type and magnitude of contact between susceptible and infectious persons.

PP-29-114

Seroprevalence of Brucellosis and Q Fever Among the Veterinarians in Veterinary Service Laboratories in Korea

Hyun-Sul Lim,[1] Kwan Lee,[1] Seok-Ju Yoo,[1] Mi Yeoun Park,[2] Sang Hee Park,[2] Hyuk Chu,[2] and Chae Jin Lee[3] *[1]Dongguk University College of Medicine, Gyeongju-si, Gyeongsangbuk-do, Republic of Korea; [2]Korea National Institute of Health, Seoul, Republic of Korea; and [3]Korea Center for Disease Control and Prevention, Seoul, Republic of Korea.*

Background/Aims: The incidence of zoonoses in Korea has increased recently. Thus, we conducted this study in order to obtain basic data for zoonoses among veterinarians in veterinary service laboratories.
Methods: We visited 45 veterinary service laboratories across the country. We conducted a questionnaire survey for work activities, and collected blood samples in order to determine the seroprevalence of brucellosis and Q fever. After more than 2 weeks, we conducted follow-up test in order to check the change of titers of brucellosis and Q fever among the serum reactor of the first test. The titers of brucellosis were measured using microagglutination test (MAT), Q fever indirect immunofluorescence assay (IFA). We diagnosed subjects as seropositive for brucellosis if single titer was more than 1:160 or the titers of follow-up test increased more than 4 fold compared with the first, and for Q fever if IgM was

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more than 1:16 or IgG was more than 1:256 or the titers of follow-up test increased more than 4 fold compared with the first.

Results: We collected blood samples from 511 veterinarians in 45 veterinary service laboratories. The seroprevalence of brucellosis was 0.4% (2 persons), and Q fever was 1.0% (5 persons). The single titers of brucellosis were 1:160 and 1:640, respectively. For Q fever, there were 1 person whose titer was more than 1:16 (IgM), 1 person whose titers were more than 1:16 (IgM) and 1:256 (IgG) both, and 3 persons whose titer was more than 1:256 (IgG).

Conclusion: In this research, the seroprevalence of brucellosis was relatively low. The reasons are assumed to be because of continuous preventive measures against the bovine brucellosis and education for high risk group. Nevertheless, the seroprevalence of Q fever was still rather high. Therefore, we need to pay attention to other zoonoses including Q fever as well as brucellosis.

AIR QUALITY AND EXPOSURES IN TRANSPORTATION ENVIRONMENTS (ISIAQ SYMPOSIUM)

S-31B2-1

Real Time, Size-resolved Prediction of Ultrafine and Accumulation-mode Particle Concentrations on Freeways

Srijan Aggarwal, Ricky Jain, and Julian Marshall *University of Minnesota, Minneapolis, MN.*

Background/Aims: Because on-freeway concentrations of ultrafine particles (UFP; diameter <100 nm) are relatively high, time spent on freeways can be a significant fraction of total daily UFP exposure. Here, we model size-resolved concentrations of UFP and some accumulation-mode particles (size: 100–600 nm) in freeway air.

Methods: Our approach is analogous to land-use regression, but using real-time meteorological data (temperature, wind speed, humidity) and traffic data (traffic speed and volume, derived from in-roadway loop detectors). Size-resolved particle concentrations (size: 5.5–600 nm) were measured on Minnesota freeways during the summers of 2006 and 2007. The modeling involves 2-way stratified multi-regressions.

Results: Meteorological parameters play only a minor role in predicting real-time UFP concentrations on freeways; traffic speed and volume play a major role. Our regression model for particle number concentration has an adjusted R^2 of 0.77. Model performance is better for UFP (size: 10–100 nm; adjusted R^2: 0.79–0.89, average R^2: 0.85) than for the accumulation-mode particles studied here (size: 100–600 nm; adjusted R^2: 0.41–0.83, average R^2: 0.65).

Conclusion: Our model estimates real-time, size-resolved concentrations of particles (size: 5.5–600 nm) on freeways. The approach developed here is useful for identifying hotspots and as an important step toward modeling population exposure to UFP.

S-31B2-2

Commuter Exposure to Vehicle Exhaust Plumes in New Delhi, India

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Background/Aims: Concentrations of air pollutants emitted from vehicles are elevated along roadways, indicating that human exposures in transport microenvironments are not adequately characterized by conventional centrally located air quality monitoring systems. We report the results of real-time exposure measurements of fine particle mass concentration ($PM_{2.5}$) and ultrafine particle number concentration (PNC) inside a ubiquitous type of unenclosed commuter vehicle, the autorickshaw, in New Delhi, India.

Methods: We conducted $PM_{2.5}$ and PNC measurements inside the passenger cabin of an autorickshaw traveling over a fixed 19-km commute route between southern and central New Delhi. Measurements span approximately 35 hours of driving during 16 morning and evening weekday commutes in February–March 2010. To compare in-vehicle and ambient concentrations, we conducted contemporaneous rooftop measurements of ambient $PM_{2.5}$ and PNC in a residential neighborhood at the origin of the sampling route. We collected data at 1–10 seconds frequency, allowing us to identify the contribution of individual exhaust plumes to time-integrated exposures.

Results: Commute-averaged in-vehicle $PM_{2.5}$ and PNC exposure concentrations (321 $\mu g/m^3$; 288,000 particles/cm^3) were respectively 1.5 $\times$ and 7.1 $\times$ higher than contemporaneous ambient levels. Short duration encounters (1–30 s) with vehicle exhaust plumes resulted in very high transient exposure concentrations. The average 95th percentile measurement across all commutes exceeded 550 $\mu g/m^3$ for $PM_{2.5}$ and 880,000 particles/cm^3 for PNC. We infer that undiluted vehicle exhaust plumes contribute incremental exposures above on-road baseline concentrations that account for 16%–35% and 50%–60% of the total commute-integrated $PM_{2.5}$ and PNC exposure, respectively.

Conclusion: Despite regulations that limit New Delhi's daytime vehicle fleet to primarily light-duty vehicles and natural gas-fueled buses, our measurements indicate that mean and peak in-vehicle $PM_{2.5}$ and PNC exposure concentrations are substantially greater than contemporaneous urban ambient levels. The exposure concentrations we report are 5–20 $\times$ greater than values reported in contemporary US and European studies of transport microenvironments.

S-31B2-4

Traffic-generated Pollutants Measured on and Near Roadways and in Community Air of Beijing: Assessing the Effectiveness of Controls During the 2008 Olympic Games

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Background/Aims: Traffic and coal combustion-generated pollutants were monitored in 3 microenvironments: on-road, near road, and in community air of Beijing before, during, and after the Olympic Games of 2008. The aims of the study were (1) to assess the effectiveness of control efforts put in place to meet clean air goals of the 2008 Olympics, (2) to assemble and employ monitors to collect data in on-road microenvironments, and (3) to investigate the impacts of emissions from traffic on community air

Methods: Advanced monitoring methods were employed to gather time-resolved measurements while driving on roadways for black carbon, particle numbers, and submicron particle size distributions as well as CO and CO_2. In addition to the metric collected during on-roadway monitoring, monitoring of super micron particle size distribution and $PM_{2.5}$ mass were conducted at community and near-roadway locations.

Results: Traffic patterns for heavy duty truck usage were clearly shown to impact community air quality during the summer of 2007 with much reduced impacts found during the 2008 summer Olympics. Monitoring conducted during the winter months of 2009–2010 demonstrated a strong impact of emissions from heating and power plants that burned coal combined with strong inversions to create very highly polluted community air. Truck activity differed during the winter period due to changed traffic patterns imposed on trucks, and this change was reflected in reduced levels of pollutants in community air. Data collected on highways were employed to determine emission factors for carbon, ultrafine particles, and CO from over 300 trucks and buses.

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Conclusion: Protocols developed by the investigators were suitable to study the nature and impacts on community air quality of traffic-generated pollutants in developed and developing countries. The pollution control activities instituted during the Olympic Games appear to have reduced particulate matter levels in community air.

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S-31B2-5

Traffic Pollution and Cardiovascular Diseases in Greater Vancouver in Association With Small and Medium Scale Socioeconomic Status Indicators

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Background/Aims: The objective of this research is to analyze, in a combined framework, the risk of cardiovascular diseases relative to traffic air pollution. The study is using 2 levels of aggregation for the socioeconomic variables. This study considers the chronic exposure to residential traffic air pollution and road proximity.

Methods: We identified 346,356 subjects between 45 and 84 years as of 1 January 1999 with complete residential and covariate history and without predisposing conditions. We estimated risk of chronic exposure on cardiovascular diseases with Cox proportional hazard models. We applied temporally adjusted traffic-based land use regression models for NO, NO_2, particulate matter ($PM_{2.5}$), and Black Carbon as well as road proximity measures in association with socioeconomic covariates at 2 levels of aggregation.

Results: Traffic concentrations of NO, NO_2, $PM_{2.5}$, and BC showed an increasing trend in HR estimates for cardiovascular health outcomes (NO: 1.12, 1.01–1.24; NO_2: 1.13, 1.01–1.25; $PM_{2.5}$: 1.10, 1.00–1.21; and black carbon: 1.05, 0.95–1.16 for the fourth quartile of exposure). Living within 50 m of a highway was associated with an elevated HR (1.46, 1.18–1.80); living within 50 m from secondary highways and major roads was associated with an HR of 1.16 (1.05–1.28). Living within 150 m from expressways and primary highways or within 50 m from secondary highways and major roads was associated with an HR of 1.20 (1.10–1.30).

Conclusion: The results of this study suggest that residential traffic-related air pollution exposure increases the risk of cardiovascular heart disease even in a region with relatively lower levels of traffic and ambient pollution in a cohort of subjects with no comorbidities associated with cardiovascular diseases. Even more compelling evidence of the increased risk posed by traffic is produced by the analyses considering road proximity as a surrogate for traffic pollution.

PERSISTENT ORGANIC POLLUTANTS: NEW RISK FACTORS FOR CHRONIC DISEASES

S-31B3-1

Exposure to Polychlorinated Biphenyls Is Associated With an Increased Risk of Hypertension and Cardiovascular Disease

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Background/Aims: Environmental exposures other than tobacco smoke are rarely considered as risk factors for hypertension and cardiovascular disease. However, recent studies using the National Health and Nutrition Examination Survey data set in the United States (Ha et al, 2007, 2008; Everett et al, 2008) and our studies of 2 different populations find strong associations between exposure to polychlorinated biphenyls (PCBs) and other persistent organochlorines and diseases of the circulatory system. Studies of 335 Native Americans exposed to PCBs via consumption of contaminated fish found that serum PCB concentration was correlated with self-reported incidence of both heart disease and hypertension (Goncharov et al, 2008). The association was not direct, however, but was mediated through a PCB-induced increase in serum triglycerides and to a lesser extent cholesterol. Elevated serum lipids are known to be a major risk factor for cardiovascular disease. These results suggest that PCB exposure increases risk of cardiovascular disease through a stimulation of lipid synthesis by the liver.

Methods: We have also studied 759 residents of Anniston, Alabama, site of a large Monsanto facility that manufactured PCBs from 1929 to 1972. Serum PCBs and lipid concentrations were determined and 3 measures of blood pressure obtained.

Results: Rates of hypertension increased significantly ($P < 0.05$) with age and serum PCBs. Using linear regression analysis of blood pressure for 394 participants who were not on antihypertensive medication, serum PCBs was a stronger determinant of blood pressure than BMI, total serum lipids, gender, race, smoking, or exercise, after adjustment for age. There was a significant relationship between blood pressure and serum PCB concentration even for individuals with blood pressure in the "normal" range. Single congener analysis showed that the strongest relationship was with those congeners containing multiple (2–4) orthochlorines. There was no significant relationship with 9 different organochlorine pesticides.

Conclusion: These results suggest that serum PCBs are important risk factors for hypertension.

S-31B3-2

Diabetes and Exposure to PCBs, DDE, Polybrominated Diphenyl Ethers in Frequent and Infrequent Great Lakes Sport Fish Consumers

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Background/Aims: Dioxin, PCBs, DDE, and other persistent halogenated chemicals have been identified as potential etiological factors for diabetes.

Methods: The hypothesis that diabetes is related to environmental exposures was investigated in a cohort of Great Lakes sport fish consumers. Since the establishment of the cohort in 1993, participants have been followed periodically through 2005 for health parameters and exposure biomarkers. Serum PCB and DDE levels decreased during the study period, while polybrominated diphenyl ethers increased. In 2004–2005, DDE and polybrominated diphenyl ethers were similar, and PCBs were slightly higher than levels measured in 2003–2004 in a random sample representative of the US population (National Health and Nutrition Examination Survey). Analysis of PCB and DDE serum concentrations and diabetes occurrence was investigated using the 2004–2005 cross sectional data from 503 participants and prospective analyses in 471 participants with exposure measurements in 1994–1994 and an average of 8.4 years of follow-up.

Results: Cross sectional data revealed associations of serum DDE and dioxin-like PCBs with diabetes, but only the association with DDE was independent of other pollutant exposures. An important limitation of the cross sectional analysis is the lack of knowledge about the temporality of exposure and disease incidence, leading to the possibility that this association reflects alterations in DDE metabolism caused by diabetes. Prospective analyses in the cohort were consistent with cross sectional results and showed that incident diabetes was associated with serum DDE levels. The association of DDE with diabetes remained when cases occurring during the first 6-years of follow-up were excluded, reducing the possibility that reverse causality was responsible for the relationship.

Conclusion: This study is one of the first prospective studies showing an association of DDE with development of diabetes. Further studies will follow-up the cohort to identify additional incident diabetes cases and explore biological mechanisms.

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S-31B3-3

Can Low Dose Persistent Organic Pollutants Explain the Current Epidemic of Type 2 Diabetes?

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Background/Aims: A current paradigm for type 2 diabetes rests on a sequence of events. Obesity occurs due to energy imbalance between energy input and output, insulin resistance is due to obesity, and exhaustion of pancreatic beta cells is due to overproduction of insulin to compensate for insulin resistance, ultimately progressing to type 2 diabetes. However, there is emerging evidence that the background exposure to persistent organic pollutants (POPs), a group of chemicals that mainly accumulates in adipose tissue, may be critically involved in the pathogenesis of type 2 diabetes.
Methods: It has been recently reported that serum concentrations of POPs were strongly associated with the prevalence of type 2 diabetes in the US general population.
Results: After adjusting for known risk factors for diabetes, compared to people with very low concentrations of POPs, the prevalence of type 2 diabetes among those with detectable concentrations of POPs increased by 15–40 fold. Also, the associations were more strongly observed among obese than nonobese persons. Although dioxins have been widely studied as the most toxic chemical among POPs, organochlorine pesticides and polychlorinated biphenyl congeners were strongly associated with type-2 diabetes. In particular, it was striking that when POPs concentrations were very low, prevalent type 2 diabetes was very rare even among the obese with BMI $\geq$30 kg/m^2. Serum concentrations of these POPs were also associated with insulin resistance and adverse lipid profiles among those without diabetes. Recent findings from prospective studies and experimental studies support these cross-sectional associations.
Conclusion: Adverse metabolic effects may occur at the low and persistent exposures to POPs currently observed in the general population even as there is a decreasing trend of chlorinated POPs during recent decades. These low levels of POPs may contribute to the epidemic of type 2 diabetes.

CHEMICALS AND CHILDREN'S HEALTH

O-31B4-2

Longitudinal Food Consumption Frequency Determination and its Implication for Dietary Pesticide Exposure and Risk Assessment

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Background/Aims: Dietary pesticide exposure assessments typically rely on national nutrition surveys or similar large-scale studies for empirical data to describe population-level variability in consumption.
Methods: We used the US National Health and Nutrition Examination Survey (NHANES) and the longitudinal Children's Pesticide Exposure Study (CPES) and Metro Atlanta Cohort (MAC) to illustrate the magnitude of potential error introduced by using national-scale, cross-sectional data to estimate consumption frequencies for smaller cohorts. We focused on foods commonly eaten by US adults (age, 18–60), children (age, 3–11), and items likely to contain pesticide residues. We defined "percent eaters" as the percent of study participants who reported eating a particular food in a 24-hour period. We calculated percent eaters for each sampling day for the CPES and MAC participants, and compared these to the computed weighted percent eaters and 95% confidence limits for children and adults, using the NHANES 24-hour dietary recall data.
Results: In general, across all sampling days, a greater proportion of adult participants reported eating common and seasonal food items, such as banana, broccoli, grapes, lettuce, peach, pear, peas, strawberries, string beans, and tomatoes than the national estimate, while the proportion of non-seasonal food, such as apple was similar. For certain foods, particularly the seasonally available produce, such as apples, peaches/nectarines, melon, grapes, pears, strawberries, the CPES percent eaters fell outside the NHANES 95% confidence limits on many sampling days.
Conclusion: The data illustrate how a higher proportion of adults and children may eat certain foods than the national average depending on season or other factors. Although the differences we observed for certain foods may be due in part to measurement error, they also likely reflect seasonal and geographic patterns among the CPES data that the public release NHANES data do not capture. An exposure assessment that ignored this difference could underestimate dietary pesticide intakes.

O-31B4-3

Polybrominated Diphenyl Ether (PBDE) Exposure Among Mexican Children and Mexican-American Children in the CHAMACOS Cohort, and NHANES

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Background/Aims: Polybrominated diphenyl ethers (PBDEs) are a class of flame retardants used in textiles, furniture, and electronic products. Recent studies have documented widespread PBDE exposure to humans, with higher levels measured in children than adults.
Methods: As part of the Center for Children's Environmental Health Research at UC Berkeley (CHAMACOS study), we analyzed PBDE levels in blood collected from 7-year old Mexican-American children living in California (n = 264), and 5-year old children living in areas of Mexico where the CHAMACOS mothers originated (n = 286). We compared PBDE concentrations from these 2 populations to levels reported for 192 Mexican-American children (12–19 years old) participating in the National Health and Nutrition Survey (NHANES 2003–2004).
Results: The most frequently detected PBDE congeners in child serum were BDEs 47, 99, 100, and 153, all of which were measured in 100% of the Californian children's samples, and in more than 73% of the Mexican children's samples. Geometric mean total PBDE concentrations (Σ 4 congeners) were significantly higher among CHAMACOS children compared to the Mexican and NHANES children (GM [CI] = 83.5 ng/g lipid [76.1, 91.6] vs. 11.7 ng/g lipid [10.4, 13.1], and 59.9 ng/g lipid [52.7, 68.2], respectively; $P < 0.01$). Factors associated with higher PBDE levels in the CHAMACOS children were mother's country of origin, length of time residing in the United States, education, and parity. In future analyses, we will examine predictors of PBDE exposure such as diet, breastfeeding history, consumer electronics use, BMI, time outside the United States, and housing quality.
Conclusion: Findings suggest that Mexican-American children living in California are experiencing higher PBDE exposure from their environment compared to children sampled from the general US population and Mexico.

O-31B4-4

Latent Immunological Effects of Gestational Exposure to Heptachlor Epoxide

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Background/Aims: The commercial milk supply on the Hawaiian island of Oahu was contaminated with heptachlor epoxide (HE) during a 15 month period (1981–1982), resulting in gestational exposure to offspring of women who drank cows' milk during that period. The aim of this study was to evaluate whether the gestational exposure to heptachlor epoxide resulted in latent effects on immunological function in the exposed population as young adults.

Methods: We recruited 399 Oahu-born and 57 comparison young adults who were not born on Oahu, matched by age and ethnicity, who would have been in utero at the time of the earlier milk contamination episode. We interviewed the parents about the pregnancy, including asking the mother how much cows milk she consumed while she was pregnant with the study subject. We had conducted an earlier biological marker study in which we found that reported cows milk consumption was significantly associated with measured heptachlor epoxide in serum and breast milk, so we used reported cows milk consumption as a surrogate indicator of exposure in this study. Indicators of immune function include skin tests for standard recall antigens; antibody titer response to immunization with tetanus and multivalent pneumococcal vaccine; Th1 and Th2 type CD4+ cell subsets in peripheral blood; and susceptibility of peripheral blood T cells to activation-induced cell death using in vitro analysis of Fas (CD95) and its ligand (CD95L) expression.

Results: Among Oahu-born participants, reported mothers' milk consumption during pregnancy was inversely associated with maximum antibody titer and antibody titer response to immunization with pneumococcal vaccine. No other significant differences in immunological function were observed.

Conclusion: Gestational exposure to heptachlor epoxide may be associated with decreased antibody response to pneumococcal vaccine, a T cell independent carbohydrate antigen, through at least 25 years of age.

AIR POLLUTION - SOCIAL FACTORS

O-31B5-1

Burden of Disease of Seoul Citizens Attributable to Air Pollutants From Municipal Solid Waste Incinerators: Source-specific Approach for Environmental Burden of Disease

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Background/Aims: There have been no studies quantifying the integrated health burden, both mortality and morbidity, of air pollutants on the population in the vicinity of the incinerators. The aims of this study were to estimate the attributable burden of disease caused by incinerators in Seoul, Korea and to present a source-specific exposure-based approach for the estimation of environmental burden of disease.

Methods: We integrated air dispersion modeling, Geographic Information Systems, the population distribution of exposure, and the exposure-response relationship. We then estimated the PAFs caused by additional concentrations of 4 air pollutants (PM_{10}, NO_2, SO_2, and CO) emitted from 4 municipal solid waste incinerators in Seoul in 2007. We, finally, estimated the attributable burden of disease, using the disability-adjusted life years method developed by the Global Burden of Disease Group of World Health Organization and the estimated PAFs.

Results: PAF for NO_2 to all-cause mortality was assessed at about 0.02% (95% CI: 0.003%–0.036%), which was the highest among 4 air pollutants included. The PAFs for respiratory and cardiovascular disease were 0.12% (95% CI: 0.01%–0.16%) and 0.10% (95% CI: 0.04%–0.16%), respectively. The sum of the attributable burden of disease for 4 pollutants was about 297 person-years (95% CI: 121–472 person-years) when the incinerators observed to the emission standards. The attributable burden of respiratory disease and cardiovascular disease were about 0.2% and 0.1% of the total burden of respiratory disease and cardiovascular disease for the year 2007, respectively.

Conclusion: Although the air emissions from one risk factor, the incinerator, are small, the burden of disease can be significant to the public health when population exposures are considered. This source-specific and population exposure-based burden of disease could contribute to prioritizing emission reduction policies with regard to their effects on human health impact.

O-31B5-2

Risk-based Prioritization Among Air Pollution Control Strategies in Yangtze River Delta, China

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Background/Aims: The Yangtze River Delta (YRD) is the fastest growing economic development region in China and one of the most densely populated regions in the world, with recent dramatic increases in energy consumption and atmospheric emissions. We study how different emission sectors influence population exposures and corresponding health risks to inform air pollution control strategy design.

Methods: The Community Multiscale Air Quality (CMAQ) model is applied to an emission inventory we developed to model the marginal contribution to baseline concentrations from different sectors in 2006. We focus on NO_x control while taking into consideration other pollutants that impact particulate matter ($PM_{2.5}$) and ozone concentrations. We develop concentration-response functions for $PM_{2.5}$ and ozone mortality for China to evaluate the anticipated health benefits.

Results: In YRD, health benefits per ton of emission reductions vary significantly across pollutants, with primary $PM_{2.5}$ from the industry and mobile source sectors having the greatest benefits. Combining these estimates with emission reductions given plausible control strategies, the greatest mortality reductions of about 13,000 fewer deaths per year are associated with controlling primary $PM_{2.5}$ emissions from the industry sector and SO2 from the power sector. Benefits are lower for NO_x controls given lower formation of secondary $PM_{2.5}$ and increases in ozone concentrations within VOC-limited regions.

Conclusion: Health benefits of emission reductions in YRD are substantial, especially for sectors and pollutants with both higher population exposure per unit emissions and large potential for emission reductions. These findings can provide the basis for prioritizing pollutant control strategies in YRD.

O-31B5-3

Air Pollution and Health Ulaanbaatar City of Mongolia

Saijaa Nagniin, Ouynbileg Janchiv, Enkhtuya Palam, and Kupul Jalkhaa *Public Health Institute, Ulaanbaatar, Mongolia,*

Background/Aims: Some studies suggest that Ger areas in Ulaanbaatar are responsible for emitting approximately 70 percent of the city's air pollution. An air pollution assessment of emissions from linear and mobile sources, and focally-stationed, concentrated pollution in Ger areas, estimates that the city's "P" index is at P = 3.78 using the formula ($P = \sqrt{\Sigma K2}$), or at "mild level" pollution. The goals of the survey are to define Ulaanbaatar city's air pollution level, determine the correlation between air pollution and morbidity & mortality rates from respiratory diseases among the population, and develop recommendations for air pollution-related disease control and prevention, and air pollution reduction.

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Methods: Assessment and conclusions will be developed on the basis of data processing and analysis of 2004–2008 statistical data on morbidity and mortality from respiratory diseases among the population of Ulaanbaatar city and 2004–2008 data on the most common air pollutants; sulfur dioxide, nitrogen dioxide, particulate matter of different sizes, and data on meteorological measurements using appropriate methodology.

Results: According to the measuring results of 4 air quality monitoring stations in Ulaanbaatar, the concentration of sulfur dioxide (SO2) increased by 1.39 ± 10.9 $\mu g/m^3$or 9.9% and nitrogen dioxide (NO_2), by 4.49 ± 6.9 $\mu g/m^3$or by 13.46%. The concentration of suspended particulate matter $PM_{2.5}$ reaches its peak between October and January every year ranging between 83.74 ± 11.77 $\mu g/m^3$–184.32 ± 12.03 $\mu g/m^3$ and decreases to its lowest point in June, July, and August with a range of 4.51 $\mu g/m^3$–9.76 ± 2.79 $\mu g/m^3$. In the wintertime, the concentration of particulate matter $PM_{2.5}$ raises by 40.29%–72.87% compared to the National standard; whereas in the springtime, it raises 13.76%–40.29% greater than the standard requirement. We can see a direct but insignificant correlation between the concentration of sulfur dioxide in the atmosphere and morbidity of respiratory diseases among the population ($R = 0.39$; $P = 0.02$).

We compared the monthly average concentration of sulfur dioxide in the atmosphere of Ulaanbaatar city to morbidity of respiratory diseases per 10,000 population, in order to determine the association between these factors. The average concentration of sulfur dioxide in the atmosphere increases annually during the period of November to January and February. When it reaches its peak (20.45 ± 8 $\mu g/m^3$–30.81 ± 4.8 $\mu g/m^3$) in January–February, the morbidity of respiratory diseases per 10,000 population was 30.65 ± 5.38–50.19 ± 16.37; however, in April and May, when the concentration of sulfur dioxide decreased to 7.99 ± 1.3 $\mu g/m^3$–4.76 ± 1.5 $\mu g/m^3$, the morbidity of respiratory diseases per 10,000 population increased reaching 47.82 ± 20.13–49.42 ± 219.00.

A comparative analysis indicates that there is no statistically significant correlation existing between:

- The mortality rate of respiratory diseases and the concentration of sulfur dioxide ($R = 0.14$, $P = 0.05$).
- The mortality rate of respiratory diseases and the concentration of nitrogen dioxide ($R = 0.04$, $P = 0.05$).

Air pollution in Ulaanbaatar city has increased every year for the past 5 years and showed a significant increase (1.39–4.49 $\mu g/m^3$) from 2004 to 2008. The present survey shows that the air pollution level of Ulaanbaatar city is "severely polluted" with the "P" index of P = 10.78, when the "P" index is estimated for the city as a whole rather than for individual districts.

Conclusion: The mortality rate of respiratory diseases increases when the concentration of sulfur dioxide, nitrogen dioxide, and particulate matter in ambient air increases. Between 2004 and 2008, the morbidity rate of respiratory diseases increased by 44.9 percent. There is a direct correlation between the common air pollutants and the morbidity rate of respiratory diseases among the population. (Rxy = 0.73, $P < 0.001$). Population growth in Ulaanbaatar (mainly due to mechanical increase), and an increase of Ger area households have resulted in the increased number of home stoves as well as increased use of raw, low-quality coal for heating. The above-mentioned factors in addition to poor city planning and management, all contribute to the increased concentration of common air pollutants and the morbidity rate of respiratory diseases which had an annual increase in recent years.

O-31B5-4

A Clean Air Scorecard for Asian Cities

Maria Katherina Patdu and May Antoniette Ajero *Clean Air Initiative for Asian Cities, Pasig City, Philippines.*

Background/Aims: There is growing interest among various groups, including the general public, media, international organizations, and policy-makers, for an understanding of the air quality management status and trends in Asia, especially in the city-level. While there are tools that measure environmental performance in general, there has only been a limited methodology specifically for assessment of air quality management for cities. A lack of guidance has resulted in a number of reports and publications using the good versus bad list analysis—100 dirtiest cities, top 10 cities with best air quality, usually only considering air quality levels for a city. This is problematic as they may not put the data into context, for example, they may only look at 1 pollutant, or only 1 year or not consider seasonal differences. Further, this paints an incomplete picture as it does not consider the (1) air quality management capacity and (2) the clean air programs and actions being implemented in the city.

Methods: Recognizing this need, CAI-Asia has developed an objective and comprehensive analysis tool for understanding the air quality management status in cities which incorporates (1) air quality levels, (2) clean air management capacity, and (3) clean air policies and actions—the Clean Air Scorecard.

Results: CAI-Asia has recently developed the Clean Air Scorecard Tool Version 1 which can evaluate the current situation of a city based on 3 indices: (1) Air Pollution and Health Index, (2) Clean Air Management Capacity Index, and (3) Clean Air Policies and Actions Index.

Conclusion: This presentation will provide a background on the development of the scorecard including an overview of the existing tools available for assessing the air quality management, basis and structure of the clean air scorecard, a short demo of the actual tool, and the preliminary results for the pilot implementation in Manila, Bangkok, and Jakarta.

HEALTH IMPACT ASSESSMENT AND BURDEN OF DISEASE

O-31B6-1

An Evaluation of Exposure-response Function Entering an Integrated Health Assessment of Active Transportation Policies

Audrey de Nazelle and Mark Nieuwenhuijsen *Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain.*

Background/Aims: Work presented on behalf of the Transportation, Air Pollution, and Physical ActivitieS (TAPAS) workshop participants. Cities are increasingly turning towards transportation policies that encourage walking and cycling to tackle a range of problems from physical inactivity to local air pollution and climate change. It has thus become particularly important to understand how such strategies may overall affect health.

Methods: To inform the development of an integrated assessment of active travel policies, an international workshop was held in November 2009, gathering 45 international experts from 29 institutes/research groups in fields of social and policy sciences, behavioural psychology, epidemiology, transportation and urban planning, environmental sciences, and public health. The objective was to review the state of the art knowledge in relevant fields, discussing strengths and limitations of evidence of different linkages between urban and transportation policies, exposures and public health, to determine the relevance and appropriateness of exposures, outcomes, and exposure-response functions to be included in a quantitative assessment.

Results: The choice of policy scenarios, exposures, and outcomes to be integrated, and assessment methods, were debated. Greatest benefits may be expected from increased physical activity, and most robust quantitative relationships from health benefits of physical activity and reductions in certain air pollutant. Linking policies to behaviours and exposures is more uncertain. Traffic injuries could be an important health driver, with many factors influencing risks. Many other impacts (eg, noise, UV, diet, social interaction, crime) may not be sufficiently researched to allow quantification. Most appropriate assessment methods depend on audience and outcomes chosen.

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Conclusion: Participants agreed on the importance of a comprehensive assessment of active travel policies and underlined its complexity. Optimal design solutions can be investigated for positive net health benefits including physical activity and obesity outcomes.

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O-31B6-2

Environmental Burden of Disease in European Countries—The EBoDE Project

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Background/Aims: Development of policies for the protection of public health needs quantitative estimates of the significance of various hazards. The Multinational European EBoDE project was started in 2009 to assess the impacts of a set of environmental stressors on a variety of health endpoints in a comparable way across 6 countries.

Methods: The selection of environmental stressors was based on their public health relevance, potential of high individual risks, public concern, and/or large economical impacts. The final set of stressors selected included (in alphabetical order): benzene, dioxins (including furans and dioxin like PCBs), environmental tobacco smoke (ETS), formaldehyde, lead, noise, ozone, particulate matter, and radon. In the EBoDE project, these risks were ranked using undiscounted disability adjusted life years (DALYs), which were estimated using country-specific exposure data and WHO burden of disease data.

Results: Results suggest that roughly 7%–12% of the total burden of disease in the participating countries may be associated with the selected environmental stressors. Particulate matter is the leading factor associated with 6000–9000 DALYs per million people, followed by noise, radon, and environmental tobacco smoke.

Conclusion: Several controversies and uncertainties were identified in the assessment. The availability and comparability of exposure data across the countries prove to be one of the main difficulties. For example, lead has been the success story in environmental policies, but the follow-up in exposure data in general populations is poor; formaldehyde is associated with a large discrepancy in widely used models due to the impossibility to establish a safe threshold for cancer effects. The latter may also be the case for dioxins. In addition, not all health effects that are potentially related to the environmental exposures could be included in the calculations, due to lack of evidence or applicable exposure response relationships. Results should therefore be interpreted as crude estimates.

O-31B6-3

Burden of Childhood Respiratory Illness and Indoor Air Pollution in the Niger Delta, Southern Nigeria

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Background/Aims: This study investigated respiratory symptoms and indoor and ambient air pollution in school children in the Niger-Delta, a part of Nigeria that experiences considerable air pollution from oil production. This presentation relates to symptoms and indoor air quality – the outdoor air pollution findings were presented at ISEE 2009.

Methods: A total of 1397 school children aged 7–14 years, in and around Warri, Delta State, Nigeria, completed written questionnaires on respiratory symptoms (using ISAAC-based questions) and environmental exposures.

Results: Doctor diagnosed asthma was rare, reported by 0.9% (95% CI: 0.4%–1.3%), while wheeze in the last 12 months was reported by 5.4% (4.3%–6.6%). Prevalences of other respiratory symptoms were high, in particular night cough 23.3% (21.1%–25.5%); nose problems 19.2% (17.1%–21.3%) and phlegm production 16.6% (14.7%–18.6%). Older children (11–14 years) had higher prevalence rates of all health outcomes, than younger (7–10 years) children, except 12-month wheezing. Most conditions showed higher female prevalences at all ages and higher prevalences in rural than urban communities. Prevalence rates found in this study were generally lower than rates found in previous studies in Ibadan/urban westernized areas of Nigeria. Housing conditions were poor with 83.8% (81.9%–85.8%) of participants living in sub-standard homes. There was also evidence suggesting significant indoor air pollution—a quarter of children (23.6%; 95% CI: 21.3%–25.8%) reported cooking by the entrance to a room, 15% used a shared kitchen, while 41.4% (38.8%–44.0%) reported cooking in a poorly ventilated area. Kerosene was the main fuel used for cooking, used by 66.1% (63.6%–68.6%) of respondents, 30.1% (27.7%–32.6%) used wood or coal, while only 3.8% (2.8%–4.8%) reported using gas.

Conclusion: These results suggest that respiratory illness among school age children may be a public health problem in Warri. Also, improvements in domestic cooking facilities and use of cleaner fuel types are required to improve indoor air quality.

O-31B6-4

CAREX Canada—Development of a National Environmental Carcinogen Exposure Surveillance Tool

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Background/Aims: Our goal is to produce indicators for the surveillance of Canadians' exposures to environmental carcinogens that reflect spatial variability.

Methods: We developed a spreadsheet-based tool to estimate life-stage weighted average daily intake. Factors considered include frequency of detection, bodyweight, intake rates, and time spent indoor and outdoor for 5 life-stages (infant, small child, child, teen, and adult). Using benzene as an example, we populated the tool with data from the National Air Pollution Surveillance network, Canadian Food Inspection Agency reports, US Food and Drug Administration Total Diet Study reports, the 2006 Statistics Canada Food Statistics report, California Office of Environmental Health Hazard Assessment cancer potency values, and peer-reviewed literature. For outdoor air, we linked the results with a spatial model of benzene concentrations and block point population data from Statistics Canada.

Results: Estimated lifetime average daily intake levels (and associated cancer risk) are: outdoor air, 3.4 μg/d (1:161,000); indoor air, 32 μg/d of benzene (1:20,250); drinking water, 1.5 μg/day (1:388,500); and food, less than $2.25 \times 10-6$ μg/day (>1:114 billion). After including the spatial variation in population locations and outdoor benzene concentrations, we assigned estimated excess lifetime risk for each of 487,000 block point locations (50th percentile = 1:263,000, 5th percentile = 1:399,000; 95th

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percentile = 1:75,250). Overall, we estimate that in 2006, the lifetime excess risk of cancer was 1:100,000 or more for 11.1 million Canadians, 35 percent of the total population.

Conclusion: The tool provides a flexible but comprehensive method for producing comparable screening level indicators of exposure and excess cancer risk for numerous known and suspected carcinogens. Incorporating spatial variation, when appropriate, provides a new level of detail that aids in targeting prevention efforts.

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PP-31-136

Environmental Burden of Diarrhea for Water, Sanitation, and Hygiene in Thailand

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Background/Aims: The study aimed to undertaken rapid assessments of water, sanitation, and hygiene linkages to health situation by using the environmental burden of disease methodology in Thailand. This study scoped only diarrhea that almost caused by water, sanitation, and hygiene (WSH).

Methods: The study took place in the central (Chachoengsao province), south (Suratthani province), north (Chiang Mai Province), and northeast (Khon Kaen province) of Thailand by selecting a province in each part that had the highest incidence of diarrheal during 5 years. In each province studied in urban and rural areas, the sample size was 1957 households by calculation and using a random simple sample for urban area (699 households) and rural area (1258 households). Data collections were used by questionnaires, interviewing, and then analyzing and estimated the disability-adjusted life year.

Results: The situation of WSH in urban and rural areas was assessed, which had improved water supply and basic sanitation in a country that was not extensively covered by those services, and where water supply was not routinely controlled. Results in Khon Kaen province showed the relations of the rates of diarrhea cases in rural and urban sampling areas were associated between the groups of having drinking water with and without treatment before drinking (OR = 2.60, 95% CI = 1.04–6.46, $P = 0.02$ and OR = 2.74, 95% CI = 1.11–6.96, $P = 0.02$, respectively). Disability-adjusted life year s for diarrhea was found 0.7898548 years and 0.3973632 years in rural and urban sampling area, respectively. The findings revealed that the year of life lost was zero. If the data were adjusted to the whole population of Thailand, the year of life lost due to disability was 2431.7650 years. Attributable burden to WSH in the whole country was 680.5051 years.

Conclusion: However, we have a recommendation to compare the actual incidence from the hospital.

PP-31-137

Comparison of the Population-specific Mini-Nutritional Assessment, Subjective Global Assessment, and Serum Albumin Level in Hemodialysis Patients

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Background/Aims: This study aims to apply the Mini-Nutritional Assessment (MNA) with population-specific anthropometric modifications and Subjective Global Assessment (SGA) in hemodialysis patients and compare their association with serum albumin level, anthropometric and health parameters.

Methods: This study was conducted in Hemodialysis Unit of E-Da hospital in Kaohsiung, Taiwan in 2007. A total of 80 hemodialysis patients were evaluated concomitantly their nutritional status by the MNA and SGA.

Results: Nearly 1% and 34% of hemodialysis patients were at malnutrition and at risk of malnutrition classified by MNA version I and II, while nearly 8% and 36% of hemodialysis patients were at malnutrition and at risk of malnutrition classified by SGA. MNA version I and II scores correlated positively with albumin, creatinine, body mass index, mid-arm circumferences, calf circumferences, appetite, and negatively with number of medicine use (all $P < 0.05$). Serum albumin level was not associated with any anthropometric, serum, and health parameters. MNA version II had better association with nutritional biomarkers and better reflected health status of hemodialysis patients than MNA version I, SGA, and serum albumin level.

Conclusion: Both the modified versions of MNA can evaluate nutritional risk of hemodialysis patients in Taiwan. MNA version II that modified population-specific anthropometric cut values coupled without body mass index measurement can better reflect nutritional and health status of hemodialysis patients than MNA version I and SGA.

PP-31-139

Monitoring of Occurrence of Thyroid Gland Disorders in Human Population in Industrial Regions

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Background/Aims: Thyroid disorders are the most common endocrinologic diseases. Hypo- and hyperfunction of thyroid gland affects metabolic processes in the body causing different damages to human health.

Methods: The incidence of the most common diseases of thyroid gland was studied directly in the endocrine clinics. We studied a sample of 24,928 patients during 8 years in 2 different areas of eastern Slovakia—Prešov and Košice region. Both regions are highly industrially exposed. In studied sample, we focused on the incidence of thyrotoxicosis, hypothyroidism, thyroiditis, and malignant thyroid tumors.

Results: In the research we found the following results:

1. The incidence of thyrotoxicosis (133 cases in 2000, 86 cases in 2008) and thyroiditis (1401 patients in 2000, 739 in 2008) had a downward trend in Košice region.
2. The increase in Košice region was monitored in patients with hyperthyreosis (479 in 2000, 618 in 2008) and malignant thyroid tumors (62 in 2000 and 91 in 2008).
3. In Prešov region, the increased incidence of all observed diseases of thyroid gland—thyrotoxicosis (52 in 2000, 154 in 2008), hypothyroidism (345 in 2000, 844 in 2008), thyroiditis (1208 in 2000, 1989 in 2008), and malignant neoplasms (15 in 2000, 68 in 2008) was found.

Conclusion: Hypothyroidism, hyperthyroidism, thyroiditis, and thyrotoxicosis are generally declining, in opposition with the malignant tumor of the thyroid gland which records the increase. According to the results, we recommend the medical practice to include the examination of thyroid gland into standard preventive examination.

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PP-31-140

Health Risk Assessment for Residents of Vicinity of Abandoned Mines in Gyeongsangbuk-do, Korea

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Background/Aims: The objective of this study was to evaluate the health risks for residents living at the vicinity of abandoned metal mines in Gyeongsangbuk-do, Korea. The abandoned mine tailings are remnants from an earlier flotation mill and mining operation that was in business from the early 1930 until 1970.

Methods: The soil, stream water, drinking water, and crops in and around 2 abandoned mine areas, Woogok and Tohyun, and 2 control areas located in Gyeongsangbuk-do were analyzed for levels of Cd, Pb, Cu, As, and Hg. Potential chronic health effects were evaluated by medical examination. Blood and urine samples were collected for Pb, Cd, and As concentration determinations.

Results: Some samples of soil and stream exceeded the Korean standard for soil contamination in farmland and the Korean standard of water contamination in streams, respectively. The amounts of oral intake of heavy metals were less than the acceptable daily intake level recommended by World Health Organization. Urine arsenic levels of the residents in the vicinity of the both abandoned mine sites (geometric mean: 10.07 μg/g Cr, 13.44 μg/g Cr) were significantly higher than that of the residents in the control areas (geometric mean: 8.19 μg/g Cr, 8.73 μg/g Cr). There were no significant differences between the mining and control areas in terms of blood pressure, Hb, BUN, creatinine, SGOT, SGPT, blood sugar, β2-microglobulin, N-acetyl-β-glucosaminidase, bone density, and the prevalence of potential chronic diseases.

Conclusion: The results of the assessment suggested that the 2 abandoned mine sites do not pose an apparent health risk to nearby residents. Nevertheless, the elevated urine arsenic levels in the residents of the abandoned mine site suggested that it might be an important source of heavy metals contamination. Therefore, a nationwide evaluation program is needed to assess the potential health risks of residents living in the vicinity of abandoned mine sites.

PP-31-141

Influenza Surveillance and Excess Associated Mortality in Guangzhou, China

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Background/Aims: Although surveillance for influenza-like illness (ILI) is widely accepted as syndromic surveillance of influenza, the question remains whether ILI surveillance can serve as an early warning of influenza activity. There is a great deal of evidence that influenza is associated with considerable morbidity and mortality. However, few studies of disease burden of influenza are from outside developed countries. This study aimed to describe surveillance of influenza and assess mortality impact of influenza in Guangzhou, China.

Methods: Guangdong Center of Disease Control and Prevention (CDC) provided data of weekly number of ILI and influenza virology data for the 3-year period of 2004–2006 in Guangzhou, China. The influenza data was matched with weekly counts of mortality and meteorological measures. Cross-correlation was performed to examine the time lag between weekly number of cases with ILI and positive rate of influenza isolation, after filtering the trend and seasonality of each time-series and controlling for meteorological effects. Poisson regression was used to model weekly counts of mortality on influenza activity after adjustment for potential confounding.

Results: Influenza was circulated through the whole year during the period 2004–2006 in Influenza was circulated through the whole year during the period 2004–2006 in Guangzhou, China. Variation of weekly number of ILI cases preceded the positive rate of influenza isolates by 3 weeks. The excess mortality associated with influenza was 2.8% and 6.6% for cardiovascular diseases and respiratory diseases, respectively. Correspondingly, the influence-associated deaths per 1000 population were 6.4 and 7.3, respectively. The estimates of ILI-associated mortality were triple or fourfold.

Conclusion: Compared with laboratory-based virology surveillance, clinical surveillance of ILI from sentinel hospitals offers earlier warning of increased incidence of influenza in population. Influenza poses a substantial burden on mortality in Guangzhou, China, where the virology surveillance of influenza should be strengthened.

PP-31-142

Cardiovascular Risk on Workers Exposed to Heavy Metals, Pb, and Cd

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Background/Aims: Sudden cardiac death caused by malignant ventricular arrhythmias represents a major public health problem. We tried to determine the cardiovascular risk on workers exposed to Pb and Cd from a nonferrous metallurgical plant, based on the repolarization changes and the beat-by-beat variability of the RR and QT intervals that is known to be in relation with the SVT.

Methods: We investigated 70 workers with mean age = 36.0 + 8.2 years and mean time of exposure = 12.1 + 7.6 years. We made clinical examinations, standard questionnaires regarding the effects of Pb and Cd on the human organism, biochemical and biotoxicological investigations: total cholesterol (TC), triglycerides (TG), HDL-chol (HDL-C), LDL-Chol (LDL-C), glycemia, seric ferrum, anemia degree, blood picture, Ca and Mg in blood, DALA, blood cadmium, blood lead, EKG registering. From this group, 30 workers, aged 30–50 years, with normal myocardium and representative length of service were hospitalized in the Clinic of Occupational Health, completely investigated and followed up by Holter high resolution EKG.

Results: More than 80% of the investigated workers presented a small variability of RR interval with TSH fraction significant increased as during the mental stress, and in conclusion a great risk for sudden death due to the supranormal sympathetic drive that is arrhythmogenic and life-threatening. These workers had normal values of lead and cadmium in blood but great values of the lead storage in organism, emphasized by the provocation tests with EDTA that allow to classify great absorption of lead. Ten percent of workers had great levels of serum lipids (TC, TG, LDL-C) LDL-C being known as an aeterogenic factor.

Conclusion: The obtained data suggest that heavy metals—in our case Pb—could generate an increase of the SVT with ventricular arrhythmias and sudden death, the risk being assessed by RR-QT variability from the Holter high resolution EKG.

WATER, WASTE AND HEALTH

PP-31-143

Methodology in Assessing the Health Risks on Proposed Water Resource Developments in Malaysia

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Background/Aims: Methodology in assessing the risks of proposed water resource developments to the health of the community in Malaysia is being develop. This assessment aims to evaluate the potential impacts of the few water resource developments to the health of the community within the zone of influence.

Methods: Our assessment methodologies consist of descriptive epidemiology on the existing human environment and the prediction of the health risks from the proposed development. Data on burden of diseases and the community profiles and other health determinants provide the baseline for the existing community health status. These data were obtained through a house to house survey and a secondary data review. For waterborne diseases, the prevalence of intestinal parasite infections among children of the affected community is determined. The ecology of mosquito vectors is determined using the 3 different techniques: bare leg catch, CDC light trap, and larval survey. Schistosomiasis and zoonotic studies could also be carried out.

Results: The community health risks to these communicable diseases are qualitatively determined. The quantitative health risk assessment is applied to any water supply project. The quantitative health risk assessment is applied to any water supply project. The emerging and re-emerging diseases and community participation also need to be addressed.

Conclusion: The health risk assessment methodology is important for policy direction and decision-making in the environmental management for health.

O-31B7-1

Association Between Type 2 Diabetes and Chronic Arsenic Exposure in Bangladesh

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Background/Aims: Chronic exposure to inorganic arsenic in drinking water has been associated with type 2 diabetes (T2D). Most research has been ecological in nature and has focused on high levels of arsenic exposure with few studies directly measuring arsenic levels in drinking water as an index of arsenic exposure. The effect of low-to-moderate levels of arsenic exposure on diabetes risk is largely unknown.

Aims: To determine the association between chronic arsenic exposure, as measured in drinking well water, and prevalent T2D in a representative sample of Bangladesh residents.

Methods: The study is an analytical cross-sectional study of 1004 randomly selected men and women aged >30 years living in Bangladesh who had continuously consumed arsenic-contaminated drinking water for at least 6 months. T2D cases were defined using the new diagnostic criteria (fasting blood glucose >126 mg/dL) from the WHO guideline (WHO 2006), or a self-reported physician diagnosis of T2D.

Results: A total of 1004 individuals participated in the study. The prevalence of T2D was 9% (95% CI: 7%–11%). After adjustment for diabetes risk factors, an increased risk of T2D was observed for arsenic exposure over 50 μg/L with those in the highest category having almost double the risk of T2D (OR = 2.1; 95% CI: 1.3–3.2). For most levels of arsenic exposure, the risk estimates are higher with longer exposure; a dose-response pattern was also observed.

Conclusion: These findings suggest an association between chronic arsenic exposure through drinking water and T2D. Risks are generally higher with longer duration of arsenic exposure. The risk of T2D is highest among those who were exposed to the highest concentration of arsenic for more than 10 years.

O-31B7-2

Arsenic in Drilled-well Drinking Water: Use of Existing Surveillance Data to Prioritize Regions for Intervention and to Evaluate Dug Wells as an Alternative Water Source

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Background/Aims: Arsenic in drinking water is a public health crisis. Interventions include isolation of contaminated wells, alternative water sources, and filtration. Progress in severely impacted countries like Bangladesh is encumbered by the scale of the problem. Designing and assessing national risk management strategies may be more feasible in Southeast Asia, where arsenic levels are comparably high but the exposed population and geographic regions are less daunting. The goal of this study is to evaluate dug wells as alternative water sources in regions of Cambodia where arsenic is common in drilled "tube" wells.

Methods: We examined Cambodia 2008 census database, aggregated by commune; "WellMap" GIS arsenic database (38,418 tube wells); and a GIS database with multiple water quality indicators for 6302 tube wells in 3 provinces, plus 289 dug wells installed by an NGO (RDI-C) in Kandal province.

Results: Overall, 10,922 (28%) sampled tube wells had arsenic ≥50 ppb, the national standard. Three provinces had highest number or prevalence of contaminated wells: Kandal (6093, 36%), Kampong Cham (2732, 40%), Prey Veng (1606, 17%). Based on census reports of primary household water source, the estimated number of people using a contaminated tube well is 136,067 in those 3 provinces (plus 10,228 elsewhere). Five of 10 communes with highest numbers were in Kien Svay District (Kandal), site of the dug well program. There were 104 sampled tube wells within 500 m of a sampled dug well (n = 244): arsenic was ≥50 ppb in 73% of tube wells but 5% of dug wells. Elevated manganese was less frequent in dug wells, but microbial contamination was more common.

Conclusion: Existing data can be used to prioritize arsenic mitigation interventions in Cambodia. Dug wells are one simple alternative water source. Arsenic contamination is less likely, but individual wells should still be tested. Education and good practices can minimize microbial exposure, but boiling and filtration are common in much of Cambodia.

O-31B7-3

The Level and Distribution Characteristics of Heavy Metals in Sediments of Huaihe River

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Background/Aims: To describe the pollution characteristics of heavy metals in the Huaihe River sediment.

Methods: We collected the articles on heavy metals in Huai River Basin and analyzed the pollution characteristics of 8 heavy metals elements in 50 sediment sections.

Results: The average level of Cr in sediments of the Huaihe River is 63.7 mg/kg (47.2–123.6 mg/kg), which is 1.10 times the average levels in stream sediments of China and higher than that in other water systems in China except the Yangtze River. The Mn is 719 mg/kg (439–1124 mg/kg), which is 1.05 times the average levels in stream sediments of China. The Cu is 29.9 mg/kg (6.0–65.6 mg/kg), which is 1.42 times the average levels in stream sediments of China. The Zn is 79.2 mg/kg (39.2–230.1 mg/kg), which is 1.16 times the average levels in stream sediments of China. The Cd is 0.29 mg/kg (0.10–0.96 mg/kg), which is 2.07 times the average levels in stream sediments of China. The Pb is

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29.5 mg/kg (17.3–72.8 mg/kg), which is 1.18 times the average levels in stream sediments of China. The Hg is 0.08 mg/kg (0.03~0.36 mg/kg), which is 2.00 times the average levels in stream sediments of China. The As is 12.6 mg/kg (9.0–21.8 mg/kg), which is 1.38 times the average levels in stream sediments of China. The percentage of cross-section where the levels of heavy metals in sediments of Huaihe River are higher than average in stream sediments of China are 90.5% for As, 86.0% for Cd, 68.0% for Zn, 66.7% for Hg, 65.0% for Cu, 57.6% for Mn, 55.3% for Cr, and 50.0% for Pb, respectively.

Conclusion: The levels of heavy metals in Huaihe River sediments are at a relatively high level compared with other river basins in China. Of them, the Cr is the most serious pollution, which is higher than that of other 6 China's major river basins, except the Yangtze River.

O-31B7-4

Characterization of Finished Products of Building-Street Field Samples: Chemical and Ecotoxicological Approach

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Abstract:

Background/Aims: European community has developed waste management norm giving always greater importance to prevention and recycling. In order to avoid a direct and/or indirect negative effect on the environment and human health, there is a need for characterization. Aim of the study was to characterize finished products of building-street field samples by chemical and ecotoxicological approach.

Methods: Finished products of building-street field samples used for to characterization had the following composition: 50%–60% inert from demolition corresponding UNI10006, 2.5%–3% sodium silicate, <30% waste CER 100207* powders by dangerous smoke, 300 kg/mc cement. Samples were submitted to leaching process defined in EPA Methods, 1991. Eluates were characterized for chemical species: PAH, heavy metals, hydrocarbons C10–C40, and pesticides. Vibrio fischeri and Daphnia magna were use to determine ecotoxicity of the eluates. The same tests were carried out on samples come from: building site, public garden, and uncultivated site. PAH was determined by HPLC with UV-VIS and FL, while heavy metals by AAS after acid mineralization. Hydrocarbons C10–C40 and pesticides after extraction and purification through PSE and GLP, respectively, has been carried out by GC/FID and GC/ECD.

Results: Finished products of building-street field samples show an elevated toxicity for Vibrio fischeri before and after pH correction, while they are not toxic for Daphnia magna. Public garden samples result toxic for Vibrio fischeri. Building site and uncultivated site samples result not toxic for Vibrio fischeri.

Conclusion: Chemical classification, by comparing results with limit values fixed in CEMWE (Criterion and Evaluation Methods of Waste Ecotoxicity) proposal, indicates that there are strong evidence to classify finished products of building-street field samples as ecotoxic, but not so by biological tests. Similar to scientific evidence in literature our experience evidences the necessity to have a norm, uniform for all European Community countries, to define appropriates chemical and ecotoxicological standards for secure waste characterization before recycling.

S-31B8-1

Measures of Exposure to Water Disinfection Byproducts and the Effect of Exposure Measurement Error on Epidemiological Study Power

Exposure and Susceptibility Biomarkers and Their Potential Application in Epidemiological Studies of Disinfection Byproducts

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Methods: We obtained a survey-based measure of THM exposure that incorporated individual water use behavior and compared this with several other individual measures and ecological (area-based) measures. We also conducted simulation studies using ecological and case-control designs.

Results: The Pearson correlation coefficients of the survey-based measure of THM exposure (the assumed "gold standard") with 3 other individual measures varied between 0.75 and 0.78. Exclusion of water use behavior from these exposure measures reduced the correlations to between 0.18 and 0.24. Based on these results and our simulation, a proposed ecological study in Sydney would have 73% power to detect as significant an observed attenuated association when the assumed true RR was 1.16.

Conclusion: Estimating individual exposure to disinfection by-products without incorporating water use behavior appears to introduce a high degree of measurement error. However, a moderate-sized ecological study can have sufficient power to detect a positive association between disinfection byproducts and health outcome if an association exists.

S-31B8-2

Levels of Trihalomethanes in Tap Water and Human Blood in a Representative US Population, National Health and Nutrition Examination Survey 1999–2004

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Background/Aims: Water disinfection reduces infectious disease outbreaks, but can also form potentially harmful disinfection byproducts such as trihalomethanes (THMs). Improved exposure assessment tools and data are needed to better understand THM exposure prevalence, magnitude, and its potential health impact.

Methods: Household tap water and blood samples were collected from 3229 adult participants of the US National Health and Nutrition Examination Survey from 1999 to 2004. THM levels in these samples were quantified based on stable isotope internal standard response generated by analysis with solid phase microextraction coupled with GC-MS.

Results: We found detectable levels of 4 THMs in the following percent of blood samples: chloroform: 100%, 97%, 92%; bromodichloromethane: 97%, 98%, 73%; dibromochloromethane: 87%, 76%, 48%, and bromoform: 74%, 81%, 40% collected during 1999–2000, 2001–2002, and 2003–2004, respectively. These detection frequencies suggest widespread exposure to THMs in the US population. Tap water originating from private wells had significantly lower levels of all 4 THMs compared with tap water originating from other sources. Implementation of more stringent regulatory limits in 2001 corresponded to decreased tap water chloroform levels from 1999 to 2004; blood chloroform levels also decreased over this same time frame. The median levels of the other 3 THMs decreased slightly over the 6 years in both water and blood. The adjusted geometric mean bromodichloromethane was significantly higher in non-Hispanic whites than non-Hispanic Blacks ($P < 0.002$) and higher in non-Hispanic Blacks than Mexican-Americans ($P < 0.006$). Additional variables associated with increased blood bromodichloromethane levels included the following: recent water-related activity (showering and bathing), having body mass index >25, and time of day of sample collection.

Conclusion: These population data for THM exposure establish a nationally representative baseline for THM exposure in the United States

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and provide data for evaluating the efficacy of regulatory changes designed to reduce human exposure.

S-31B8-3

Colorectal Cancer and Disinfection Byproducts in Italy and Spain

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Background/Aims: Experimental data suggest that disinfection byproducts (DBPs) are colorectal carcinogens but epidemiological evidence is contradictory. To evaluate colorectal cancer risk associated with long-term DBP exposure.

Methods: A case-control study was conducted in Italy and Spain. Cases were newly diagnosed and histologically confirmed, aged 20–85 years, and living in the study areas. Controls were matched to cases by age, gender, and area of residence. Study area comprised Barcelona (Spain) and Milan, Pordenone and Udine (Italy). Study subjects were interviewed on potential risk factors of colorectal cancer, residential history and water uses including ingestion, showering, bathing, dishwashing, and swimming in pools. Blood samples were collected to obtain DNA sample. Retrospective data on trihalomethane levels in the study areas have been collected through water companies, and water samples have been collected to measure a range of DBPs.

Results: Based on 500 cases and 436 controls in Spain and 400 cases and 363 controls in Italy, the longest residence lasted 35 years on average in Spain and 37 years in Italy. Drinking water at the longest residence was from public water supply among 56% subjects in Spain and 46% in Italy. The rest consumed bottled water or from other sources. Those drinking water from public supplies compared to bottled water had an odds ratio and 95% confidence interval of 1.17 (0.87–1.58) in Spain and 1.18 (0.79, 1.77) in Italy, adjusting for potential confounders. Taking long compared to short showers (above vs. below median) yield an odds ratio of 1.04 (0.80–1.40) in Spain and 1.16 (0.83–1.63) in Italy. Mean trihalomethane levels in Italy were <10 μg/L and ranged from 17.6 to 134 μg/L in Spain. Residential trihalomethane level was associated with an increased colorectal cancer risk for some exposure categories without a clear dose-response.

Conclusion: These initial results suggest a weak association between colorectal cancer and DBP exposure.

S-31B9-1

Microbial Exposure Science

Shay Fout and Shannon Griffin *US Environmental Protection Agency, Cincinnati, OH.*

Background/Aims: Identifying microbial agents that cause waterborne disease is relatively straightforward, but a critical weak point in developing risk assessments for microbial agents associated with drinking water is exposure assessment. There are limited data on pathogen fate and transport in drinking water sources, and there have been only a few studies which provide direct exposure measurements. The National Exposure Research Laboratory of the US Environmental Protection Agency has recently developed a framework for exposure research. The aim of this presentation is to describe the framework with an emphasis on research needs for environmental microbial exposure.

Methods: Data from several studies on enteric virus occurrence in groundwater and on the waterborne contribution to endemic community illness will be used to illustrate important microbial exposure science concepts.

Results: Human enteric viruses can be present in groundwaters, but their occurrence is variable, even in vulnerable systems. Viruses have to be present for exposure to occur, but occurrence does not equal exposure. It is estimated from studies designed to determine waterborne disease incidence that between 0% and 30% of endemic acute gastrointestinal disease is due to drinking water. Based on these studies, the US Environmental Protection Agency estimates that there are 16 million acute gastrointestinal cases associated with drinking water in the United States. However, there is a great deal of uncertainty in all these estimates, leading to the need for better exposure assessments.

Conclusion: A microbial exposure science framework is needed to define the critical components for exposure assessment and guide future research.

S-31B9-2

Enteric Virus and Indicator Occurrence in Groundwater Sources of Public Drinking Water

Shay Fout *US Environmental Protection Agency, Cincinnati, OH.*

Background/Aims: Many communities throughout the world use untreated groundwater for drinking water, especially in rural areas. Simple bacterial indicators, such as total coliforms and *Escherichia coli*, are used as the means of indicating water quality. However, about 1/2 of the drinking water outbreaks that have occurred in the United States since 1971 have been due to untreated groundwaters, and recent studies have shown that many groundwaters can contain human enteric viruses in the absence of indicators. The aim of this presentation is to demonstrate from recent studies that the effectiveness of the use of indicators to predict water safety depends upon aquifer vulnerability.

Methods: The data from 6 studies of groundwater quality in the United States were combined and analyzed to examine indicator/virus relationships. Indicators in the studies were measured using standard analytical methods and human enteric viruses were measured using traditional cell culture and molecular methods. A total of 1187 samples from 166 wells were included in the data analysis.

Results: In all, 4%–21% of the samples and 18%–38% of the sites were positive for virus by cultural methods or cultural plus molecular methods combined, respectively. Wells were divided into vulnerability categories based upon whether they would be detected as vulnerable on basis of the US Total Coliform Rule violations, Total Coliform Rule plus US Ground Water Rule monitoring violations, and all other wells. Indicators were highly effective predictor of virus occurrence for the first category, moderately effective for the second, and ineffective for the third, with true positive rates (percentage of virus positive wells that were also indictor positive) being 100%, 88%, and 0%, respectively.

Conclusion: The use of indicators for measuring the safety of drinking water from groundwater sources is very effective for vulnerable aquifers, but becomes progressively less effective as the vulnerability decreases.

S-31B9-3

Current Studies of Norovirus Contamination in Groundwaters of Korea

Yong Jeong *Kyung Hee University, Seoul, Republic of Korea.*

Background/Aims: Noroviruses are a leading cause of acute gastroenteritis and have been responsible for waterborne outbreaks of acute gastroenteritis worldwide. International studies have detected noroviruses in groundwaters used for drinking water, including systems

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that are not required to treat their water. To determine the degree of contamination in Korea, the Ministry of Environment and the National Institute of Environmental Research of Korea have directed a continuous nation-wide survey of groundwaters for norovirus contamination since 2007.

Methods: More than 500 groundwater facilities were subjected to monitoring of fecal or sewage contamination through detecting nucleic acids of noroviruses, viable indicator microorganisms, and specific geochemical components in order to track contamination sources. Selected samples from river water and treated sewage water were also analyzed for noroviruses and indicator microorganisms in order to understand indirect influences of certain geographical and residential characteristics.

Results: Noroviruses were detected in about 20% of the groundwater facilities studied. General heterotrophs, total coliform bacteria, *Escherichia coli*, and coliform bacteriophages were also detected in groundwater samples, but there was no clear relationship between these indicators of fecal contamination and the presence of norovirus nucleic acids material in the samples. Nevertheless, certain geochemical parameters, including isotope tracking of oxygen or nitrogen, and residential characteristics turned out to be quite useful to "score" a level of probable quality of a given facility in conjunction with indicator microorganisms. Additional survey results on schools and related facilities conducted by Korea Food and Drug Administration will be discussed.

Conclusion: Noroviruses have been found in groundwaters in Korea, but to date, the majority of facilities that have been targeted were suspected of being vulnerable to contamination. Therefore, the practical percentage for nation-wide contamination should be somewhat less than 20% when less vulnerable sites are included in the survey.

S-31B9-4

National Surveillance Policy for Norovirus in Groundwater of Korea

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Background/Aims: Norovirus is widely known for the major microorganism causing enteritis throughout the world. This agent is transmitted via fecal-oral route, originated from human excrements and spreads to people through water, foods, and soil. Consumption of the norovirus-contaminated water and food seems to be a major cause of the enteritis and the secondary infection often leads to outbreaks due to its highly contagious characteristics. It is reported that the infectious enteritis by norovirus affects to all generations from children to adults. Recent outbreaks of food poisoning with norovirus are not limited in the winter but occur throughout the seasons. Norovirus incidences in Korea generally begin at training centers, schools and daycare centers where use underground water for various purposes (NIER Report, 2008).

Methods: Research efforts to improve methods for detecting norovirus have been continued (KEI, 2008) and NIER provides the test method of sample collecting, pretreatment (secession/concentration), and genetic analysis by setting up the "Guidelines of Norovirus Analysis on Groundwater" in May 2007 (NIER, 2007).

Results: Ministry of Environment of Korea has performed the surveillance in order to understand the current status of norovirus contamination in groundwater and the results of norovirus-positive in genetic analysis were 15.4%, 17.3%, and 20.3% in 2007, 2008, and 2009, respectively. Based on these results, the Ministry of Environment decided to review the problems of groundwater management policy. Overall study for the current status of the groundwater management and utilization is also ongoing to provide scientific supports for the review in addition to the continuous norovirus surveillance.

Conclusion: Efforts are underway to improve groundwater quality as a result of the norovirus surveillance program.

S-31B9-5

Public Health Significance and Prevention of Norovirus

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Background/Aims: Over the past 20 years, the importance of norovirus (NoV) in public health has been increasingly recognized in both developing and developed countries. NoV is highly infectious and known to have low infectious doses. Additionally, NoV is known to be very resistant to various environmental stresses. In this presentation, various physical and chemical disinfectants will be examined for controlling NoV in water.

Methods: Physical and chemical disinfectants evaluated in this study include 254 nm ultraviolet germicidal irradiation, chlorine, ozone, and chlorine dioxide. Due to inability of cultivation of human NoV, murine NoV was used as a surrogate as well in this study. In this study, inactivation of viruses was evaluated by conventional plaque assay, real-time TaqMan reverse transcriptase polymerase chain reaction (RT-PCR), and long template RT-PCR assays.

Results: Murine NoV were susceptible to tested physical and chemical disinfectants. Both long template RT-PCR and real-time TaqMan RT-PCR significantly underestimate the infectivity measured by plaque assays.

Conclusion: Our data indicated that proper use of physical and chemical disinfectants would be able to effectively control viral infection and associated diseases.

LONGITUDINAL BIRTH COHORT STUDIES IN ASIA

S-31C2-1

Japan Environment and Children's Study

Toshihiro Kawamoto,[1] Naoya Tsukamoto,[2] Masaharu Tanto,[2] Hiroshi Nitta,[3] Katsutaka Murata,[4] Fujio Kayama,[5] Reiko Kishi,[6] and Hiroshi Satoh[7] *[1]University of Occupational and Environmental Health, Kitakyushu, Japan; [2]The Ministry of Environment, Tokyo, Japan; [3]National Institute for Environmental Studies, Tsukuba, Japan; [4]Akita University, Akita, Japan; [5]Jichi Medical School, Tochigi, Japan; [6]Hokkaido University Graduate School of Medicine, Sapporo, Japan; and [7]Tohoku University Graduate School of Medicine, Sendai, Japan.*

Background/Aims: Ministry of Environment of Japan is planning to launch a nation-wide birth cohort study (Japan Environment and Children's Study; [JECS]) in 2010. The study protocols have been decided by the working group of JECS.

Methods: The study structure is composed of a core center, a medical support center, and a dozen of unit centers. Around 10 working hypotheses are proposed to clarify the effects of the exposure to chemical and physical environmental factors on the health and development of children in Japan. Each unit center registers maternity hospitals in its study areas as many as possible, and participants (pregnant women) are recruited at their first visit at the hospitals.

Results: Around 100,000 pregnant women will be recruited between 2010 and 2012 for 3 years. Their children are observed from fetus to age 12. In order to evaluate the exposure to environmental factors, we are going to measure heavy metals, POPs, pesticides, and so on in biospecimens from mother and their children besides questionnaires or interviews. The targeted outcomes are physical development (low birth weight, developmental retardation, etc.), congenital anomalies (hypospadias, cryptorchidism, cleft palate, GI obstruction, ventricular septal defect, Down syndrome, etc.), psychoneurodevelopment impairments: autism (learning disorder), ADHD (attention-deficit hyperactivity disorder, etc), immunologic impairments (allergy, atopic dermatitis, asthma, etc), metabolic/endocrinologic impairments (genital hypoplasia, brain sexual differentiation, thyroid dysfunction, impaired glucose tolerance, obesity, etc.).

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Conclusion: The study results obtained from JECS will be published at an appropriate time.

S-31C2-2

Taiwan Birth Cohort Studies on Children's Environmental Health

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Abstract: Children's environmental health is increasingly recognized as a global public health issue of great importance. Given our current limited knowledge, the distribution of environmental contaminant exposure levels among reproductive-age, infants, and children is unknown; and the role of prenatal and postnatal exposures to environmental and genetic factors in the etiology of adverse child health is unsolved. The current problems in Taiwan we have identified to perform researches including the following: the prevalence of asthma is still increasing up to more than 10%; preterm delivery has been increasing up to 9% in 2003; neurodevelopmental disorders are highly prevalent and affected 8% of the examined children under the age of 4 years; and the prevalence of childhood obesity has doubled; also, there were up to one-seventh infants born by foreign mothers in 2004. Therefore, we started to conduct Taiwan birth cohort studies to investigate prenatal and postnatal factors on infant and early childhood health. Through these prospective birth cohorts, the main health outcomes focused on child growth and development, atopic diseases, and neurocognitive and language development. We investigated the main prenatal and postnatal factors including infection, herb use in pregnancy, breastfeeding, allergens, and other pollutants such as environmental tobacco smoke, heavy metals, nonpersistent pesticides and perfluoroalkyl chemicals, and psychosocial stress under the consideration of interaction of the environment and genes. These studies bridge knowledge gaps and answer unsolved issues in the low-level, prenatal or postnatal, and multiple exposures, genetic effect modification, and the initiation and progression of "environmentally related childhood diseases." In addition, we play an active role in education, research, and services in the field of "pediatric environmental health" via integrating multidisciplines.

S-31C2-3

Birth Cohort Studies Conducted by Peking University, China

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Background/Aims: Large birth cohort study with long-term follow-up is a powerful and feasible way to assess the impact of environment, genetics, and environment-genetics interaction on different health outcomes of both pregnant women and their offspring, by prospectively collecting extensive data and specimen during various periods from preconception to childhood or even later life.

Methods: Peking University Institute of Reproductive and Child Health have conducted 3 large birth cohort studies.

Results: First cohort study includes about 230,000 children, whose mother had participated in a previous folic acid intervention study to prevent the occurrence of neural tube defects in China. Women entered the program either at premarital health assessment or at any stage of pregnancy. Second cohort includes 17,000 children, whose mother had participated in a 3-armed randomized controlled trial to assess the impact of iron-folic acid and multi-micronutrient supplementations on mortality, morbidity, and complications during pregnancy, labor, and delivery in China. Women were enrolled before 20 weeks of gestational age, women's venous blood and baby's cord blood were collected, and children born to the enrolled women are being followed up. Third cohort study is now enrolling women, and is planned to enroll 10,000 women before or during early pregnancy, to collect women's venous blood, and follow these enrolled women up to 42 days postpartum. For all 3 cohort studies, maternal and children's data about demographic, relevant obstetric and pregnancy outcomes, folic acid supplements taking, and body growth were collected at the time of entry, subsequent prenatal visits, delivery, or at the follow-up.

Conclusion: These cohort studies provide exciting opportunities to explore the cause and prevention measures for various interested health outcomes including the adverse health effects of environmental contaminants.

S-31C2-4

The Mothers and Children's Environmental Health Study (A Multicenter Longitudinal Study in Korea)

Eun-Hee Ha,[1] Boong-Nnyun Kim,[2] Se-young Oh,[3] Byung-Mi Kim,[1] Ju-Hee Seo,[1] Moon-Hee Chang,[1] Eun-Kyo Park,[1] Ha Mina,[4] Hye-Sook Park,[1] Bo Eun Lee,[1] Young Ju Kim,[5] Yun-Chul Hong,[6] Yangho Kim,[8] Namsoo Chang,[9] Young-Man Roh;[9] and The MOCEH Study Group,[1] [1]*Department of Preventive Medicine, School of Medicine, Ewha Womans University, Seoul, Republic of Korea;* [2]*Division of Child and Adolescent Psychiatry, Department of Psychiatry and Institute of Human Behavioral Medicine, Seoul National University College of Medicine, Seoul, Republic of Korea;* [3]*Department of Food and Nutrition, Kyung Hee University, Seoul, Republic of Korea;* [4]*Department of Preventive Medicine, Dankook University College of Medicine, Cheonan, Republic of Korea;* [5]*Department of Obstetrics Medicine, College of Medicine, Ewha Womans University, Seoul, Republic of Korea;* [6]*Department of Preventive Medicine, Seoul National University College of Medicine, Seoul, Republic of Korea;* [7]*Republic of Korea;* [8]*Department of Nutritional Science and Food Management, Ewha Womans University, Seoul, Republic of Korea; and* [9]*Department of Health Science, Simon Fraser University, Vancouver, British Columbia, Canada.*

Background/Aims: The MOCEH study is a prospective hospital- and community-based cohort study designed to collect information related to environmental exposures (chemical, biological, nutritional, physical, and psychosocial) during pregnancy and childhood, and to examine how exposure to environmental pollutants affects growth, development, and disease.

Methods: The MOCEH network includes 1 coordinating center, 4 local centers responsible for recruiting pregnant women, and 4 evaluation centers (a nutrition center, bio-repository center, neurocognitive development center, and environment assessment center).

Results: At the local centers, trained nurses interview the participants to gather information regarding their demographic and socioeconomic characteristics, complications related to the current gestation period, health behaviors, and environmental factors. These centers also collect samples of blood, placenta, urine, and breast milk. Environmental hygienists measure each participant's level of exposure to indoor and outdoor pollutants during the pre- and postnatal periods. The participants are followed up through delivery and until the child is 5 years of age. The MOCEH study plans to recruit 1500 pregnant women between 2006 and 2010 and to perform follow-up studies on their children.

Conclusion: We expect this study to provide evidence to support the hypothesis that the gestational environment has an effect on the development of diseases during adulthood. We also expect the study results to enable evaluation of latency and age-specific susceptibility to exposure to hazardous environmental pollutants, evaluation of growth retardation focused on environmental and genetic risk factors, selection of target environmental diseases in children, development of an environmental health index, and establishment of a national policy for improving the health of pregnant women and their children.

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AIR POLLUTION - SHORT-TERM HEALTH EFFECTS

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O-31C3-1

Health Risks of Air Pollution on Mortality in Klang Valley, Malaysia

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Background/Aims: In the first coordinated Public Health and Air Pollution in Asia (PAPA) study, the results showed that short-term exposures to polluted air were associated with daily mortality rates in some major cities in Asia. However, there are limited numbers of health effects of air pollution studies in Malaysia due to lack of capacity in environmental epidemiology. In this study, we conducted the first daily air pollution time series study in Klang Valley which is a heavily industrialized urban area in Malaysia, using a protocol developed by the PAPA study.

Objective: To estimate the health risks of 5 criteria air pollutants on mortality in Klang Valley.

Methods: Daily deaths records for Klang Valley from 2000 to 2006 were obtained from the Statistics Department. For the same period, daily concentrations of the criteria air pollutants (PM_{10}, SO_2, NO_2, O_3, and CO) and the daily meteorological data (temperature, relative humidity, and rainfall) were obtained from the Department of Environment and the Meteorological Service Department, respectively. Descriptive analysis was performed to identify the trend for the air pollutants and the mortality data. We used Poisson regression to model the daily mortality counts while controlling for time trends, temperature, rainfall, month and day of the week, and assessed effects of single pollutant and multiple pollutants.

Results: The main air pollutants in the Klang Valley region were ozone and PM_{10}. In the single pollutant model, the RRs of all pollutants were found to be greater than 1.0 except for NO_2 and SO_2 at lag 0 and lag 1, respectively. However, these RR were insignificant. The natural-cause mortality risk was significant for PM_{10} at lag 1 and ozone at lag 2 and at average lag 0 to lag 2 concentrations. In the multiple pollutant models, the highest excess risk was found for ozone at lag 2 with 1.10% per 10 $\mu g/m^3$ increase in ozone. The risks on respiratory and cardiovascular mortality were also found.

Conclusion: The study confirms the association between mortality risks and air pollutants, particularly for ozone and PM_{10}, as with magnitude similar to those by other studies worldwide.

O-31C3-2

The Effects of Short-term Air Pollution Exposure on Blood Pressure Changes in Nonsmoking Adults

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Background/Aims: Previous studies demonstrated inconclusive associations between short-term air pollution exposure and blood pressure changes.

Methods: We used a population-based approach, including 9238 nonsmokers over 20 years of age, to investigate short-term air pollution exposure on blood pressure changes. Individuals' exposures to sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), particulate matters with diameter <10 mm (PM_{10}), and nitrogen dioxide (NO_2) were calculated from the data of Taiwan Air Quality Monitoring Network. A generalized linear model was applied to analyze the data.

Results: For an interquartile range (IQR) of SO_2, CO, O_3, PM_{10}, and NO_2, pulse pressure narrowed 1.0 (95% confidence interval [CI]: −1.2 to −0.7), 1.1 (95% CI: −1.4 to −0.8), 0.6 (95% CI: −0.9 to −0.2), 1.5 (95% CI: −1.9 to −1.1), and 3.0 (95% CI: −3.5 to −2.5) mm Hg; systolic blood pressure decreased 0.6 (95% CI: −1.0 to −0.3), 1.2 (95% CI: −1.4 to −0.9), 0.4 (95% CI: −0.8 to −0.1), 0.5 (95% CI: −0.9 to 0.0), and 2.6 (95% CI: −3.1to −2.0) mm Hg. An IQR of SO_2, O_3, PM_{10}, and NO_2 increased 0.9 (95% CI: 0.8 to 1.1), 0.5 (95% CI: 0.2 to 0.8), 0.6 (95% CI: 0.2 to 0.9), and 1.1 (95% CI: 0.7 to 1.5) mm Hg of diastolic blood pressure. The effects of CO and O_3 on narrowing pulse pressure were more significant in female than in male.

Conclusion: Short-term air pollution exposure can narrow the pulse pressure, indicating decreased cardiac output. Female are more vulnerable to short-term air pollution exposure.

O-31C3-3

Particulate Air Pollution From Wood Combustion and Blood Pressure Among Elderly Persons

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Background/Aims: Fine particles ($PM_{2.5}$; diameter <2.5 μm) are associated with adverse health effects such as cardiovascular diseases. Combustion of wood and other forms of biomass for heating and cooking is common all over the world. Our objective was to evaluate the association between particles from biomass combustion and blood pressure (BP), an important risk factor for coronary artery disease, among elderly subjects.

Methods: Daily levels of $PM_{2.5}$ were measured at a central outdoor measurement site in Kuopio, Finland, between November 2008 and May 2009. Levoglucosan (LG), an indicator of biomass combustion, was determined from 24-hour filter samples of $PM_{2.5}$. Concurrently with the air pollution measurements, 36 elderly subjects (>59 years of age) were followed monthly for 6 months with clinical visits. Subjects lived within 2 kilometers from the central measurement site. Approximately half of the subjects (N = 19) had some form of heart disease. Systolic (SBP) and diastolic (DBP) blood pressure were measured during every clinical visit. Associations of 24-hour outdoor $PM_{2.5}$ and LG concentrations with SBP and DBP were assessed using generalized additive models in R adjusting for month and temperature.

Results: Daily median concentrations of $PM_{2.5}$ and LG were 5.0 $\mu g/m^3$ and 27.8 ng/m^3, respectively. There were 207 successful clinical visits in total. No associations were observed between blood pressure and $PM_{2.5}$ or LG.

Conclusion: Low levels of ambient $PM_{2.5}$ and $PM_{2.5}$ from wood combustion were not associated with blood pressure.

O-31C3-4

Elevated $PM_{2.5}$ Nickel and Vanadium Increases Cardiovascular Mortality in Hong Kong

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Background/Aims: Depending on the chemical composition, some $PM_{2.5}$ may be more dangerous than others. There is evidence that the toxicity

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and composition of airborne $PM_{2.5}$ vary from one city to another. In Hong Kong, the recently available $PM_{2.5}$ component time series data allow us to examine the heterogeneity in toxicity of $PM_{2.5}$ components and its effects on cardiovascular disease mortality at a population level.

To examine the association between the levels of $PM_{2.5}$ chemical components and cardiovascular disease (CVD) mortalities in Hong Kong.

Methods: Generalized additive model with log link and Poisson error was used to analyze the cardiovascular mortality, $PM_{2.5}$ components, and covariate factors of the 2 years 2001 and 2005 in Hong Kong. As the $PM_{2.5}$ components data were available only once every sixth day, we used the moving total mortality count as the health outcome for the time-series analysis. The results were provided as the percentage excess risk (ER) in CVD mortality per interquartile range difference in the concentration of each $PM_{2.5}$ component.

Results: We found statistically significant evidence that CVD mortalities were higher in days with higher concentrations of vanadium (ER = 4.7%; 95% CI: 1.5%–8.0%), nickel (ER = 4.1%; 95% CI: 1.1%–7.1%), and organic carbon (ER = 0.8%; 95% CI: 0.2%–1.4%). On average, the health effects of $PM_{2.5}$ on day 0 became apparent in the subsequent days: day 2, day 3, and day 4. The nickel/vanadium and CVD mortality association echoes the earlier Hong Kong experience of the CVD mortality decrease linked to the airborne nickel/vanadium reduction in the 1990s.

Conclusion: The nickel/vanadium and CVD mortality association warrants attention to the health effects due to marine bunker oil emissions in Hong Kong.

ENVIRONMENTAL EXPOSURES FOR SVOCS, HUMAN UPTAKE AND HEALTH (ISIAQ SYMPOSIUM)

S-31C4-1

The Full Chain Model Following SVOCs Indoor From Sources to Health Effects

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Abstract: During the last decades, there has been a progress in the societal work focusing on reduction of environmental toxicants from large local point emissions such as industrial plants, wastewater systems, and occupational settings. The concerns faced today are more related to the diffuse emissions of chemicals from articles or products that may be harmful for the environment and humans. Most of these new consumer products are related to our daily life and often used indoor meaning that our homes and nonindustrial workplaces are important places for exposure. This means that the general population is exposed including the more sensitive fetuses and infants. Many of these new chemicals have been shown to be toxic in studies on animals and an increasing body of evidence suggests that they also have impact on human health. Among all the chemicals that have been introduced to the environment during the last decades the endocrine disrupting compounds are of particular concern—ie, chemicals that can alter the function(s) of the endocrine system with several adverse health effects as possible results. Endocrine disrupting compounds can be found in many commonly used products. Examples are phthalates, bisphenol A, 4-nonylphenol, flame retardants, perfluorochemicals, etc. When establishing new scientific knowledge on the importance of environmental toxicants for human health and how to reduce such health risks it is fruitful to use a "full chain model." Such a model is focusing on toxicants in the environment and their sources as well as identification of modifying factors for environmental exposures. It is further focusing on human uptake as well as pathways and finally examines health effects and involved biological mechanisms. Such data regarding sources and environmental exposures, human uptake, and health effects are essential input for risk management.

S-31C4-2

Long-term Integrated Sampling of Semivolatile Organic Compounds in Indoor Air: Measurement of Emerging Compounds Using Novel Active and Passive Sampling Methods

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Background/Aims: A pilot study evaluated newly developed, long-term integrated active and passive air samplers targeting a suite of semivolatile organic compounds (SVOCs), some not previously measured in air.

Methods: Active samplers collected air at 1 L/min continuously for 20–30 days and were designed to be minimally invasive to residents. Active air samples of particulate and vapor phase materials were collected using URG personal pesticide sampling cartridges with XAD resin and polyurethane foam plugs. Passive air samples were collected using a similar glass cartridge containing only polyurethane foam plugs. To our knowledge, this study is one of the first to evaluate long-term, integrated active air sampling techniques for a wide range of SVOCs of emerging concern and to evaluate compact passive samplers in parallel. Samplers were deployed in 2 residences and 1 office location and analyzed for 113 SVOCs.

Results: A total of 90 SVOCs were detected, including 6 phthalates, 13 flame retardants, 14 polycylic aromatic hydrocarbons, 2 glycol ethers, 17 pesticides, 11 phenolic compounds, and 17 fragrance compounds. Due to the lack of historical experience with long-term integrated air sampling for these compounds, a number of quality assurance/quality control samples were used to characterize method performance. Quality assurance/quality control measures included duplicate field samples to evaluate precision; spiked samples to evaluate accuracy by estimating analyte degradation and recovery; field blanks to evaluate potential contamination; and cartridges in series to evaluate breakthrough. Because passive sampling methods may be useful exposure measures in large-scale epidemiological studies, they were collected in parallel and compared with active samples across the full range of analytes.

Conclusion: Strengths and limitations of the new sampling techniques will be discussed. In addition, we will summarize a range of available methods for measuring a broad suite of SVOCs in air and dust in the context of exposure and epidemiological studies.

S-31C4-3

Semi-volatile Organic Compounds Distributions in Residential Dust Samples From 5 US Communities: Key Lessons for Improving Residential Exposure Assessment

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Background/Aims: In addition to uncertainties surrounding health effects, significant gaps remain in our understanding of the dominant sources of exposure to semi-volatile organic compounds. While dietary, occupational, and ambient exposures may contribute, it is known that residential exposures can be dominant for some compounds (eg, polybrominated diphenyl ethers [PBDEs]).

Methods: Settled dust and survey data were collected from approximately 250 households across 5 US communities (Cape Cod and Roxbury, Massachusetts; Richmond and Bolinas, California; and Gadsden County, Florida). These study sites represent various climates and population densities and our study populations varied by ethnic, racial, and socioeconomic composition. Within each home, settled dust samples were

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collected using modified vacuum cleaners, and analyzed by GC/MS selected-ion monitoring for compounds represented several; key several chemical classes, including phthalates (eg, diethyl phthalate, diisobutyl phthalate), pesticides (eg, permethrin, cypermethrin, and chlorpyrifos), PBDEs (eg, BDE100, BDE47, and BDE99), and polycyclic aromatic hydrocarbons (eg, benzo(a)pyrene).

Results: Comparisons across study sites were suggestive of potential differences in sources. PBDEs were more common in the California communities. Phthalates were widely detected across all study sites, with more than 90% above the method reporting limit for diethyl phthalate and diisobutyl phthalate. In general, the Gadsden County households showed the highest levels of pesticides and the greatest variety in detected analytes. Gadsden county households also showed the lowest detection prevalence for several key polycyclic aromatic hydrocarbons. Household data from each study site will be used to test underlying assumptions about key exposures.

Conclusion: Within- and between-cohort variations in household concentrations of semi-volatile organic compounds can be used to identify opportunities to improve survey techniques, visual inspections and in-home sampling methodology.

S-31C4-4

Semivolatile Organic Compounds Exposure of the General Population: The Example of Phthalates

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Background/Aims: The German health-related environmental monitoring program is based on following 2 instruments: the German Environmental Survey (GerES) and the German Environment Specimen Bank.

Methods: In GerES IV (2003–2006), 11 phthalate metabolites were measured in morning urines from 600 randomly selected children. In the Environment Specimen Bank, the metabolites were measured in 950 students 24 h urine sampled between 1988 and 2008.

Results: All metabolites could be quantified in nearly all samples of the children. Exposure to most of the phthalates analyzed was higher than in the United States. In 1.5% of the children exposure to DEHP exceeded the HBM-I-value (500 μg/L, sum of 5OH-MEHP and 5oxo-MEHP) defined by the German HBM Commission. The children's intake of DEHP, DiBP, and DnBP exceeded in up to 1.4%, 11.7%, and 9.1% the corresponding TDI (EFSA) values. For the students, the TDI was only trespassed in some cases. A considerable number of children had an excessive (overshooting) exposure to more than 1 phthalate. This indicates that a cumulative risk assessment should be discussed. The analysis of the students over the 10 years time period revealed that DEHP exposure has decreased while exposure to DiNP has increased. This demonstrates that DEHP in products is increasingly substituted by DiNP or a mixture of phthalates. Exploring exposure pathways of phthalates is a difficult task. In an additional small exposure study, nutrition was the most important exposure pathway. In GerES, significant correlations between the metabolites in urine and the phthalates in house dust were found for DnBP, DiBP, and BBzP, but no correlation for DEHP and DiNP.

Conclusion: Meanwhile, the use of BBzP, DEHP, DnBP, and DiBP is restricted in the European Union and these phthalates are on the REACH priority ("Authorization") list, which means that they have been identified as substances of very high concern that might face further restrictions.

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S-31C4-5

Impact of Polybrominated Diphenyl Ethers on Thyroid Hormone Levels Among California Women During Second Trimester of Pregnancy

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Background/Aims: In animal studies, polybrominated diphenyl ether (PBDE) flame retardants are linked to hypothyroidism, characterized by reduced free and total thyroxine (T4) levels. However, associations between PBDEs and thyroid hormone levels in humans have been inconsistent. We examined the association between PBDEs and thyroid hormone levels during the second trimester of pregnancy among women in California, where exposures are expected to be elevated due to the state's unique furniture flammability standard (TB117).

Methods: Serum samples were collected from 25 pregnant women (gestational age: 19–23 weeks) at San Francisco General Hospital between 2008 and 2009. Eighteen samples to date were analyzed for 19 tri- to deca-substituted PBDE congeners. A summary measure of 4 frequently detected congeners (47, 99, 100, and 153) was also constructed (ΣPBDEs). Samples were analyzed for thyroid-stimulating hormone (TSH), and free and total T4. Analysis of polychlorinated biphenyls and perfluorinated compounds are underway.

Results: The study population was 36% Hispanic, 40% Black, 12% White, and 12% Asian. The majority of patients used public insurance. Mean age was 23 years (range: 16–42 years). PBDE levels among this study population (geometric mean; BDE-47: 45 ng/g lipid, ΣPBDEs: 81 ng/g lipid) were elevated compared to pregnant women in National Health and Nutrition Examination Survey 2003–2004 (n = 75) (geometric mean; BDE-47: 24 ng/g lipid, ΣPBDEs: 54 ng/g lipid). Serum BDE-47 was inversely associated with free T4 ($R^2 = 0.26$, $P = 0.02$) and positively associated with TSH ($R^2 = 0.14$, $P = 0.07$). Associations remained unchanged after adjusting for race, age, or gestational age. Similar associations were observed for ΣPBDEs, BDE-99, and BDE-100 but not BDE-153.

Conclusion: PBDEs are associated with decreased T4 and increased TSH among pregnant women. These effects are consistent with findings from animal studies, and warrant further investigation since maternal subclinical hypothyroidism during pregnancy has important implications for fetal development. The elevated PBDE exposures are also consistent with higher use of flame retardants in California.

FORMALDEHYDE AND VOLATILE ORGANIC COMPOUNDS (VOCS) IN INDOOR ENVIRONMENTS: LINKING SOURCES AND HUMAN EXPOSURES (ISIAQ SYMPOSIUM)

S-31C5-1

Sources of Volatile Organic Compounds and Emission Modeling in Real Buildings

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Background/Aims: Volatile organic compound (VOC) emission source models and room air quality simulation models have been developed based on idealized situations. Application of these models to real buildings is challenging under the best of circumstances—single zone spaces with very few emission materials inside.

Methods: Case studies in the literature are scarce regarding the predictability of indoor VOC concentrations as well as how such predictions could be performed. This presentation will first introduce a

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newly developed IAQ simulation program (DeST-IAQ), then attempt to predict the indoor VOC concentrations based on the materials use and ventilation conditions.

Results: This presentation will first introduce a newly developed IAQ simulation program (DeST-IAQ), then attempt to predict the indoor VOC concentrations based on the materials use and ventilation conditions.

Conclusion: The "accuracies" of the simulation results as compared to the measured data are given, and some key factors to ensure the above simulation results meaningful are also discussed.

S-31C5-2

Linking Chamber Derived Emission Factors to Indoor Exposure Concentrations

Randy Maddalena,[1] Noel Aquilina,[1,2] and Thomas McKone1

Background/Aims: Standardized emissions testing protocols for building materials are used extensively for regulatory compliance testing across a wide range of jurisdictions. These tests use controlled chambers loaded with a prescribed emitting surface area of material and ventilated with a known flow of conditioned air. The protocols are designed to provide consistent results for comparison to regulatory "ceiling" values and results are typically reported in terms of concentration (ppm).

Methods: More recently, these chamber-based test procedures have been used to characterize material-specific emission factors and to identify the relative contribution of different materials to whole building pollutant loading. There are several challenges when using chamber-derived emission factors to estimate whole building exposure concentrations. The "scaling up" requires consideration of building ventilation rates, variation in temperature and humidity, and potential interactions with both emitting and nonemitting surfaces.

Results: In this study, we assess these factors using case studies that include intermittent volatile organic compound emissions from office equipment, elevated formaldehyde in emergency housing units, and reactive sulfur gas emissions from dry wall. The case studies use small emission chambers containing individual materials; an intermediate scale chamber mock up loaded with several materials having loading rates that are representative of a common room; a large scale chamber containing multiple units from specific source categories and whole-house scenarios including a range of environmental conditions.

Conclusion: This work illustrates the challenges with using chamber-derived emission factors for predicting whole-house exposure concentrations. We consider a range of modeling and experimental strategies, which are available to address these challenges.

ENVIRONMENTAL HEALTH EFFECTS ON SUSCEPTIBLE POPULATIONS

O-31C6-1

Nitrate Exposure to Mexican American Women of Childbearing Age From Bottled Water and Maquinas de Aqua

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Background/Aims: Interview data from the National Birth Defects Prevention Study identified 42% of Texas participants drinking bottled water exclusively at the beginning of pregnancy. Little information is available on the nitrate content of bottled water. Substantial numbers of low-income Mexican American women along the Texas/Mexico border reside in marginalized areas called colonias. Common concerns related to these areas are persistent poverty, lack of infrastructure, neighborhood deprivation, and uncertain water sources. In addition to bottled water purchased in grocery stores, the border population also buys water from maquinas de aqua (water machine or water kiosks), which may be subject to little or no regulation of water quality. The objective of this study was to collect samples of bottled water and water from maquinas de aqua in order to determine nitrate level.

Methods: Using 3- to 5-mile buffers around addresses, neighborhoods along the 800-mile Texas-Mexico from Brownsville to El Paso, where the National Birth Defects Prevention Study participants resided, were identified. Trained promotora and researcher surveyed all traditional, convenience, and nontraditional food stores for bottled water; maquinas de aqua were identified; and 100 samples of bottled and water mill water were collected. Water samples were transported to the University of Iowa Hygienic Laboratory (UHL) for testing. UHL will utilize EPA Method 300.0, Inorganic Anions by Ion Chromatography, Rev 2.1 in Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600/R-93/100).

Results: A total of 195 food stores (supercenters, supermarkets, grocery stores, convenience stores, and dollar stores) and 113 maquinas de aqua were identified. Samples were collected from more than 75 locations. Nitrate levels varied by geographic locale and type of water.

Conclusion: Considering the growth of water machines and greater reliance by marginalized communities on water from other than tap, it is no longer appropriate to use nitrate content of tap water as singular proxy for nitrate exposure from water.

O-31C6-2

The Effect of VOCs Exposure During Pregnancy on Newborn's Birth Weight in Mothers and Children's Environmental Health (MOCEH) Study

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Background/Aims: Epidemiologic studies have reported the association between fetal exposure of Volatile organic compounds (VOCs) and birth outcome such as birth weight or gestational age at birth. We aimed to investigate the relationship between VOCs and birth weight, focused on individual compounds of VOCs.

Methods: Prospective birth cohort study(MOCEH) was conducted in Seoul, Cheonan, and Ulsan since 2006 and total of 1558 pregnant women were enrolled. Basic investigations on maternal information including demographic and socioeconomic status, previous obstetric and residential characteristics were done by questionnaires. Three hundred seventy-eight personal VOCs were assessed by using passive sampler during pregnancy. We analyzed 11 individual compounds of VOCs including benzene, toluene, ethylbenzene, formaldehyde, and total VOCs as an environmental exposure. Following delivery, the trained nurses investigated medical records to attain obstetric and neonatal information. After excluding twin, abortion, and stillbirth, total 296 were used in analyses. In statistical analyses, VOCs was log-transformed for skewness and multivariate general linear model (GLM) was used (SAS 9.1).

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Results: The mean concentrations of TVOC and HCHO were 234 $\mu g/m^3$ and 77.29 $\mu g/m^3$, respectively. TVOC was related to the number of cohabitants, existing of sofa, and distance to factory. HCHO concentrations showed positive relationship with the number of cohabitants, using air conditioner and existing of bed but negative relationship with house age. Elevated VOCs exposure showed significant relationship with birth weight when log-1-unit increase of benzene ($\beta = -208.98$, $P = 0.04$), TVOC ($\beta = -181.2$, $P < 0.01$), HCHO ($\beta = -156.30$, $P = 0.05$), and toluene ($\beta = -76.04$, $P = 0.05$) after adjusting maternal age, gestational age at delivery, family income, parity, newborn's gender and related residential factors such as house age.

Conclusion: These results indicated that elevated exposure to VOCs during pregnancy may decrease birth weight of newborns, particularly benzene. Moreover each compound of VOCs shows different estimates to birth weight. Therefore it is needed to pay special attention to individual compounds not just TVOC in pregnant population.

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O-31C6-3

Prenatal Exposure to Soy Isoflavones and Anogenital Distance in Male Newborns

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Background/Aims: Soy products are traditionally consumed among many Asian countries, including susceptible population such as pregnant women and infants, in their daily life. This has raised concerns over the health effects to fetuses and infants by soy isoflavones that has estrogenic activity. Fetal exposure to soy isoflavones disrupts reproductive development in animals. However, there are few studies that examined the potential effect in humans. The purpose of the present study was to assess relationship between fetal exposure to daidzein, and its metabolite, equol, and reproductive endpoint of male newborns.

Methods: Spot urine samples were collected from 101 Japanese pregnant women after obtaining informed consent. The urinary concentrations were measured by gas chromatography-mass spectrometry (GC-MS) after solid phase extraction of urine samples and derivatization. For the male newborns, birth outcomes and anogenital distance (AGD), the distance from the center of the anus and external genitalia, were measured. AGI (mm/kg bw) was defined as AGD corrected by birth weight.

Results: The median urinary concentrations were 1.42 and 0.137 mg/g cre for daidzein and equol, respectively. The levels were comparable to the reported values in Japan but higher than those of female subjects in the United States by 20 times. Equol was detected in 58% of the subjects. Mean AGI was 14.7 mm/kg and normally distributed. In multiple regression analysis, there was no association between urinary daidzein or equol concentration and AGI of male newborns (standardized partial regression coefficient (β) = 0.157, $P = 0.115$ for daidzein; $\beta = -0.130$, $P = 0.224$ for equol).

Conclusion: We found no association between prenatal exposure to daidzein and equol and anogenital distance of male newborns in Japan. However, since estrogenic isoflavone exposure level is much higher in Japanese fetus than in other populations, we may need to carefully examine its potential effects.

O-31C6-4

Early-life Household Environmental Exposures Increase the Risk of Childhood Asthma

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Background/Aims: The aim of this study is to explore the relationships between exposure to dampness, pets, and environmental tobacco smoke (ETS) early in life and asthma in Taiwanese children, and to discuss their links to early- and late-onset asthma.

Methods: We conducted a 1:2 matched case-control study from the Taiwan Children Health Study, which was a nationwide study that recruited 12- to 14-year-old school children in 14 communities. The 579 mothers of the participants were interviewed by telephone about the environment their children were exposed to before they were 5 years old, and during their in-utero period. We used conditional logistic regressions for our statistical analysis.

Results: Childhood asthma was associated with exposure to certain antagonists before the participants were 5 years old, such as cockroaches (odds ratio [OR] = 2.16; 95% confidence interval [CI]: 1.15–4.07), visible mould (OR = 1.75; 95% CI: 1.15–2.67), mildewy odors (OR = 5.04; 95% CI: 2.42–10.50), pets (OR = 2.11; 95% CI: 1.20–3.72), more than one cigarette daily (OR = 3.15; 95% CI: 1.93–5.15), and more than 1 hour of ETS per day (OR = 1.93; 95% CI: 1.16–3.23).

Conclusion: Exposure to these factors led to dose-responsiveness in the risk of asthma. The ORs for mildewy odors, feather pillows, and ETS before the age of 5 years were greater among children with late-onset asthma. Cockroaches, pets, and ETS during pregnancy affected the timing of early-onset asthma. In-utero exposure to a greater number of smokers, duration, and amount of ETS led to higher risks of early-onset asthma for children ($P < 0.05$).

O-31C6-5

Exposure to Phthalates Affects Insulin Resistance in the Elderly

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Background/Aims: High plasma levels of insulin and glucose due to insulin resistance (IR) are believed to be the origin of metabolic syndrome and type 2 diabetes, including its complications. In this study, we tried to determine whether exposure to phthalates affects insulin and glucose levels and HOMA index as IR indices and oxidative stress in elderly.

Methods: We recruited 525 of aged persons more than 52 years old and obtained blood and urine samples during 3 medical examinations. We measured urinary level of mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP) and mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP) as DEHP metabolites, and mono-n-butyl phthalate (MnBP) as a DBP metabolite. We also measured levels of insulin and glucose in serum in order to assess IR. In addition, the HOMA, an indirect index for the assessment of IR, was calculated. Malondialdehyde (MDA), an oxidative stress biomarker, was also measured in urine samples.

Results: When we estimated the effect of MEHHP, MEOHP, and MnBP on each IR index and MDA level using repeated analysis, all MEHHP, MEOHP, and MnBP levels showed positive relationships with insulin, glucose, HOMA index, and MDA levels after being adjusted for age, sex, BMI, and cotinine level (MEHHP-insulin, $\beta = 0.0954$, $P = 0.0013$; MEOHP-insulin, $\beta = 0.1116$, $P = 0.0002$; MnBP-insulin, $\beta = 0.1149$, $P = 0.0003$; MEHHP-glucose, $\beta = 0.0446$, $P < 0.0001$).

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Conclusion: Our study results suggest that the exposure to phthalates increases IR and oxidative stress in the elderly.

O-31C6-6

Myocardial Infarction Rate and Air Pollution: Modification Effect by Neighborhood Socio-economic Characteristics and by Sex. A Bayesian Modeling Conducted at a Small-area Scale

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Background/Aims: Short-term air pollution variability is known to be associated with mortality/hospital admissions for cardiovascular diseases; the link with myocardial infarction (MI) is less documented. Moreover, several sub-group of the population are recognized to be more vulnerable, specifically women or disadvantaged groups. This study aimed to investigate the association between air pollution and the occurrence of MI events, and to evaluate effect modification by sex and/or socioeconomic status.

Methods: An ecological study was conducted in the Strasbourg Metropolitan Area (SMA, 450,000 inhabitants) located in North-eastern France. We studied 1193 MI events aged 35–74 years in 2000–2003. A deprivation index quantified the neighborhood deprivation level. PM_{10} and NO_2 concentrations were modeled at the census block level by ADMS-Urban (n = 190 in the SMA). A long-term exposure indicator was estimated by annual-average of modeled pollutant concentrations in each census block during the study period. An individual short-term exposure indicator was also assigned to each event with different time-lags: at the case day (lag 0) and 1 or 2 previous days (lag 0–1 and lag 0–2). The short-term exposure indicator was assessed in each block as the average of the short-term exposures across all cases living within the block. A Bayesian approach was applied to consider both spatial dependence and high variability of MI rates. We investigated the interactions between deprivation status and air pollution levels by gender.

Results: A clear interaction between the deprivation level and the short-term PM_{10} exposure was shown for women only; the relative increase of MI risk among females is 22% (95% CI: [2%, 46%]) per 10 $\mu g/m^3$ increase in PM_{10} concentrations (lag 0–2) by unit increase of deprivation level (ranging between 0.03 and 4.4). Similar trends were observed with NO_2.

Conclusion: These findings suggest a strong differential susceptibility, since a previous environmental justice study had demonstrated in Strasbourg that the most exposed groups did not leave in the most deprived areas. (eg, Elderly, Children, Pregnant Women)

PP-29-160

Environmental Exposure to Lead Elevates Blood Pressure in the Elderly

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Background/Aims: The purpose of this study was to find out the influence of blood lead level on the blood pressure in the elderly.

Methods: We enrolled 411 subjects who were 56–86 years old in Seoul, South Korea. We gathered the data including age, sex, height, weight, urinary cotinine, blood lead, temperature, and blood pressure in 2008 and conducted follow-up survey in 2009. The data were analyzed by proc mixed procedure using SAS 9.1.

Results: The level of mean blood lead was 2.32 ± 1.35μg/dL. In the univariate analysis, the blood lead level elevation of 1 μg/dl led to the increase in both the systolic blood pressure of 1.66 mmHg (95% confidence interval [CI]: 0.73 to 2.58) and the diastolic blood pressure of 1.04 mmHg (95% CI: 0.51 to 1.57). After adjusting sex, age, body mass index, uninary cotinine, and temperature, the blood lead elevation of 1μg/dL led to the statistically significant increase in the diastolic blood pressure (0.55 mmHg, 95% CI: 0.02 to 1.08) and the statistically borderline increase in the systolic blood pressure (0.91 mmHg, 95% CI: −0.01 to 1.83).

Conclusion: This study revealed that the blood lead level elevation was related with the increase in the blood pressure of the elderly.

PP-31-097

The Comparison of Nutrient Intakes and Patterns of Alcohol Consumption According to Social Status in Workers

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Background/Aims: Alcohol consumption is 1 of the 5 most important risk factors for the global burden of disease and disability. Furthermore, the drinkers have excess energy as a result of consumption of alcohol and various snacks; and additionally, they also had irregular dietary habits which caused malnutrition. However, researches on nutrient intakes and patterns of alcohol consumption according to social status (position and educational status) at workplace were limited. The objectives of this study were to analyze the association of nutrient intakes and alcohol consumption according to social status.

Methods: A cross-sectional survey was carried out among 6605 (male: 6181 with a mean age of 42.8 years, female: 424 with a mean age of 36.1 years) employed individuals in Korea. Data were derived from a baseline survey and assessment of nutrient intakes (including alcohol), using a computerized food frequency questionnaire originally developed by the Korea Centers for Disease Control and Prevention and modified by our institution for workers.

Results: The intake of alcohol and alcohol (E%) was significantly higher in male worker than in female worker. Higher social status was generally associated with the higher alcohol intake, with higher energy and fat ($P < 0.05$). No differences were found in fiber and sodium across educational status groups.

Conclusion: The social status like position and educational status affects the nutrient and alcohol intake. These data provide evidence that nutrient and alcohol intake depends on social status and suggest the necessity of prevention and intervention strategies considering characteristics of dietary behavior across social to reduce risk of disease and malnutrition caused by dietary and alcohol intake in workplace.

PP-31-098

Weather–Mortality Association in Patients With Chronic Heart Failure: 5-year Longitudinal Study Across 4 Different Regions in Israel

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Background/Aims: The objective of our research was to study the weather effect on death events in patients with chronic heart failure (CHF) controlling for the natural cycles.

Methods: The study dataset contained everyday counts of death events in CHF patients from November 2001 to June 2005, accompanied by daily weather measurements (temperature and its range, barometric pressure, humidity, and wind speed) in 4 Israeli districts (Southern, Haifa, Central, and Tel-Aviv). The nationally representative cohort was comprised of 14,020 patients hospitalized at least once with a primary discharge diagnosis consistent with decompensated heart failure, 8131 of whom died

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during the study follow-up. Annual, seasonal, and other cycles were used for decomposing weather variables into sums of trigonometric functions. Either Poisson or negative binomial regression model based on special time series technique was used for analysis. To account for possible delay, the model terms also included 1- to-3-day lagged weather variables.

Results: At large, effect of weather on CHF mortality was found in each district. With that, effect of humidity (the actual and lagged values including interaction terms with the trigonometric functions) on CHF mortality was widespread; but the effect of other variables was different. That is, temperature influence (including the lagged values and the interaction terms) was significant everywhere, but absent in Haifa (the largest seaport). Influence of temperature range (including again the lags and the interactions) was in universally but out in Tel-Aviv (a coastal metropolitan). Barometric pressure and wind speed values (with lags and interactions) had an effect in each region but Central district (an inland part of the country).

Conclusion: Obtained weather effects are reasonable and match the climate characteristics of the considered regions of Israel. Understanding the impact of weather may better help guiding therapy of patients with CHF.

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PP-31-099

Organophosphate Pesticide Exposures and Fetal Development in Shanghai, China

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Background/Aims: Although pesticide use is widespread, little is known about the levels of organophosphate pesticides in Chinese people and potential adverse health effects of in utero exposure. We investigated the effects of organophosphate pesticides exposure during pregnancy on fetal growth and gestational duration in Shanghai, China.

Methods: Between September 2006 and January 2007, 193 mother-infant pairs were enrolled in our study. In all, 193 questionnaires and 187 maternal urine samples, 187 neonates' growth developments were examined. We measured nonspecific metabolites of organophosphate pesticides (dimethyl and diethyl phosphates) in maternal urine collected during pregnancy.

Results: The geometric means of metabolites of organophosphate pesticides were dimethyl phosphate, 25.75; diethyl thiophosphate, 11.99; diethyl phosphate, 9.03; and diethyl dithiophosphate, 9.45 μg/L organophosphate pesticides levels in the present population were higher than that in the United States and Netherlands population, which suggested that potential adverse health effects of in utero exposure of OP pesticide should be carefully considered. We failed to demonstrate relationship between fetal growth and any measure of in utero organophosphate pesticide exposure. However, we did find decreases in gestational duration in girls associated with 1 measure of in utero pesticide exposure: urine diethylphosphate (β adjusted = -1.79; 95% confidence interval: -1.27–1.26, $P = 0.001$).

Conclusion: The long-term effect of prenatal exposure to organophosphate pesticides on childhood development needs to be further investigated.

PP-31-100

Prenatal and Postnatal Lead Exposure and Intelligence Quotient in Children at 2, 5, and 8 Years Old in Taiwan

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Background/Aims: Recent studies have focused on the importance of low-level lead (Pb) exposure to children's intelligence quotient (IQ). An act of phase-out leaded gasoline in Taiwan was executed on 2000 to reduce the sources of Pb. We aim to evaluate the influence of using unlead gasoline on children's IQ by longitudinal study.

Methods: A total of 417 pregnant women were initially recruited at the third-trimester at Taichung, Taiwan during 2000–2001. In all, 119, 76, and 66 children were followed up at their age of 2, 5, and 8 years old, respectively. Pregnant women answered a detailed questionnaire in the obstetric clinic. We collected blood samples from pregnant women and children at 2 years old, and these samples were analyzed for whole blood Pb (B-Pb) levels in a certification analytical laboratory in medical center. We also assessed the children's IQ at their age of 2, 5, and 8 years using Bayley Scales of Infant Development-II, Wechsler Preschool and Primary Scale of Intelligence-Revised, and Wechsler Intelligence Scale for Children-version III, respectively.

Results: We found that Wechsler Intelligence Scale for Children-III (8 years) was significantly negative correlated with children B-Pb at 2 years (β: -0.229, $P = 0.048$) after adjustment for maternal age, education, and gender. We also observed a significant negative correlation between children B-Pb at 2 years and Wechsler Preschool and Primary Scale of Intelligence-Revised (5 years) (β: -0.229, $P = 0.044$) after adjustment for maternal education. Significant correlation was found between Bayley Scales of Infant Development-II and maternal B-Pb at 2 years (β: -0.206, $P = 0.039$). Maternal education in our model was a protective factor for children's IQ before 9 years old.

Conclusion: We concluded that blood Pb in children at 2 years can be a good predictor for children's neurodevelopment before 9 years old. More reduction action of Pb in the environment should be taken in Taiwan to reduce the body burden of Pb in children.

PP-31-101

The Role of Air Pollution as a Determinant of Sudden Infant Death Syndrome: A Systematic Review and Meta-analysis

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Background/Aims: Our objective was to synthesize the existing evidence and to consider the directions necessary for future research to coherently address the issue of the impact of air pollution on Sudden Infant Death Syndrome (SIDS).

Methods: We performed a systematic literature search of the Medline database from 1950 through June 2009. No date or language restriction was placed on the literature search. We collected data from papers that had measured the same environmental variables despite the differences in units of measurement.

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Results: Nine studies met the inclusion criteria and provided data for meta-analysis. The risk of SIDS was estimated to increase by 8% (95% Confidence Interval: 4%–14%) per 10 ppb exposure to NO_2 and 9% (95% Confidence Interval: 1%–12%) per 1 ppm exposure CO. The summary effect estimate for particulate matter (PM_{10}) indicated an increased risk of SIDS, but the study-specific effect estimates were heterogeneous, whereas the effect estimate for $PM_{2.5}$ based on 2 homogeneous study-specific effect-estimates suggested consistently lack of effect. The results for SO_2 and O_3 were inconclusive. The risk of SIDS was related to levels of NO_2 and CO exposure during the 3 days preceding the onset, as well as to the previous day level of SO_2.

Conclusion: Both short-term exposure to NO_2 and CO prior the onset as well as long-term exposure to these pollutants in early infancy or months prior to the onset increase the risk of SIDS. In addition, short-term exposure to SO_2 may play a role in the onset of SIDS, but the role of PM_{10} and $PM_{2.5}$ remains inconclusive.

PP-31-103

Increased Vigilance Needed to Prevent Young Children From Accidental Element Mercury Intoxication

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Background/Aims: Mercury is naturally present, and mercury exposure is ubiquitous in the global environment. Compared with monomethyl mercury, element mercury (Hg0) exposure during childhood remains less concerned but vital health risk issues. Concern for children exposed to elemental mercury prompted the Chinese hygiene administration departments to explore the sources of elemental mercury exposures in children, to identify the usual location and proportion of children affected, to make recommendations on how to prevent and deal with these exposures.

Methods: We studied 12 young children of element mercury intoxication aged 0–4 years from 1 January 2007 through 31 December 2009 in our clinic. Full investigations, including history taking, physical examination, and x-ray photos if necessary were performed. Total mercury contents in blood, hair, and urine were examined. Local excision was performed on 1 boy's floor of mouth to remove the mercury residues. DMSA was prescribed for 2 children under the precondition of thoroughly separating children from the sources of mercury exposure.

Results: Young children were found exposed to element mercury by 3 ways: broken thermometer (9 cases), embryonic maternal exposure (2 cases), and accidental inhalation of mercury vapor during embryonic and lactation period (1 case). On admission, they all had a clear history of elemental mercury exposure, and had relatively high blood, urinary and hair mercury levels compared with normal children. X-ray images helped to identify the positions of mercury residues in 4 cases because the children were punctured their bodies by mercury-in-glass thermometers. Good responses to chelation therapy (oral DMSA) were found in 2 cases.

Conclusion: Serious consideration for substitutions of mercury-in-glass thermometers and stricter surveillance to prevent pregnant women from mercury exposure were suggested. The education toward Chinese parents, health care practitioners, and the public about preventing young children from element mercury intoxication and properly dealing with accidental element mercury intoxication in young children should be promoted.

PP-31-105

Spatial Distribution of Hospitalizations for Asthma in Elderly in the Brazilian Amazon

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Background/Aims: To analyze the geographical and seasonal distribution of hospital admissions for asthma in the elderly population of the Brazilian Amazon during the period 2001–2007.

Methods: Descriptive study of short-stay, nonelective hospital admissions, based on Kernel's method, rates of hospitalization in annual and monthly series, seasonal climate, and a comparison of the proportion of hospitalizations during dry, intermediate, and rainy seasons.

Results: Hospitalizations for asthma among the elderly are spatially distributed in the northern and eastern parts of the Brazilian Amazon. The Amazon experienced a decline in the rate of hospitalizations during the study period. Rondônia had approximately twice the number of hospitalizations than the other states had, ranging from 11.8% in 2002 to 7.2% in 2006. The rate of hospitalizations during the dry season was as much as 3 times that of the rainy and intermediate seasons, with the biggest rates in Rondônia (5.8%) and Mato Grosso (3.3%).

Conclusion: The hospital admissions for asthma in the elderly presented a declining trend and significant seasonal variation, with the highest rate of hospitalization observed during the dry season.

PP-31-106

Survival Analysis to Estimate the Association Between Long-term Exposure to Different Sizes of Airborne Particulate Matter and Risk of Infant Mortality Using a Birth Cohort in Seoul, Korea

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Background/Aims: Several epidemiologic studies suggest that exposure to particulate matter air pollution is associated with infant mortality. However, most of these studies have focused on short-term exposure to larger particles. Our objective was to evaluate the associations between long-term exposure (during pregnancy, and from birth to death or end of study period) to different sizes of particles (TSP, particulate matter [PM_{10}], $PM_{10-2.5}$, $PM_{2.5}$,) and infant mortality in the birth cohort in Seoul, Korea for the period 2004–2007.

Methods: The study includes 359,459 births with 225 deaths. We used the extended Cox proportional hazards model with time-dependent covariates to investigate the effect of particulate matter air pollution on infant mortality from all-cause, respiratory causes, and sudden infants death syndromes. We calculated the lifetime exposures from birth to death (or the end of the study period) and pregnancy exposure (gestation and each trimester) and treated these exposures as time-dependent variables for the subjects' exposure levels of each pollutant. Results are adjusted by sex, length of gestation, season of birth, maternal age, education level of mother, and heat index. Each cause of death and exposure timeframe (pregnancy or birth to death or end of study period) was analyzed separately.

Results: We found a statistically significant relationship between gestational exposures to particulate matter and infant mortality from all causes or respiratory causes for normal birth weight infants. Our analysis found a risk of 1.04 (95% confidence interval [CI]: 1.01–1.08), 1.08 (95% CI: 1.02–1.13), 1.14 (95% CI: 1.07–1.23) for all-cause mortality and 1.16 (95% CI: 1.02–1.32), 1.30 (95% CI: 1.06–1.60), 1.44 (95% CI: 1.08–1.92) for respiratory mortality per 1 $\mu g/m^3$ increase in TSP, PM_{10},

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and $PM_{2.5}$, respectively. However, we did not find a relationship between any of particulate matter measures and sudden infants death syndromes.
Conclusion: Our findings provide supportive evidence of a long-term effect of particulate matter air pollution on infant mortality.

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PP-31-107

Association Between Ambient Air Pollution and Adverse Pregnancy Outcomes in Beijing

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Background/Aims: To explore the association between ambient air pollution and the main adverse pregnancy outcomes such as preterm birth, low birth weight (LBW) in Beijing.
Methods: The birth records data were obtained from the Birth Registration System of Hai Dian Maternal and Child Health Hospital from June 2007–June 2009. A total of 25,310 single birth cases with birth date, gender, and maternal information such as age, gestational week, and other potential factors, which may affect the birth outcomes were collected for data analysis of our research. Average level of the maternal exposure to ambient particulate matter (PM_{10}), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) was calculated during the first trimester after the last menstrual period, the last trimester prior to the delivery, which have been assumed to be 2 key window periods for the occurrence of preterm birth and LBW in some previous studies; moreover, the average concentration of each month during these 2 trimesters was also calculated. Binary Logistic regression model was used for risk evaluation of the preterm birth and LBW to air pollutants after adjusting for weather factors, maternal age, birth order, infant gender, and other factors.
Results: The increase in preterm birth was associated with each 100 $\mu g/m^3$ increase of air SO_2 in the first trimester (odds ratio [OR] = 1.50, 95% confidence interval [CI]: 1.04–2.18) and the last month of the pregnancy (OR = 1.79, 95% CI: 1.30–2.46), respectively, and to PM_{10} during the second month before delivery (OR = 1.45, 95% CI: 1.15–1.84, for per 100 $\mu g/m^3$ increase). LBW was associated with exposure to SO_2 during the first trimester after last menstrual period (OR = 1.50, 95% CI: 1.09–2.05, for per 100 $\mu g/m^3$ increase), on the contrary, no statistical significances ($P > 0.05$) were found on the association between NO_2 (and PM_{10}) and Preterm birth.
Conclusion: Ambient SO_2 may be a risk factor on preterm birth and LBW of the pregnant women.

PP-31-108

Petrochemical Industrial Estate and Its Effects on Pregnancy Outcomes on the Surrounding Residents of Rayong Province, Thailand

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Background/Aims: Studies in many countries have shown that living near petrochemical industry results in adverse pregnancy outcomes. Petrochemical industrial estate located in Rayong Province, Thailand houses more than 60 petrochemical plants with a plan to be the hub for petrochemical industry in Southeast Asia. Air quality monitoring data indicate high levels of benzene, vinyl chloride, chloroform, and ethylene dichloride exceeding United States Environmental Protection Agency standards. Examining the effects of living near this petrochemical industrial estate on pregnancy outcomes is a part of a larger epidemiological study.
Methods: This population-based case-control study identifies cases as all mothers of children aged 10 years or less who are residing within 10 kilometers radius from the petrochemical industry and were born with low birth weight (less than 2500 g), prematurely (less than 37 weeks gestation), and small for gestational age. Controls were randomly selected from mothers with normal births occurring during the same time period as the cases. Consequently, this study composes of 229 cases and 487 controls. Industrial-related air pollution exposure was determined by distance from study subjects' residence to the center point of the petrochemical industrial estate, using geocoding address. Information on potential confounders was collected using standardized interview. Multiple logistic regression was used to calculate odds ratio (OR) and 95% confidence interval (CI).
Results: After adjusting for possible confounding factors, we found statistically significant association between premature outcome of less than 37 weeks and residing within less than 4 kilometers to the industrial estate (OR = 1.84; 95% CI: = 1.05–3.22), whereas nonsignificant associations were found for premature outcome less than 34 weeks (OR = 2.53; 95% CI = 0.80–7.29), low birth weight (OR = 1.02; 95% CI = 0.44–2.38), and small for gestational age (OR = 1.20; 95% CI = 0.43–3.38).
Conclusion: The findings suggest that mothers who live closer to the petrochemical industrial estate have a higher risk of delivering adverse pregnancy outcomes.

PP-31-109

The Effect of Ambient Temperature on Preterm Delivery

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Background/Aims: Temperature during pregnancy or at birth was reported to have impact on adverse birth outcomes. Only a few studies examined the effects of temperature during pregnancy. This study aimed to assess the effect of ambient outdoor temperature during gestation on preterm delivery (PTD) and to investigate effect of paternal occupation and area-level socioeconomic status on the association between temperature and PTD.
Methods: Birth data from the Korean National Statistics Office consisted of records on 433,173 singleton births in 2000–2003 and included individual characteristics. Area-level characteristics were also controlled for in 25 administrative regions in Seoul, Korea. Maternal exposure to ambient temperature was calculated at individual level for each trimester using information from the Korean Meteorological Administration. Birth outcome was dichotomously coded as follows: term birth (gestation $\geq$ 37 weeks) or PTD (gestation $<$ 37 weeks). For multilevel analysis, we conducted a hierarchical logistic regression with a random intercept for each administrative area.
Results: In fully adjusted models, an 1° increase in mean ambient outdoor temperature was associated with 4.21% (95% Confidence Interval: 3.51, 4.91), −4.69% (−5.31, −4.07), and −3.86% (−4.58 to −3.13) change in the probability of PTD during the first, the second, and the third trimester, respectively. Effect modification by paternal occupation showed the Else group had more adverse effects than the Professional and officer groups. The result of the effect modification by area level socioeconomic status (measured by monthly average income) showed areas with low income had more adverse effects by temperature than areas with high income during the first trimester and the third trimester.
Conclusion: Higher ambient outdoor temperature during the first trimester of pregnancy or lower ambient outdoor temperature during the second and third trimester is associated with preterm birth.

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PP-31-110

In Utero Exposure to Neurotoxic Metals and Neurodevelopment at 2 Years of Age

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Background/Aims: Manganese, lead, arsenic, and mercury are common neurotoxic metals in environment. Nonetheless, the association between prenatal exposure to low-dose neurotoxic metals and neurodevelopment in children were not clear. The objective of this study is to explore the association between in-utero exposure to environmental neurotoxic metals and neurodevelopment at 2 years of age.

Methods: Our study was included a total of 235 pairs of non-smoking and non-occupational exposed mothers and their full-term and singleton children from the Taiwan Birth Panel Study. Manganese, lead, arsenic, and mercury levels in umbilical cord blood were analyzed by using Agilent 7500c inductive coupled plasma–mass spectrometry. We used Comprehensive Developmental Inventory for Infants and Toddlers (CDIIT) to evaluate child developmental status at 2 years of age and examined the association between in-utero exposure to environmental metals in cord blood and neurodevelopment by linear regression models.

Results: The median concentration of manganese, lead, arsenic, and mercury in cord blood were 47.97 μg/L (17.88–106.85), 11.49 μg/L (0.16–43.22), 4.06 μg/L (1.50–12.88), and 12.32 μg/L (1.53–64.87) in this study, respectively. After adjusting for maternal age, infant gender, environmental tobacco smoke during pregnancy, and Home Observation for Measurement of the Environment, the manganese and lead levels in umbilical cord blood were significantly associated with cognitive developmental quotients of CDIIT (Mn: per log10 unit $\beta = -6.52 \pm 2.83$, $P = 0.0224$; Pb: per log10 unit $\beta = -3.06 \pm 1.22$, $P = 0.0131$), respectively. The lead and arsenic levels in umbilical cord blood were significantly associated with social developmental quotients of CDIIT (Pb: per log10 unit $\beta = -3.29 \pm 1.40$, $P = 0.0193$; As: per log10 unit $\beta = -5.46 \pm 2.33$, $P = 0.0202$), respectively.

Conclusion: In utero exposure to environmental neurotoxic metals may be associated with neurodevelopment at 2 years of age.

PP-31-111

Exposure to Drinking Water Trihalomethanes Through Different Routes and Low Birth Weight Risk in Genetically Susceptible Women

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Background/Aims: Recent epidemiological studies have suggested that trihalomethanes (THM) exposures during pregnancy might impair fetal growth. However, the estimation of relationships of THM and low birth weight (LBW) relied on relatively crude exposure assessment not examining genetic susceptibility to environmental hazards.

Methods: We performed an epidemiological study to examine the relationship between THM internal dose and the risk of LBW and term-LBW among genetically susceptible women in Kaunas, Lithuania. The study included 527 women. Residential history, water drinking, showering and bathing habits during pregnancy, and known risk factors for LBW, were measured with interview. Mothers were characterized for GSTM- and GSTT polymorphisms. Integrated exposure to THM was measured using THM concentration and ingested amount, bathing, and showering. We examined the relation of THM exposure to LBW and term-LBW with a multiple linear-regression models, adjusting for gestational age, maternal education, family status, body mass index, blood pressure, and parity.

Results: We found a weak association of THM exposure during third trimester with term-LBW (OR: 3.69; 95% CI: 0.65–21.0) for the exposure level over median among women GSTM1-null genotype carriers; a statistically significant increase in risk LBW (OR: 3.89; 95% CI: 1.11–13.64), and no association between exposure and fetal growth among women GSTM1-present genotype carriers. However, a small number of adverse birth outcomes reduced the statistical significance of these results.

Conclusion: The study data suggest a potentially impact relation between third trimester exposure to THM and fetal growth in genetically susceptible subjects.

PP-31-112

Effects of Printer Emissions in Mice With Preexisting Allergic Airway Responses

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Background/Aims: Indoor air pollution in working places is widely recognized as one of the most serious environment risks to human health. With the advent of electronic technology, especially electronic equipment is now a potential source of indoor pollutants in office environment. To study the effects of printer emissions on the allergic responses, inflammation, and oxidative stress, an ovalbumin sensitized and challenged mouse model of allergic airways disease was utilized, along with the nonallergic mice. After the final challenge, both allergic and nonallergic mice were subjected to printer emissions. Physiological and inflammatory responses were measured after 30th day. Exposure to printer emissions has resulted in increased pulmonary responsiveness, BAL inflammatory cells, and oxidative stress Printer emissions exposure results in pulmonary effects that are more intense in mice with chronic allergic pulmonary inflammation.

Methods: Female Balb/c mice aged 7 weeks (KOATECH, Korea) were acclimatized to laboratory conditions for a week. Mice that were sensitized and challenged with ovalbumin were referred to as allergic, whereas mice that did not undergo any sensitization or challenge were defined as nonallergic. Mice were divided into 4 groups, namely allergic (asthma induced), nonallergic, allergic + printer emissions, and nonallergic + printer emissions. After 24 hours of final exposure, BAL was performed and BAL cells were counted to analyze airway inflammation and lactate dehydrogenase activity in acellular BAL fluid, and histopathological evaluation of the lung was carried out to assess the lung injury.

Results: Epidemiologic and experimental studies suggest that anthropogenic air pollutants in indoors are important cofactors in the development of respiratory health disorders (Destaillats et al, 2008). Previous studies have shown that chronic inhalation exposure to toner dust and volatile organic compounds VOC (which include printer emissions are studied separately) produces significant pulmonary response in normal rats (Muhle et al, 1991). Studies with regard to the direct exposure to printer emissions and the effects of printer emissions in populations with comprised airways are nil. This finding is related to acute inhalation exposure and the direct exposure to printer emissions via inhalation. Changes lactate dehydrogenase, and BAL cells represent significant increases in lung epithelial permeability, cytotoxicity, and lysosomal enzyme release, respectively. Increases in these biochemical indices of lung injury were associated with printer exposure, but the effect of printer emissions was significantly greater in allergic-sensitized mice. The results of this study showed that physiologic and inflammatory responses to ovalbumin challenge in sensitized mice were enhanced after exposure to printer emissions, an emission source particulate matter (PM) with a high

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content of VOC and toner dust. The overall toxicological effects in the current study might be attributed to the various chemicals released during the operation of the laser printer. Volatile organic compounds, semivolatile organic compounds, ozone, PM_{10}, ultrafine aerosol particles, emitted from printer operation can cause airway epithelial injury and lung inflammation via oxidant injury. The toners used in laser printers contain a wide variety of chemicals in addition to fine, black carbon particles, or dyes and pigments for color toners. The study of Schnell et al (1992) reported that the concentration of black carbon aerosol produced by a photocopier is equivalent to black carbon levels observed in urban areas under moderate vehicle traffic and the respiratory health effects of black carbon aerosols are well documented which correlated with the increased particle concentration observed with the time of printer operation. The significant changes noted in the asthmatic mice exposed to printer emissions suggests the increased oxidative stress and inflammatory cells due to the exogenous and endogenous sources might have caused respiratory epithelial injury.

Conclusion: The observed increased influx of inflammatory cells and lung injury might be due to the exposure to high VOCs and particle concentration generated during printer operation. In conclusion, exposure to printer emissions resulted in an increased pulmonary damage in nonsensitized mice and these responses were amplified in OVA-sensitized and challenged mice with greater than additive increase in pulmonary inflammatory cell infiltration and lung injury.

PP-31-113

Association of Atopic Dermatitis With Indoor Environmental Factors

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Background/Aims: The specific causes or the origination of atopic dermatitis have been unknown, however, nowadays, the significance of environmental conditions, as aggravating factors of atopic dermatitis, is being raised. Most of the existing researches, which examined the correlations between atopic dermatitis and environmental conditions, were conducted through questionnaires. At present, the examination of the causes through measurement of environmental factors is not properly done.

Methods: Between April 2008 and April 2009, this study was carried out that included 153 subjects: 61 of children's parents of the Happy district nursery and 92 of inpatients and outpatients of the Samsung Medical Center. Of these, 21 subjects were of Group 1 (Normal skin), 54 of Group 2 (Mild AD), and 78 of Group 3 (Severe AD). The subjects wanted researchers' measurement of environmental conditions in their dwellings. Between April 2008 and April 2009, researchers visited 153 subjects' homes to measure the density of dispersers inside the homes: PM_{10}; HCHO; total volatile organic compounds; floating bacterias and molds; and gases such as CO, CO_2, and NO_2.

Results: As the consequence of the measurement of floating bacterias, the groups 1 and 2, and the groups 1 and 3 showed statistically major differences. The values of measurement in the groups 2 and 3 were higher than the standard value, 150 CFU, recommended by World Health Organization.

Conclusion: These results were because of the inappropriate room temperature and humidity, including a climate of humidity in the summer.

PP-31-114

Hospitalization of Children for Asthma in the Brazilian Amazon: Trend and Spatial Distribution

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Background/Aims: To analyze the distribution of hospitalizations of children for asthma in the states comprising the Brazilian Amazon, as well as the variations of hospitalization, according to climatic seasonality.

Methods: A descriptive study of the distribution of hospitalizations for asthma of individuals aged 0 to 14 years living in the Brazilian Amazon, according to trend, spatial distribution, and climatic seasonality over the period between 2001 and 2007. We used the database of authorizations for hospitalizations of the Hospital Information System of the Brazilian Ministry of Health.

Results: The spatial distribution of hospitalizations for asthma resembles the configuration of the "arc of deforestation," mainly in the states of Rondônia and Maranhão. The distribution of annual hospitalizations for asthma decreased from 8.1 to 2.6 hospitalizations per 1000 inhabitants during the period. There was a peak of hospitalizations in March and May in all states. The seasonal differences were on average 10%, with the highest rates during the rainy season.

Conclusion: We concluded that hospitalizations for asthma are more frequent in the months of more intense rainfall, with greater magnitude in the states comprising the "arc of deforestation" in the Brazilian Amazon, especially Rondônia and Maranhão.

PP-31-115

Exposure to di-(2-ethylhexyl) Phthalate Affects Pulmonary Function and Oxidative Stress in the Elderly

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Background/Aims: Phthalates have been reported to be related with adverse health effect. In this study, we evaluated the effect of di (2-ethylhexyl) phthalate (DEHP) on pulmonary function and oxidative stress in the elderly patients.

Methods: We recruited 525 persons aged more than 52 years and obtained urine samples during 3 medical examinations. We measured urinary level of mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP) and mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP) as DEHP metabolites. Malondialdehyde as an oxidative stress biomarker was measured in urine samples.

Results: When we estimated the effect of MEHHP and MEOHP on pulmonary function and oxidative stress using repeated analysis, MEHHP and MEOHP were found to be associated with decreased pulmonary function in the elderly patients after being adjusted for age, BMI, and cotinine level (MEHHP-FEV1, $\beta = -0.0188$, $P = 0.0595$; MEOHP-FEV1, $\beta = -0.0202$, $P = 0.0159$; ΣDEHP-FEV1, $\beta = -0.0305$, $P = 0.0037$; MEHHP-FEF25-75, $\beta = -0.0515$, $P = 0.0212$; and ΣDEHP-FEF25-75, $\beta = -0.0638$, $P = 0.0070$). Moreover, MEHHP and MEOHP also showed a positive relationship with malondialdehyde level in the elderly patients (MEHHP, $\beta = 0.1943$, $P < 0.0001$).

Conclusion: Our study results suggest that the exposure to DEHP decrease pulmonary function and increase oxidative stress in the elderly patient.

PP-31-116

Sunlight Exposure and Parkinson's Disease in California

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Background/Aims: Recently, attention has turned to the question whether inadequate sunlight exposure may lead to deficient production of vitamin D, and consequently to Parkinson disease (PD). However, this hypothesis has yet to be investigated in human populations, and thus to date, it is not known whether vitamin D might be neuroprotective against oxidative damage in PD. We are examining whether long-term sunlight exposure, which generates vitamin D, decreases the risk of PD among 368 incident PD cases and 341 population controls residing in 3 largely rural Central California counties and enrolled in the Parkinson's Environment and Genes (PEG) study.

Methods: Patients were diagnosed between January 1998 and January 2007 and confirmed as having either probable or possible idiopathic PD by PEG movement disorder specialists. Controls older than 65 years of age were identified from Medicare lists or recruited from randomly selected residential parcels. We developed a sophisticated exposure model using geographic information systems tools to link geocoded residential and occupational address data obtained from study participants to available Average Daily Total Global Solar Radiation data produced by the Department of Energy to determine historical spatially oriented ultraviolet (UV) measures.

Results: Average lifetime UV exposure levels for the PEG population were 5033 Wh/m^2 (range: 3886–5460), with no appreciable differences between cases and controls; estimated levels were higher among nonwhites, subjects with lower education levels, and outdoor workers. In logistic regression models adjusted for age, gender, education, race/ethnicity, smoking, and pesticide exposures, high average lifetime UV levels weakly, if at all, protected against PD (OR = 0.81, 95% CI = 0.51, 1.30, comparing fourth to first quartile).

Conclusion: We will extend our analyses further by adding data for additional newly recruited subjects, adding UV data for international addresses, and using an additional approach to estimate UV levels in our geographic information systems model.

PP-31-119

Prenatal PCB Exposure and Thyroid Function at Birth

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Background/Aims: Michalovce region in the Eastern Slovakia was characterized by intense polychlorinated biphenyls (PCB) production within 1959–1984; although it stopped in the 80s, substantial environmental PCB contamination still exists. We assessed the effect of prenatal environmental PCB exposure on thyroid functions in mothers with newborns born in Michalovce.

Methods: Mothers with newborns (N = 220) were recruited after hospital admission for delivery, and samples of maternal and cord blood sera were collected. Concentrations of thyroid hormones (thyroid stimulating hormone, tT3, and fT4) were measured using electrochemiluminescence immunoassay. Congener-specific analysis of PCBs was done using high-resolution mass spectrometry. Twenty-seven PCB congeners (74, 66, 99, 118, 105, 146, 153, 138, 167, 156, 157, 178, 187+182, 183, 177, 171, 172+192, 180, 170+190, 189, 202, 199, 196+203, 195, 194, 206, 209) with the minimal amount of 66% samples with concentrations more than limit of detection were used for further assessment.

Results: The mean and median levels of the sum of PCBs were 809 and 467 ng/g lipids in mothers and 667 and 381 ng/g lipids in newborns; the levels significantly correlated between maternal and cord blood ($r = 0.87$, $P < 0.001$). Using multivariate regression analysis, significant positive associations between PCB exposure and fT4 levels in maternal blood and between PCB exposure and tT3 levels in cord blood were found, without changes in thyroid stimulating hormone levels.

Conclusion: Differences between our results and some published data on PCB exposure and thyroid function may be explained by specific conditions of exposure in eastern Slovakia; PCB exposure is still relatively high and long-term in this region. However, our data agree with published data on adult Slovak population living in eastern Slovakia (Langer et al, *Chemosphere*. 2007;70:110–118).

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PP-31-120

Postnatal PCB Concentrations and Child Behavior at Age 45 Months

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Background/Aims: Data on relationship between polychlorinated biphenyl (PCB) exposure and child behavioral development are inconclusive. Our study analyzed the association between postnatal PCB exposure and child behavior assessed using the Child Behavior Checklist and the Pre-School Activities Inventory as assessment of play behavior.

Methods: During regular follow-up of the cohort of 45-month-old children (N = 398) living in the area polluted by former PCB production, mothers completed the Child Behavior Checklist (1.5–5 years) with subscale scores calculated for the 7 syndromes and for internalizing and externalizing behaviors and the Pre-School Activities Inventory as assessment of play behavior (3 subscales: masculine, feminine, and composite). The associations between PCB levels (sum of PCBs and individual PCB congeners 138, 153, and 180) in blood of children, behavioral scores, and data from questionnaires (lifestyle and socioeconomic factors) were estimated using linear regression models.

Results: Besides other relevant confounders, regression analysis was adjusted for The Raven's Progressive Matrices in mothers and Home Observation for Measurement of the Environment results of children at 16 month of age. Neither maternal nor postnatal total PCB exposures were associated with any of the behavioral scales assessed. Higher PCB exposure was found in children who were breastfed for at least a year, born to smoking mothers older than 30 years ($P = 0.003$).

Conclusion: Our results did not show the effect of developmental PCB exposure in early childhood behavioral development. On the other hand, PCB exposure in children seems to be affected by selected social characteristics of the mother.

PP-31-121

The Effect of Prenatal and Early Life Exposure to Bisphenol A on Body Size at Age 7 Years

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Background/Aims: There is a growing concern that prenatal and early life exposures to endocrine disruptors, such as bisphenol A (BPA), may program children for weight gain and contribute to the childhood obesity epidemic.

Methods: As part of the Columbia Center for Children's Environmental Health birth cohort of African American and Dominican children living in the South Bronx and Upper Manhattan, maternal prenatal urine samples and children's urine samples are being analyzed for BPA. Children are being followed up till 10–11 years of age with height, weight measures being taken at ages 5, 7, and 10–11. At ages 7 and 10–11 years, measurements of waist circumference and body composition via the

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Tanita Body Composition Analyzer (BC-148) are also being taken. At age 10–11 years, data on physical activity and food frequency data on dietary intake are also being collected.

Results: To date, body size and body composition data have been collected and validated for 246 children at 7 years of age and 18% of the 7 year-olds have been found to be obese. Prenatal and early life predictors of weight at age 7 include the following: maternal pre-pregnancy weight (β = 0.06 kg per kg of mothers weight, P = <0.001), mother receiving public assistance during pregnancy (β = −2.70 kg, P = 0.04), mother's foreign-born status (β = −3.08 kg, P = 0.11), and child's birth weight (compared to the first tertile of birth weight, children in the third tertile were 3.01 kg heavier, P = 0.06). Laboratory analyses of maternal BPA levels are ongoing and the data on the relationship between prenatal BPA exposure and body size at age 7, controlling for the identified prenatal and early life risk factors will be presented.

Conclusion: The Columbia Center for Children's Environmental Health is uniquely poised to test whether prenatal exposure to BPA plays a role in childhood weight gain among urban children.

PP-31-122

Prevalence of Eczema, Asthma, and Rhinitis Among Korean Children in Seoul City

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Background/Aims: The aim of this study was to determine the prevalence of symptoms that are suggestive of atopic diseases in children aged 1–14 years in Seoul, Korea.

Methods: A cross-sectional study of the history of atopic diseases and the environmental factors among children was conducted using the ISAAC (the International Study of Asthma and Allergies in Childhood) questionnaires which were completed by the parents. A total of 8780 children aged 1–14 years in 2009 (response rate: 84.1%) were included in the study.

Results: The 12-month prevalence of eczema, asthma, and rhinitis was 15.5%, 6.4%, and 27.4% respectively. The prevalence of doctor-diagnosed asthma and rhinitis was significantly higher in boys than in girls (10.9% vs. 7.3%, $P < 0.001$).

Conclusion: This study showed that there was a significant number of school-aged children in Seoul, Korea, who have various allergic symptoms. It also revealed that factors such as the use air freshener, new furniture in houses, and moving into a newly built house within 1 year after birth were associated with allergic symptoms.

PP-31-123

The Relationship Between Atopic Diseases and Relating Factors in Urban Elementary School Children

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Background/Aims: As the modern society has become more industrialized and developed, the prevalence of atopic diseases has tended to be more increased. We investigated the association between atopic diseases and relating factors in elementary school children

Methods: Three elementary schools were selected and classified by air quality (sub-industrial, industrial, and residential areas). Between April 2009 and February 2010, a questionnaire survey of 3281 students and a health check up of 812 students were conducted. A total of 654 subjects were analyzed.

Atopic diseases data obtained by questionnaire were referred to doctor's previous 1 year diagnosis (1 year) and lifetime symptom prevalence (ever). Atopic diseases included asthma, allergic rhinitis, atopic dermatitis, allergic conjunctivitis, and food allergy. Health check up items included CBC with differential count, urine cotinine, pulmonary function tests, skin-prick test.

Results: The prevalence of atopic diseases (1 year, ever) was 57.6% and 77.4%, respectively. The prevalence of asthma (1 year, ever) was 4.9% and 19.9%; allergic rhinitis (1 year, ever) was 33.5% and 50.2%; atopic dermatitis (1 year, ever) was 26.1% and 41.4%; allergic conjunctivitis (1 year, ever) was 19.6% and 30.6%; and food allergy (1 year, ever) was 3.8% and 18.5%, respectively.

The prevalence of asthma (ever), allergic rhinitis (1 year, ever), atopic dermatitis (1 year, ever), allergic conjunctivitis (1 year, ever) was different for each school ($P < 0.05$).

The association between skin-prick test and asthma (1 year), allergic rhinitis (1 year, ever), atopic dermatitis (1 year, ever), allergic conjunctivitis (1 year, ever), food allergies (ever) was found to be statistically significant ($P < 0.05$).

In the results of logistic regression analysis, relating variables of atopy (1 year) were skin-prick test and the school ($P < 0.05$), relating variables of atopy (ever) were total IgE, percentage of forced vital capacity, skin-prick test, and the school ($P < 0.05$). The odds ratio of atopy prevalence (1 year, ever) of the industrial area was 1.776 and 1.879 for those of residential area (95% CI = 1.214–2.600, 95% CI = 1.205–2.928).

Conclusion: The gold standard test for diagnosis of atopic diseases is not present, but the skin-prick test and the consideration of air quality will be helpful for diagnosis of atopic disease.

PP-31-124

Association of Arsenic Levels in Soil and Drinking Water With Urine of Residents in the Vicinity of Abandoned Metal Mines

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Background/Aims: Many areas near abandoned metal mines in the middle areas of Korea were contaminated by heavy metals (eg, arsenic [As], zinc). Arsenic contamination was much serious in soil and drinking water. However, little is known how exposure of As in environment has affected residents near abandoned metal mines in Korea. The objectives of this study were to investigate the correlation of As levels in soil and drinking water with those in urine of residents near abandoned metal mines (case); and to compare urinary As levels in case areas to those in reference areas.

Methods: As levels in soil and drinking water were obtained from a governmental report in 2005. An average As level per each area was calculated and divided by the regulatory limit of As (the environmental risk index) for statistical analyses. To measure urinary As levels, 2091 and 238 subjects were selected from 73 abandoned metal mines and 2 rural areas without metal mines (reference), respectively. The graphite furnace atomic absorption spectrometry was used to analyze urinary As levels. Similarly, the geometric mean of urinary As level per each area was calculated. The number of subjects with urinary As levels above limit was counted and normalized by total subjects of the corresponding area (the high risk rate). We performed a linear regression and student t test using SPSS (version 12.0) to achieve 2 study objectives.

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Results: The geometric mean of urinary As levels for case areas was 7.17 ± 3.7 mg/L, which was significantly higher than this for reference areas (5.97 ± 2.4) ($P < 0.05$).
Conclusion: These results may suggest that residents near abandoned metal mines may be at high risk of As exposure.

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PP-31-125

Perinatal Exposure to Bisphenol A: The Route of Administration Makes the Dose

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Background/Aims: Bisphenol A (BPA) is subject to wide controversy regarding its pharmacokinetic behavior, especially regarding peri- and postnatal exposure. Recent epidemiological findings regarding inhaled BPA revealed that male sexual dysfunction was observed even in low levels of overall daily intake (0.5 μg/kg bw).

The objective of this work was to investigate the effect of (*a*) the actual exposure to BPA on the developing fetus during the perinatal period and to reduce the uncertainty regarding the affecting parameters (fetus sulfation and BPA_Glu deconjugation by β-glucuronidase in the placenta) and (*b*) administration route to BPA bioavailability.
Methods: A dynamic lifetime mother-fetus PBTK model was developed for BPA, which was capable of deriving the BPA biologically effective dose through the various developmental stages and under different administration routes, integrating uncertainty through Markov chain Monte Carlo analysis under steady-state and dynamic conditions.
Results: Our results show that the fetus biologically effective dose of BPA during gestation is highly linked to the level of BPA in the mother's blood due to its high lipophilicity and small molecular weight; still this dose is almost 5 times lower than that of the mother (0.005 μg/L under a typical EFSA exposure scenario for the mother, 0.001 μg/L for the fetus). Sensitivity analysis confirmed that the dominant parameter regulating fetus free plasma BPA is fetus sulfation capacity and, to a smaller degree, placental BPA-Glu deconjugation by β-glucuronidase.
Conclusion: BPA bioavailability from inhalation exposure in adults is 6 times higher than when BPA is orally administrated because of lack of first pass metabolism before systemic circulation entrance. Exposure to 5 $\mu g/m^3$ of BPA in the air corresponds to a steady-state plasma concentration of 0.22 μg/L. In neonates, the overall clearance capability of whom is limited to almost 20% of the adult, differences in BPA bioavailability due to administration route are limited to 50%.

PP-31-126

Heatstroke in Elderly Population in Japan

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Background/Aims: In last decades many episodes of heat wave have been observed worldwide. In the heat wave 2003, in Europe, more than 35,000 excess mortalities were reported and the impacts were largest in elderly people. Even in Japan, we experienced very hot summer in 2007 and 2004. At those times, so many people suffered from heat disorder and died from heatstroke. Nearly half of the patients and more than two-thirds of mortality were elderly people 65 years or older.
Methods: We used data of the patients transported by ambulance from heat disorder in 17 largest cities all around Japan and Tokyo provided by fire and emergency office of the cities, and clinical records from heat disorder in 23 major hospitals in Okinawa prefecture. We obtained meteorological data from Japan Meteorological Agency. Both data covered 2000–2009. We analyzed the relation between daily maximum temperature and daily number of patients from heat disorder focusing on elderly population.
Results: We found positive and strong association between daily maximum temperature and daily number of patients from heat disorder in all cities and all age groups. Concerning the aged people, nearly half of the heat disorder events occurred indoors, they showed higher incidence than that in younger people, the incidence at high temperature was exponentially accelerated, and the incidence rate in Sapporo and northernmost cities showed much higher incidence than those in other western and southern cities.
Conclusion: Higher temperature had great effects on aged people.

PP-31-127

Investigation on Female Thyroid Function in Fireworks and Crackers Production Area

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Background/Aims: To evaluate the effects of fireworks and crackers occupational exposure on female thyroid function.
Methods: A field study was conducted in Liuyang, Hunan province, which is a fireworks and crackers main production area. Women of child-bearing age were chosen as the target population. Those fireworks and crackers workers are divided into exposure group and others as control group. Questionnaire was completed face to face and urine and blood samples were collected to evaluate people's thyroid function.
Results: Mean level of FT3 were 4.968 ± 0.966 μg/L in exposure group, significantly lower than 5.508 ± 1.058 μg/L in control group ($t = 1.775$, $P = 0.081$). Mean level of T3, T4, FT4, TSH had no significant difference between the 2 groups. Multiple regression analysis indicated that occupational exposure and high urine iodide can significantly reduce FT3 serum concentrations ($P < 0.10$).
Conclusion: Occupational exposure to fireworks and crackers may affect female thyroid function.

PP-31-128

Risk Factors of Atopic Diseases on the Basis of Isaac Questionnaires in Ulsan, Korea

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Background/Aims: Atopic diseases are common and increasing in industrialized world. Even though a considerable number of studies have been conducted on the causes of the diseases, there has still been controversy. This paper aims to investigate the impacts of the potential factors associated with personal traits and residential environments on atopic disease prevalence.
Methods: Based on the data for prevalence of children from the Ulsan Regional Health Survey (2006) and air quality conditions in the Ulsan metropolitan area, 3 elementary schools located at different regions (sub-urban residential [A], industrial [B], and coastal urban [C] areas) were selected for a cohort study. Data on atopic disease from a questionnaire survey for 3281 students were used to estimate potential risk factors of atopic diseases. Self-reported ISAAC questionnaire was completed by parents and was reviewed by researchers.

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Results: The prevalence of physician-diagnosed atopic diseases (asthma, allergic rhinitis, and atopic dermatitis) within recent 12 months was statistically different among 3 groups (A, B, and C). Prevalence rates in group B were significantly higher than control group A (OR = 1.355; 95% CI: 0.789–2.326 for asthma; OR = 1.352, 95% CI: 1.110–1.645 for rhinitis; OR = 1.328, 95% CI: 1.029–1.699 for dermatitis). The statistically significant risk factors for atopic diseases were found as following: family history, indoor components (residency of apartment, mold, recent remodeling, cooking fuel, daily ventilation time, home appliance, and living new house), and outdoor components (distances from traffic road, exhausts from vehicle, bed smell, irritation symptom, and noise). From multiple logistic regressions analysis with adjustment by both family history and indoor components, the risk rate of prevalence for group B was still higher than that of group A (aOR = 1.328 [asthma],1.364 [allergic rhinitis], and 1.322 [atopic dermatitis]). After controlling outdoor components, differences in the risk of atopic disease among 3 groups were not statistically significant anymore.
Conclusion: This study suggests that genetic factor is constantly associated with the prevalence of atopic diseases. Furthermore, outdoor environmental conditions could be important factors affecting increased prevalence of atopic diseases.

PP-31-129

Prenatal Exposure to Smoking in a Mother-infant Study in South Taiwan

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Background/Aims: The purpose of this study is to evaluate the effect of smoking exposure on fetus since first trimester till birth.
Methods: This is a prospective study from June 2008 to September 2009. This study was conducted in the Department of Obstetrics, Dong-Kong Hospital. Two hundred seventy-six pregnant women were enrolled. A questionnaire was administered to assess smoking exposure. Urine was collected for measurement of cotinine. Association of maternal smoking exposure and birth outcome was analyzed.
Results: The prevalence of maternal smoking, their husbands' smoking, and smoking in their family (husband excluded) was 7.6%, 59.4%, and 47.5% separately. After adjusting maternal age, the incidence of low-birth-weight babies in active smoking women was borderline significantly higher than that in nonsmoking women without exposure to smoking environment (AOR = 7.1; 95% CI: 0.86–61.61; $P = 0.07$). Newborn chest circumference was 33.0 ± 1.5 cm in the group with maternal urine cotinine ≥120 μg/g creatinine, and 32.7 ± 2.7 cm in the group with maternal urine cotinine <120 μg/g creatinine. There was a significant difference of newborn chest circumference in 2 groups ($P < 0.0001$). On postnatal day 3, the mean newborn bilirubin level in the group with maternal urine cotinine[3] 120 μg/g creatinine was significantly lower than that in the group with maternal urine cotinine <120 μg/g creatinine ($P < 0.001$).
Conclusion: Maternal smoking exposure is associated with low birth weight, great chest circumference, and low newborn bilirubin in this series.

PP-31-130

Risks of Multiple Allergy Diseases and Asthma From Indoor Exposure to Modern Chemicals and Mould Species

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Background/Aims: Extent to which multiple factors within home indoor environment independently or synergistically increase the risks of asthma and multiple allergic diseases during a "developmentally sensitive window" remains unknown. Thus, we simultaneously considered the asthma and allergy risks posed by "modern" chemical compounds, biologic allergens, including mould species and several types of pet danders, and other modifying conditions including ventilation and dampness.
Methods: In a case-control investigation, a child with at least 2 persistent symptoms of asthma, rhinitis, and eczema were enrolled as a case (n = 198). A questionnaire on home environment and lifestyle factors were given to the parents. Inspection of the home environment, and air samples were collected in the room where the child spent most time. The air samples were analyzed for the levels of 8 classes of the volatile organic compounds.
Results: Indoor concentrations of glycol ethers in air, was associated with 1.3-fold greater likelihood of being a case (95% CI: 1.1–1.6), 1.3-fold greater likelihood of asthma (95% CI: 1.0–1.6), 1.7-fold greater likelihood of rhinitis (95% CI: 1.3–2.3), and 1.4-fold greater likelihood of eczema (95% CI: 1.1–1.8), accounting for gender, secondhand smoke, allergies in both parents, chemical-based home cleaning, home construction period, butyl benzyl phthalate, di(2-ethylhexyl)phthalate, and spore count of Penicillium spp. On the other hand, other abundant secondary reaction compounds resulting from cleaning were not associated with any of the health outcomes. In addition, excess indoor moisture (g/m^3 of water in air) significantly further increased the risks of the glycol ethers.
Conclusion: Risk of multiple allergic symptoms and asthma posed by glycol ethers appear to be independent of, and additive to those posed by butyl benzyl phthalate, di(2-ethylhexyl)phthalate, and Penicillium spp.

PP-31-131

Association Between School Environment and Atopic Disease Among Elementary School Children in Seoul

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Background/Aims: The aim of this cross-sectional study was to investigate the relationship between prevalence of atopic disease and school environment in Seoul.
Methods: The children's history on atopic disease and school environmental factors were collected using the ISAAC (the International Study of Asthma and Allergies in Childhood) questionnaire and school environmental survey, respectively. Total 7564 school children (average, 10.5 ± 1.5 years old) in 12 elementary schools were participated.
Results: The 12-month prevalence of allergic rhinitis, atopic dermatitis, and asthma were 27.7%, 14.9%, and 5.2%, respectively. The prevalence of asthma in schools using electricity as heating fuel (5.9%) was significantly higher than in schools using gas (4.3%) or other materials (4.2%) ($P = 0.030$). Schools answering "yes" to having had operating fan were having lower prevalence of allergic rhinitis than schools answering "no" (27.4% vs. 37.9%, $P < 0.001$). Schools ventilating 8 times a day

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had lower risk of allergic rhinitis than schools ventilating less than 3 times a day (OR = 0.73; 95% CI: 0.59–0.90; $P = 0.003$). The risk of asthma was higher in schools with humidifier (OR = 1.29; 95% CI: 1.02–1.63; $P = 0.031$) and lower in schools providing organic food (OR = 0.77; 95% CI: 0.63–0.95; $P = 0.014$).

Conclusion: Our study demonstrated that school environment was associated with the prevalence of atopic disease. The findings suggest the need for further study on personal exposure profile of the children with atopic symptoms.

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PP-31-132

Environmental Risk Factors and the Atopy During the First Year of Life

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Background/Aims: The relationship between exposure to environmental hazards and infant's health is still poorly understood. The present study assessed the effect of environmental factors on development of atopy during the first year of life in MOCEH (Mother and Children's Environmental Health) study.

Methods: Between 2006 and 2009, pregnant women in first trimester of pregnancy were recruited in the MOCEH study and their newborns were followed up. When their children were 6 and 12 months of age, parents answered questionnaire on the children's prevalence related to atopy and other allergic diseases. Also, we collected the information on residential characteristics, environmental exposure, as well as sociodemographic factors. Physician-diagnosed atopy cases were defined by answering yes to question: "Have you ever diagnosed atopy dermatitis (congenital fever, infantile eczema)?" We used χ^2 test and logistic regression analyses to assess the associations between environmental factors and the occurrence of atopy.

Results: In univariate analysis, the development of atopy at 12 months was related to maternal allergy history ($P = 0.02$), maternal education (0.09), number of family members (0.04), factories around the house (0.09), sewage treatment plant around the house ($P = 0.047$), distance between house and road ($P = 0.03$), number of rooms (0.05), and use of hair spray (0.02). After controlling for potential confounders, the risk for atopy at 12 months was increased by maternal allergy history, factories around the house, environmental tobacco smoke, distance between house and road, number of rooms, use of hair spray, and existence of fungus. Among them, maternal allergy history (OR = 1.92; 95% CI: 1.17–3.14) and distance between house and road (OR = 1.71; 95% CI: 1.04–2.81) was significantly associated with the development of atopy during the first year of life.

Conclusion: This study suggested that living near major roads may be a risk factor of developing atopy in infancy.

PP-31-133

PCBs/Hydroxylated PCBs Exposure and Thyroid Function of Japanese Pregnant Women: Preliminary Result From a Cohort Study

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Background/Aims: Thyroid hormone is essential for fetal brain development. It is particularly so during the first trimester of pregnancy when fetus is dependent on maternal thyroid hormone supply. Recent studies indicate that environmental chemicals can interfere with thyroid hormone function. We are planning a prospective cohort study to examine the association between maternal exposure to chemicals, thyroid hormone status and development of offspring. The aim of the present study is to examine the relationship between exposure to PCBs and their hydroxylated metabolites (OH-PCBs) and thyroid hormone status in Japanese women during the first trimester of pregnancy.

Methods: We enroll pregnant women of 10–12 gestational weeks at a hospital in Tokyo after obtaining informed consent. Blood and urine are sampled at the enrollment and we analyze PCBs and OH-PCBs in serum by high resolution-GCMS, thyroid hormone status (free T4, TSH, TBG), and urinary iodine.

Results: The concentrations of PCBs and OH-PCBs in serum were not excessive level (ΣPCBs: 190–1200 pg/g wet weight; sum of OH-PCB congeners (Cl5–7): 35–360 pg/g wet weight) in the present subjects. At present, we found positive association between concentrations of some of the PCB/OH-PCB congeners and thyroid hormone status. As expected, urinary iodine concentration was high with a large inter-individual variation (72.1–1720 μg/g creatinine) and a statistically significant inverse relationship was found between the concentrations of urinary iodine and the concentrations of free T4 in serum ($r = -0.605$, $P < 0.05$, n = 17).

Conclusion: Our results suggest that exposure to some PCB/OH-PCB congeners has association with free T4 level in pregnant women and also that excessive iodine intake may adversely affect thyroid hormone status in Japanese.

PP-31-134

The Effect of Prenatal PM_{10} Exposure on Fetal Growth in the Mothers and Children's Environmental Health

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Background/Aims: A few studies have reported that the effect of air pollution on fetal growth by ultrasound measurements. Therefore, the aim of this study was to investigate the association between prenatal PM_{10} exposure and fetal growth assessed by ultrasound measurements.

Methods: We collected the eligible data of 1558 pregnant women from 3 collaborating centers metropolitan area (Seoul), industrial area (Ulsan), and medium-sized urban area(Cheonan). Questionnaire was composed of

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residential factors, environmental exposure and general characteristics. We measured indoor/outdoor PM_{10} for 271 houses. Then, we applied spatial analysis techniques, namely, inverse distance weighted averaging (IDW). Personal exposure can be approximately estimated as the time-weighted average (TWA) of microenvironmental concentration. PM_{10} spatial estimations were adjusted to correspond to relevant pregnancy periods (ie, whole pregnancy and trimesters) for each woman. Outcome variables were femur length (FL), abdominal circumference (AC), and biparietal diameter (BPD) during late pregnancy. We examined the relationship between TWA PM_{10} and fetal growth assessed by ultrasound measurements among 434 pregnant women.

Results: In multiple linear regression model after adjusting for maternal age, early ultrasound gestational age, and parity number, BPD during total pregnancy period was decreased by TWA PM_{10} ($\beta = -0.02$; SE = 0.01) in Seoul. FL during third trimester was decreased by TWA PM_{10} ($\beta = -0.01$; SE = 0.00) in Seoul, and TWA PM_{10} ($\beta = -0.01$; SE = 0.00) in total area, respectively.

Conclusion: Prenatal exposure to PM_{10} may affect fetal growth. These results suggest that developing strategies to reduce PM_{10} exposure during pregnancy are required in order to prevent risks for fetal health.

This study was supported by the Ministry of Environment, Republic of Korea.

PP-31-135

Pesticide Health Effects and Health Perceptions Among Washington DC Residents

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Background/Aims: There is a paucity of information about pesticide use and health effects among urban dwellers. We conducted a study in Washington, DC, to determine the most common pest problems and pesticide applications used in 2008. The purpose of this aspect of the project was to measure reported health problems and health attitudes among a nonrandom sample of Washington residents.

Methods: We studied 789 Washington DC residents, 18 years old or greater, in the summer of 2008, using a questionnaire approved by GWU's Institutional Review Board. The survey asked about health problems common to pesticide users, and we asked their perceptions of health issues related to using pesticide chemicals in their homes. The questionnaire asked how worried residents were if there were pesticide residues on surfaces, and we asked about the threats to health from different groups of pesticide applied to homes and gardens.

Results: For flea spray, 13% indicated these products were not very harmful, while 29% thought they were a serious threat to health. For cockroach sprays, 11.8% indicated these insecticides were not very harmful, but 35.2% thought they were a serious health threat. For room foggers/bug bombs, 7.2% indicated these were not very harmful, while 50.5% thought they were a threat to health. For chemical lawn products, 39.8% thought they would be a serious threat to health. In our sample, 46.1% expressed concern that residues on surfaces in the home can make people sick. We surveyed to determine if skin rashes, headaches, cough/sore throat, asthma, and other respiratory problems rose after residential pesticide applications; 7.5% reported these illnesses were made worse after pesticide products were used.

Conclusion: The Washington DC pesticide survey suggested that more community education would benefit residents, especially where children are concerned. Education should include pesticide safety as well as direct means of preventing the entry of pests into residences.

STATISTICAL METHODS IN ENVIRONMENTAL HEALTH RESEARCH

O-31C7-2

The Susceptible Pool and Its Impact on the Risk of Death

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Background/Aims: Researchers have theorized about the existence of a susceptible pool who are at greater risk of death from acute events such as extreme temperatures. This theory was developed because of highly changeable patterns in the risk of death which pointed towards a change over time in the at-risk population. We aimed to use mathematical modeling to estimate the number of people in the susceptible pool over time.

Methods: We modeled monthly data using a state space model with 3 states: Healthy, Susceptible, and Dead. We tried a range of different assumptions for the transition rates between states, including a seasonal risk of death and susceptibility. We aimed to create a seasonal pattern in deaths that peaked in January. We modeled acute increases in the transition rate to death to mimic the effects of cold spells and heat waves.

Results: The size of the susceptible pool was highest after summer and lowest after winter, a pattern explained by a build-up during periods of low risk, and depletion during periods of high risk. The peak in deaths due to a cold spell was followed by mortality displacement which was much stronger when the susceptible pool size was 1% compared with 10%. The median months of life lost due a cold spell was just 3 for a 1% pool size, and 22 for a 10% pool. Depletion in the susceptible pool following a heat wave early in summer meant that an identical heat wave later in summer caused fewer deaths.

Conclusion: Changes in the susceptible pool can explain some of the highly variable associations between exposure to extreme temperatures and the risk of death. Our approach has the potential to improve the early preparedness of heat intervention strategies by estimating expected burdens for the coming summer.

O-31C7-3

Spatiotemporal Estimation of $PM_{2.5}$ by Land Use Regression and Bayesian Maximum Entropy Method

Hwa-Lung Yu and Chih-Hsin Wang *National Taiwan University, Taipei, Taiwan.*

Background/Aims: Due to the popularity of Geographic information system, land use regression method has been widely used in spatial estimation of particulate matter (PM) concentration by accounting for the potential contributing factors of the local environment, eg, traffic volume. Geostatstical methods, in other hand, have the ability to account for the spatiotemporal dependence among the observations of ambient pollutants.

Methods: In this study, we assess the performance of land use regression model for the spatiotemporal estimation of $PM_{2.5}$ in Taipei area. In addition, the integration of land use regression model and geostatistical approach is performed under the framework of Bayesian maximum entropy method. The epistemic framework can assimilate knowledge bases including (*a*) empirical-based spatial trend of PM concentration by land use regression, (*b*) the spatiotemporal dependence among the PM observations information, and (*c*) the site-specific PM observations including $PM_{2.5}$, PM_{10}, and TSP (total suspended particles).

Results: Our approach is performed at the spatiotemporal estimation of $PM_{2.5}$ in Taipei area (Taiwan) during the period of 2005–2007.

Conclusion: The results show that the spatiotemporal estimation by the proposed Bayesian maximum entropy method can be more accurate than

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the prediction by only geostatistical method with hard data such as kriging method.

O-31C7-4

Modeling Time-dependent Vulnerability to Environmental Hazards Using Autism and Pesticide Data

Eric Roberts,[1] and Paul English[2] [1]*Public Health Institute, Richmond, CA; and* [2]*California Department of Public Health, Richmond, CA.*

Background/Aims: Flexible modeling of time-dependent effects is required when vulnerability to hazards can be expected to vary over time but the nature of this temporal dependency cannot be specified in advance. Current methods employing distributed lag models function best when the time period in question is short and the incidences of exposures and outcomes are high. Previous efforts using hierarchical Bayesian models suffered from difficulties with convergence and sampling inefficiency. To address these limitations, we formulated a Bayesian model specifying temporal vulnerability as a step function and both exposure frequency and magnitude as unknown parameters; these were updated by pooling information separately among cases and controls.

Methods: We evaluated the model employing data describing maternal residential proximity to organochlorine pesticide applications among 465 subjects with autism spectrum disorders, each matched with 15 controls (total 7440). Applications occurred during 2-day intervals ranging from 300 days prior to fertilization through 699 days after (post-natal age approximately 14 months) with a mean exposure incidence of 1.3 per 1000 subject-days.

Results: Autism spectrum disorders was associated with residential proximity to pesticide applications during 2 periods (all parameters are reported as posterior medians with 95% credible intervals; dates are relative to fertilization date). The first began day −36 (−130, 58) and ended day 159 (61, 257); the second began day 346 (288, 402) and ended day 531 (379, 683). Odds ratios per 10-pound increase in organochlorines were 3.1 (1.0, 9.1) and 3.2 (0.9, 9.4), respectively. Multivariate analysis, however, suggested that the former period may have appeared due to confounding with the latter period.

Conclusion: This method allowed us to detect associations between hazards and outcomes without specifying temporality in advance. We were also able to quantify uncertainty in our estimates of temporal parameters.

O-31C7-5

Bias From Administrative Censoring in Ecological Analyses of Autism, and a Bayesian Solution

Scott Bartell[1] and Thomas Lewandowski[2,3] [1]*University of California, Irvine, CA;* [2]*Gradient, Seattle, WA; and* [3]*Brooklyn College, Brooklyn, NY.*

Background/Aims: Widely cited ecological analyses of autism have reported associations with mercury emissions, with precipitation, and with race. Ecological analyses of autism are typically based on administratively censored educational data, with special data codes substituted for low counts. However, most published analyses fail to acknowledge censoring or fail to identify the specific methods used to handle censored counts, despite the fact that ad hoc substitution methods are known to introduce bias and produce artificially narrow confidence intervals.

Methods: We discuss the problem of administrative censoring, demonstrate its impact on analyses of mercury emissions and 2000–2001 autism counts in Texas, and apply a Bayesian random effects censored Poisson regression model to specifically account for the uncertainty in censored autism counts.

Results: Relative risk estimates for autism decreased from 4.44 (95% CI: 4.16, 4.74) per thousand lbs of air mercury emissions using a naive zero-substitution approach to 1.39 (95% CI: 1.08, 1.76) using the Bayesian approach.

Conclusion: Inadequate attention to censoring poses a serious and often unrecognized threat to the validity of ecological analyses of autism and other health outcomes for which low counts are masked due to privacy concerns.

PP-31-182

Impact of the Frequency of Air Quality Monitoring

Rebecca Klemm,[1] Ron Wyzga,[2] and Eddie Thomas[1] [1]*Klemm Analysis Group, Washington, DC; and* [2]*EPRI, Palo Alto, CA.*

Background/Aims: Air quality has been monitored via different frequencies (e.g., daily, every third day, every sixth day). We investigate potential policy implications associated with the frequency of monitoring.

Methods: We use daily monitoring values for 8 AQI over time period 1998–2006 for Atlanta, GA and 2001–2003 for St. Louis, MO SMSA. These daily measurements are related to daily mortality in a 4-county region (Atlanta) and a geographic area defined by counties in MO and IL (St. Louis). We use a Poisson model with time, average daily temperature, and average daily dew point temperature smoothed via splines (30-day for time, 25th and 75th percentiles for weather). Nonaccidental daily mortality is totaled by cause of death and age at death. The estimated effect of each particular AQI is calculated using the same date of monitoring as the date of death and also the prior date of monitoring as the date of death. We compare the estimated effects using AQI measured every day to the estimated effects using AQI as if measured only every third day and also every sixth day.

Results: Although the mean average daily temperature, average daily dew point, and AQI are quite consistent for all days compared to only every third and every sixth day, the estimated effects differ in an inconsistent manner. For example, the estimated effect of organic carbon lag 0 and decedents at least 65 years of age (Atlanta) is 0.0053 (2.81 *t* value) using all daily AQI measurements, 0.0009 (0.24 *t* value) using every third daily AQI measurements, and −0.0069 (−1.43 *t* value) using only every sixth daily AQI measurements. (Lag 0 AQI means the AQI is measured on the same day as the day of death.) The estimated effect of SO_2 lag 1 and decedents at least 65 years of age (Atlanta) is 0.0001 (0.92 *t* value) using all daily AQI measurement, 0.0006 (1.20 *t* value) using every third AQI measurement and 0.0012 (1.74 *t* value) using every sixth AQI measurement. Comparable differences exist for St. Louis.

Conclusion: Epidemiologists need to clarify their needs for frequency of monitoring, due to the potential impact on policy-making decisions. Additionally, researchers must carefully consider the statistical implications of imputing missing data and the methods used for imputation.

PP-31-183

Uncertainty Analysis Within the EU HEIMTSA (Health and Environment Integrated Methodology and Toolbox for Scenario Assessment) Project

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Background/Aims: Health and Environment Integrated Methodology and Toolbox for Scenario Assessment (HEIMTSA) is an Integrated Project funded under the EU Sixth Framework Programme—Priority 6.3 Global Change and Ecosystems. It aims to develop and apply new integrated approaches to the assessment of environmental health risks and their

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consequences to European policy in areas of transport, energy, agriculture, industry, household, and waste treatment and disposal. Within the project, 1 work package (WP1.2) is dedicated to uncertainty analysis.

Methods: HEIMTSA is committed to considering the effects of uncertainty within a full-chain approach, where the effects of uncertainty at each stage in a process are considered, both qualitative and quantitative, where possible using Monte-Carlo simulation techniques and Bayesian methods. The techniques developed have been used in 5 case studies, designed to facilitate the analysis of the full chain approach in a practical context. These include the Health Impact Assessments of (i) outdoor air pollutants; (ii) indoor air contaminants; (iii) of complex pollutants with multi-pathway exposure, (iv) traffic noise, and (iv) the "mega" case study, which concerns the traditional environmental health impacts of policies designed to reduce greenhouse gas emissions in Europe, or to adapt to climate change.

Results: The method of uncertainty analysis differs between the case studies in order to adapt to the different challenges they present, for example a qualitative characterization was used for the noise case study, whereas a Monte-Carlo approach was implemented in the complex pollutants case study. Due to the nature of the complexity of each stage of the full-chain, for any realistic example, the stages are considered separately by the different expert groups who use different methods and computer software. Visualizing the results of the uncertainty analysis is an integral part of the HEIMTSA spatial toolbox.

Conclusion: This presentation presents details of the HEIMTSA uncertainty framework, gives recommendations, describes lessons learnt from its 5 case studies, and discusses possible future developments in uncertainty analysis.

PP-31-184

Establishment of Nonparametric Probabilistic Model for Evaluation of Chinese Dietary

Liu Pei and Sun Jinfang *Southeast University, Nanjing, Jiangsu, People's Republic of China.*

Background/Aims: To establish a nonparametric probabilistic model for evaluation of Chinese dietary exposure and to improve the assessment accuracy and integrate into the global risk assessment on food safety.

Methods: Contamination data were from the national food contamination monitoring program during 2000–2006, including heavy metals, pesticides, and mycotoxins, amounting to 135 contaminants with 499 commodities and 4,87,819 samples. Food consumption data were obtained from the national diet and nutrition survey conducted in 2002 with 3 consecutive days by 24-hour recall method, and 66,172 consumers were included. Monte Carlo simulation was applied to derive the intake distribution, and the uncertainty of each percentile was estimated using the Bootstrap sampling.

Results: Different nonparametric probabilistic models for dietary exposure evaluation on heavy metals, pesticides, and some of the toxins were established. Taking acephate as an example, the results of its model show that, for the 7–10-year-old children, the dietary exposure in rural areas is higher than that in cities, but both are much lower than its ARfD.

Conclusion: The nonparametric probabilistic model can quantify the variability and uncertainty of exposure assessment and improve the assessment accuracy.

PP-31-185

Mortality Trend for Childhood Leukemia in the State of Rio de Janeiro, Brazil, 1980–2006

Arnaldo Couto, Jeniffer Dantas, Gina Monteiro, Rosalina Koifman, and Sergio Koifman *National School of Public Health Sergio Arouca, Rio de Janeiro, RJ, Brazil.*

Background/Aims: To ascertain the childhood mortality trend in the State of Rio de Janeiro, Brazil, along 1980–2006.

Methods: Leukemia mortality data stratified by sex in children less than 15 years along 1980–2006 in the State of Rio de Janeiro were retrieved from the Brazilian National Mortality System. Data were stratified by the locality of occurrence (the capital, City of Rio de Janeiro; the Metropolitan Area of Rio de Janeiro, excluding the capital; and the State of Rio de Janeiro countryside). Leukemia deaths were ascertained using ICD ninth revision along 1980–1995 and ICD 10th revision between 1996 and 2006. Leukemia mortality rates were ascertained by age and calendar year, being age standardization (World population) further carried out. Polynomial linear regression with a 5% significance level was used to evaluate mortality secular trend in the studied areas.

Results: The 3 studied regions revealed similar trends with a continuous declining pattern, more accentuated in Rio de Janeiro municipality. According to gender, the male leukemia mortality distribution was highest in all studied areas.

Conclusion: A declining childhood leukemia mortality trend was observed in the Sate of Rio de Janeiro, being more pronounced at the capital, Rio de Janeiro Municipality.

HEAVY METALS AND HEALTH

O-31C8-1

Prospective Study of Lead Exposure and Electrocardiographic Conduction Disturbances in the Department of Veterans Affairs Normative Aging Study

Ki-Do Eum,[1] Huiling Nie,[2] Joel Schwartz,[1] Pantel S. Vokonas,[3] David Sparrow,[3] Howard Hu,[4] and Marc Weisskopf[1] *[1]Department of Environmental Health, Harvard School of Public Health, Boston, MA; [2]Purdue University School of Health Sciences, West Lafayette, IN; [3]Veterans Affairs/Boston University School of Medicine and Public Health, Boston, MA; and [4]University of Michigan School of Public Health, Ann Arbor, MI.*

Background/Aims: Cumulative lead exposure has been associated with cardiovascular end points including hypertension, atherosclerosis, heart rate variability, and cardiovascular mortality. Few studies have examined electrocardiographic (ECG) conduction abnormalities among people nonoccupationally exposed to lead and none have examined this in a prospective follow-up setting among people free of disturbances at baseline.

Methods: We assessed the association between biomarkers of lead exposure (including bone lead measured with K-x-ray fluorescence) with ECG end points on average 8.0 (SD = 3.1) years later among 498 men free from ECG conductivity abnormalities at baseline in the VA Normative Aging Study, a cohort of elderly men from the New England area in the United States who are examined every 3–5 years. Odds ratios and 95% confidence intervals (CI) for the development of individual abnormalities were estimated using logistic regression controlling for potential confounders. Parameter estimates and 95% CI were calculated for the effect of increasing lead biomarkers on change in QT, QRS, and JT intervals using random intercept models.

Results: An interquartile range higher baseline tibia lead level (13.5 μg/g) was associated with increased odds of 1.96 (95% CI: 1.21–3.20) of QT prolongation; a 8.21 milliseconds (95% CI: 4.04–12.38 milliseconds) increase in QT interval and a 6.96 milliseconds (95% CI: 3.08–10.85 milliseconds) increase in JT interval at follow-up ECG; and greater increases in QT (0.57 milliseconds, 95% CI: 0.005–1.143 milliseconds) and QRS (1.27 milliseconds, 95% CI: 1.90–4.43 milliseconds) intervals from baseline ECG to follow-up ECG, all after adjusting for covariates. Higher baseline patella lead was only associated with longer QT (*P*-trend: 0.01) and JT (*P*-trend: 0.05) intervals at follow-up ECG. There were no associations with blood lead.

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Conclusion: This study suggests that low-level cumulative exposure to lead is associated with worse future cardiac conductivity in the ventricular myocardium as reflected in QT interval characteristics.

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O-31C8-2

Identification of Lead Exposure Sources by Isotopic Analyses in a Sample of French Children With Moderated and High Blood Lead Levels

Youssef Oulhote,[1] Barbara Le Bot,[1] Joel Poupon,[2] Jean Paul Lucas,[3] Camille Lecoffre,[4] Denis Zmirou Navier,[1] and Philippe Glorennec[1] *[1]EHESP-School of Public Health, Rennes, France; [2]Lariboisière Hospital (AP-HP), Toxicology Laboratory, Paris, France; [3]CSTB- Scientific and Technical Building Center, Marne La Vallée, France; [4]InVS- French Institute for Public Health Surveillance, Saint Maurice, France.*

Background/Aims: Great reductions in environmental lead concentrations and therefore blood lead levels (BLL) have been achieved in France thanks to Public Health policies (ban of leaded paints and leaded gasoline…). However, lead exposure remains a major public health problem among children, because of the accumulated scientific evidence for adverse effects (including cognitive and neurobehavioral deficit) at low doses, without known threshold. We used lead content and lead isotopic ratios (LIR) to identify sources of lead overexposure in a sample of 125 children in France. Preliminary results are available on 40 children.

Methods: A sample of French children (6 months to 6 years of age) with BLL $\geq$25 μg/L has been investigated. Potential lead sources from their houses were sampled: tap water, outdoor soils, home dust, paints chips, etc. Lead concentrations and LIR were determined in blood and environmental samples by Inductively Coupled Mass Spectrometry. Lead concentrations of concern for water and dust were calculated using a pharmacokinetic model (IEUBK). A source was identified as the overexposure source of lead, when its lead content was above the concentration of concern and its LIR was matching the child's blood LIR.

Results: The number of collected samples of potential sources (water, paint, dust, soil, dishes, cosmetics…) varied between 4 and 11 for each child. On first available data, different situations occur: (i) no potential source and (ii) identification of a single source or several sources with both compatible lead content and LIR. Proportion of cases when LIR have identified the likeliest source of overexposure will be presented and discussed, as well as the proportion of cases when LIR have discarded at least one source.

Conclusion: Funding: French Agency for occupational and environmental health safety, French Ministries for Housing and Health.

O-31C8-3

Mercury Usage and Risks Involved in Academic Institutions in Nepal

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Background/Aims: Mercury is a toxic heavy metal. Academic institutions potentially use elemental mercury, mercury-based compound, and mercury containing equipments like thermometers, barometers, calomel electrode in potentiometer, viscosity apparatus, manometers, sphygmomanometer, hygrometers, etc. While dealing with these chemicals and instruments, high risk of exposure is involved from frequent accidental breakage and spillage. As a result, students, instructors, lab-technicians, teachers all have a direct health impacts and several other consequences.

Methods: A total of 451 science student from 10 academic institutions were interviewed with help of questionnaire.

Results: The research findings revealed that mercury, mercury compounds, and mercury-based instruments have been found to be extensively used in the academic setting, especially in the science laboratory. The majority of the students interviewed were aware about the existence of mercury. There was no formal instruction regarding the safe handling of heavy metals like mercury and hazardous chemicals that were given and/or displayed.

Regarding handling of mercury spillage, 4%–32% of the students were found to have touched liquid mercury, 2%–18% have even inhaled the mercury, whereas 20%–70% of the student have taken mercury on paper or plate and 4%–28% played with liquid mercury. In all the institutions without exception, mercury, mercury compounds after the experiments are disposed off either in general waste stream or in drain into sink. Student have tried to collect mercury spillage by sweeping and lifting by paper leaving every chance for a fraction remain scattered on the ground to evaporate in room temperature.

Conclusion: Thus, there is a high level of negligence and hazards involved in the academic setting out of use and handling of mercury, mercury-based chemicals and instruments, aimed to be studied and shared among all.

O-31C8-4

Mercury Level and Development of Allergic Disease of Infant Over the 2 Years in Mothers and Children's Environmental Health (MOCEH) Study

Byung-Mi Kim,[1] Young Ju Kim,[2] Yun-Chul Hong,[3] Yangho Kim,[4] Namsoo Chang,[5] Boong-Nnyun Kim,[6] Se-young Oh,[7] Ju-Hee Seo,[1] Moon-Hee Chang,[1] Eun-Hee Ha,[1] Mina Ha,[8] Hye-Sook Park,[1] and Bo Eun Lee[1] *Departments of [1]Preventive Medicine and [2]Obstetrics Medicine, School of Medicine, Ewha Womans University, Seoul, Republic of Korea; [3]Department of Preventive Medicine, Seoul National University College of Medicine, Seoul, Republic of Korea; [4]Department of Occupational and Environmental Medicine, Ulsan University Hospital, University of Ulsan College of Medicine, Ulsan, Republic of Korea; [5]Department of Nutritional Science and Food Management, Ewha Womans University, Seoul, Republic of Korea; [6]Division of Child and Adolescent Psychiatry, Department of Psychiatry and Institute of Human Behavioral Medicine, Seoul National University College of Medicine, Seoul, Republic of Korea; [7]Department of Food and Nutrition, Kyung Hee University, Seoul, Republic of Korea; and [8]Department of Preventive Medicine, Dankook University College of Medicine, Cheonan, Republic of Korea.*

Background/Aims: The prevalence of allergic diseases has increased in Korean children from 1995 to 2000. Although previous studies have reported that the exposure to mercury has been contributed to the development of allergic diseases, research for infant has been limited. Therefore, we examined the relationship between mercury level and development of allergic disease over the 2 years.

Methods: The prospective cohort study of Mothers and Children's Environmental Health (MOCEH) have been built up in 2006 and we enrolled 1558 women before second trimester of their pregnancy and their partners in 2006–2009. Information on sociodemographic characteristics, psychosocial status, health behavior, and environmental exposure were collected from an interview with trained nurses. After delivery, infants were followed up at 6, 12, and 24 months and the mothers are asked for information on hospital visits due to symptoms of atopy, allergy, and asthma using the questionnaire. We measured the mercury level in maternal blood during early and late pregnancy and cord blood using atomic absorption spectrophotometer. The relationships between mercury level and development of allergic disease were measured by the generalized estimating equations (GEE) model. Statistical analyses were performed using SAS statistical software version 9.1.

Results: Mercury exposure during late pregnancy was significantly associated with an increased development of allergic diseases of infants during the 2 years (adjusted OR = 1.053; 95% CI: 1.001–1.108) after adjusting for gestational age, maternal age, maternal education, infant's sex, parity, breast feeding, postnatal ETS exposure, and maternal weight

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by the GEE. And, also mercury level in cord blood was related to develop allergic disease (Adjusted OR = 1.064; 95% CI: 1.001–1.143).

Conclusion: Present study suggests that mercury exposure may contribute to develop allergic disease of infants during the 2 years.

This study was supported by the Ministry of Environment, Republic of Korea.

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O-31C8-5

Associations of Arsenic Exposure With Impaired Lung Function and Mortality From Diseases of the Respiratory System: Findings From the Health Effects of Arsenic Longitudinal Study (HEALS)

Faruque Parvez,[1] Yu Chen,[2] Mahbub Yunus,[2] Rakib-Uz Zaman,[2] Alauddin Ahmed,[2] Tariqul Islam,[2] Maria Argos,[3] Rabiul Hasan,[2] Vesna Slavkovich,[2] Joseph Graziano,[1] and Habibul Ahsan[4] *[1]Columbia University, New York, NY; [2]New York University School of Medicine, New York, NY; [3]Columbia University Arsenic Research Project in Bangladesh, Dhaka, Bangladesh; and [4]The University of Chicago, Chicago, IL.*

Background/Aims: Epidemiologic studies have reported a positive association between high levels of arsenic (As) exposure from drinking water (>500 μg/L) and respiratory disease. However, the effects of lower levels of As exposure on respiratory disease are unknown.

Methods: We established the Health Effects of Arsenic Longitudinal Study, a cohort of 11,746 adults in Araihazar, Bangladesh. We measured pulmonary function with spirometry for 852 participants in a cross-sectional study. We also conducted cohort analyses using mortality data over the past 8 years.

Results: In the cross-sectional study, individuals with skin lesions had a reduced level of FEV1 (P = 0.02) and FVC (P = 0.08). In the overall cohort, there were 43 deaths (9%) due to diseases of the respiratory system (ICD-10 J00-J99) of which 20 were due to other chronic obstructive pulmonary disease (J44). The hazard ratios of death from diseases of the respiratory system for increasing tertile of well water arsenic concentration (0–25, 25–114, and 114+ μg/L) were 1.0 (reference), 1.7 (95% CI: 0.7–3.9), and 2.2 (1.0–4.8) for death from disease of the respiratory system (P for trend = 0.02) adjusting for baseline age, sex, body mass index, cigarette smoking status, and educational attainment. The RRs for death from diseases of the respiratory system increasing quintiles of urinary arsenic were 1.00 (reference), 1.4 (95% CI: 0.7–3.9), and 2.0 (0.9–4.5) (P for trend = 0.04).

Conclusion: The findings support that As is related to impaired lung functions and the risk of mortality from diseases of the respiratory system.

NATURAL DISASTERS AND HEALTH

O-31C9-1

The Implementation of a National Network of HEAT/HEALTH Warning Systems in the Republic of Korea

Laurence Kalkstein,[1] Scott Sheridan,[2] Kyu Rang Kim,[3] Dae-Geun Lee,[3] and Young-Jean Choi[3] *[1]University of Miami, Coral Gables, FL; [2]Kent State University, Kent, OH; and [3]Korea Meteorological Administration, Seoul, Republic of Korea.*

Background/Aims: During the last several years, a collaborative effort has been underway to develop and implement urban area heat health warning systems (HHWS) to warn the citizens of the Republic of Korea when conditions are dangerous to personal health because of excessive heat. These systems are unique because the triggers to call the warnings are based on human health response as expressed by increasing numbers of deaths attributed to heat. At present, 6 systems in large urban areas are in operation, with plans to nationalize the system over the next 2 years. In addition, extensive system evaluation is planned, and sophisticated intervention techniques are being considered.

Methods: The first step in system development is the creation of a daily air mass calendar for each locale utilizing a spatial synoptic classification. "Offensive" air masses, with historically high mortality rates, are isolated, and algorithms are developed to determine which variables within these air masses explain the greatest variations in mortality (eg, consecutive days of oppressive heat, maximum temperature, time of season).

Results: A password-protected website is then created to be used by forecasters at the Korea Meteorological Administration as guidance to call excessive heat warnings. The impact of heat varies considerably across space, even in a small country like Korea, so each urban area possesses unique heat/mortality characteristics, and hence, requires a separate website.

Conclusion: This year, we have concentrated on technology transfer and developing the spatial synoptic classification for a variety of climate environments in Korea. System evaluation and determination of effectiveness of stakeholder responses are planned to commence in upcoming years.

O-31C9-2

The Long-term Effects of Flooding on Mortality in Rural Bangladesh

Ai Milojevic,[1] Masahiro Hashizume,[2] Ben Armstrong,[1] Paul Wilkinson,[1] Katherine McAllister,[1] A. S. G. Faruque,[3] Md Yunus,[3] and Peter Kim Streatfield[3] *[1]London School of Hygiene and Tropical Medicine, London, United Kingdom; [2]Institute of Tropical Medicine, Nagasaki University, Nagasaki, Japan; and [3]International Centre for Diarrhoeal Disease Research, Dhaka, Bangladesh.*

Background/Aims: Little evidence on the long-term health impact of flooding. To determine the extent to which flooding is accompanied by change in mortality over the 3 years following flooding in rural Bangladesh.

Methods: Flooded and non-flooded areas at the time of severe flood in the summer of 2004 were identified by interviewing the head of 9524 baris (on average 5 households in a bari) which is 90% of all baris in the Matlab Health and Demographic Surveillance area with more than 220,000 residents. Mortality in the flooded areas in the 3 years after the 2004 flood was compared with mortality in the 3 years before the flood in the same areas, controlling for temporal patterns observed in "control" areas that were never flooded in 2004. Comparisons were stratified by sex, age group (0–1, 1–14, 15–59, 60–74, 75+), hygiene and sanitation, and socioeconomic status.

Results: A total of 13,957 of interviewed households (31%) were flooded in the summer 2004. Overall, there was a slight but nonsignificant excess compared to pre-flood mortality during the flood, June–September (RR = 1.16; 95% CI: 0.93–1.45) and no excess after the flood; RR = 1.02 (95% CI: 0.89–1.17), 0.93 (95% CI: 0.81–1.07) and 0.99 (95% CI: 0.86–1.18) in the year 1, 2, and 3, respectively, after the flood. Subgroup analyses showed suggestive excesses in the year after the flood in persons aged above 75 (RR = 1.20; 95% CI: 0.92–1.57) and in the low income group (RR = 1.16; 95% CI: 0.82–1.62), but precision was limited.

Conclusion: We found no evidence of an adverse effect of flood on mortality persisting beyond the flood period itself. Although power was limited, upper confidence interval suggest that risks above 1.2 in the population overall, and above about 1.6 in important sub-groups are unlikely, which contrasts with some other reports. Results for diarrhea or ARI morbidity, for which power will be greater, are being computed and will be presented.

O-31C9-3

Safety Management Systems and Disaster Reduction in Oil and Gas Industry in Nigeria

Shamusideen Kadiri *Gateway Industrial and Petrogas Institute, Ijebu Ode, Nigeria.*

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Background/Aims: Five years ago, a series of explosions rocked the BP Texas City refinery during the restart of a hydrocarbon isomerization unit. Fifteen workers were killed and 170 others were injured. Other accidents have also occurred in oil and gas industry as a result of man-made mistakes with dismaying frequency. These have also taken lives, disrupted communities, and threatened the nation's flow of gasoline and other refined oil products. This paper is concerned with man-made disasters that result primarily from the sudden uncontrolled release or impact of massive amounts of energy (thermal, nuclear, chemical, mechanical, gas pressure, fluid pressure, etc) from man-made activities, which causes major loss of life or many injuries and which may also cause major damage to property and/or the environment. Man-made disasters are virtually all preventable if industrial organizations have robust comprehensive Safety Management Systems (SMS) including prevention, reduction, control, and mitigation, all based on thorough life-cycle risk assessment, especially for major hazards. Further, independent validation and verification audits and reviews on a continuing basis are required to ensure that the SMS continues to meet hazard and risk exposures, both existing and new, and changing demands. Lessons learned from a range of man-made disasters regarding key strategies and tactics to reduce both the number of disasters and their consequences are examined, as well as some key areas for governmental and intergovernmental action in disaster prevention. Terrorist attacks as examples of man-made disasters are excluded from this paper.
Conclusion: Prevention of man-made disasters cannot be guaranteed. There is no such thing as zero risk. However, there are available proven approaches to reducing both the likelihood of occurrence and the scale of consequences.

O-31C9-4

Stock Volatility and Deaths From Heart Disease and Stroke in a Chinese Population

Weimin Song, Wenjuan Ma, and Haidong Kan *School of Public Health, Fudan University, Shanghai, People's Republic of China.*

Background/Aims: Little is known about the volatility of financial market on cardiovascular health. The Chinese stock markets were extremely volatile between 2006 and 2008. We examined the relationship between daily changes of the Shanghai Stock Exchange (SSE) Composite Index (referred thereafter as the Index) and deaths from heart disease and stroke during 2006–2008 in Shanghai, the financial capital of China.
Methods: Daily counts of deaths due to heart diseases or stroke between 1 January 2006 and 31 December 2008 were obtained from Shanghai Center of Disease Control and Prevention. Daily stock performances of the Index were obtained from the SSE website. We analyzed the data using the time-series generalized additive model. In addition to the bidirectional changes, we also analyzed the data using absolute changes without considering the direction.
Results: We observed U-shape relationships between Index changes and deaths from heart diseases or stroke: both up and down of the stock market were associated with more deaths and the fewest deaths coincided with no/little change of the market. When we used the absolute rather than bidirectional changes of the Index, each 100-point increase or decrease of the Index corresponded to 5.43% (95% CI: 1.95%, 8.91%) increase of heart disease death, and 3.13% (95% CI: 0.36%, 5.90%) increase of stroke death.
Conclusion: Our analysis showed that deaths due to heart diseases or stroke fluctuated with daily stock change in Shanghai. These preliminary data suggest that the volatility of financial market may adversely affect cardiovascular health. (eg, Forest Fire, Earthquake, Tsunami, Flooding, etc.,)

PP-29-171

Regional Characteristics of Heat-related Deaths and the Application of a Heat-health Warning System in Korea

Dae-Geun Lee,[1] Young-Jean Choi,[1] Kyu Rang Kim,[1] Laurence Kalkstein,[2] and Scott Sheridan[3] *[1]Korea Meteorological Administration, Seoul, Republic of Korea; [2]University of Miami, Coral Gables, FL; and [3]Kent State University, Kent, OH.*

Background/Aims: Temperatures seem to be rising significantly in mega-cities like Seoul. The elderly population, which is on rise, is more susceptible to the rising temperature, and may find themselves exposed to potential health risks in the future. To minimize the social and health impacts of heat, the Korea Meteorological Administration operates an Extreme Heat Warning System (EHWS) since 2007. EHWS gives warnings by absolute criteria, the duration of daily maximum temperature and the heat index. KMA and Applied Climatologists are developing a Heat-Health Warning System (HHWS) based on a spatial synoptic classification for major Korean cities to minimize population vulnerability to heat.
Methods: We studied regional characteristics of mortality and meteorological conditions in Seoul and Busan during the extreme heat wave of 1994. We estimated the relationship between EHWS's fixed criteria and observed deaths during 1991–2005. During the same period, HHWS's warning criteria and observed excess deaths were calculated and compared to the EHWS's to test the reliability of the system.
Results: Deaths attributed to heat varied between Seoul and Busan due to the difference in heat wave intensity, initiation of the season, and duration of the heat wave. Maximum temperature exceeded the seasonal norm by 8°, which contributed to the extreme heat intensity in Seoul. In Busan, the heat wave commenced about 20 days earlier than in a typical year, which suggests that the expedited time of season influenced the acclimatization. Warning frequency of EHWS was observed on 12 days in 1994, while HHWS detected 66 such days that year. Observed excess deaths for the warning criteria were 352 deaths with EHWS and 754 deaths with HHWS. HHWS thus produced more exacting information for public health officials to minimize negative health outcomes.
Conclusion: Because of increasing urban vulnerability, the application and development of a heat warning system is imperative. Application of HHWS will reduce the urban health risks and provide efficient decision-making for public health officials.

ENVIRONMENTAL THREATS TO THE HEALTH OF CHILDREN

S-01A3-1

Environmental Exposures and Neurobehavioral Risks to Children

David Carpenter *Institute for Health and the Environment, University at Albany, Rensselaer, NY.*

Background/Aims: Children's brains are uniquely vulnerable to toxic insults from environmental contaminants that cause impairments in cognitive function and altered behavior. The evidence continues to grow indicating that a remarkably diverse group of exposures appear to do almost the same thing.
Results: The best studied is lead, which causes an intelligence quotient (IQ) deficit of about 5–7 IQ points, a shortened attention span, and an increase in disruptive and antisocial behavior. There is strong evidence that polychlorinated biphenyls and methyl mercury do the same things, even through their chemical structures are very different. Recent studies show cognitive deficits from arsenic, fluoride, environmental tobacco smoke, and particulate air pollution. Although there has been less study of the associated behavioral effects of these latter exposures, at least for environmental tobacco smoke exposure results in disruptive behaviors. Furthermore, there is independent evidence that IQ is a protective factor against antisocial behavior.

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Conclusion: There are a number of important but unanswered questions related to IQ, behavior, and environmental contaminants. If a child is exposed to more than 1 contaminant, are the effects additive, less than additive or synergistic? In the case of lead we now know that there is no safe level and that increments at low concentrations are more damaging than increments at higher concentrations. Is this also true for the other contaminants that alter IQ and behavior? What are the mechanisms whereby such diverse chemicals all appear to do the same thing? While the developing brain is most vulnerable, there is increasing evidence that adults also suffer cognitive decline upon exposure to these chemicals. There are very significant equity and public health concerns that arise from these exposures, since poor people and people in developing countries often have significantly greater exposures. Productivity in any society is dependent on the brain power of its citizens.

S-01A3-2

Longitudinal Cohort Studies on Child Health in South East Asia

Peter Sly *University of Queensland, Brisbane, Queensland, Australia.*

Abstract: Children are more vulnerable to adverse environmental exposures than adults and are often exposed to higher doses of toxicants. The consequences of exposure depend on the developmental stage during which the exposures occur. While many organ systems are mature at or soon after birth the respiratory, immune, and central nervous system have prolonged periods of postnatal maturation making them vulnerable to environmental exposures occurring after birth. While cross-sectional studies can provide information about associates between exposures and health outcomes, the optimal method for determining the adverse effects of environmental exposures is to follow a group of children from before or at birth, carefully measuring exposures and outcomes over time. Longitudinal cohort studies present a particular set of challenges that need to be overcome. Such studies are expensive to undertake and require dedicated personnel. Many studies are too small to identify links between exposures and less common outcomes. Here, the use of harmonized protocols can be beneficial in allowing data to be combined from a number of studies, thus increasing the power to detect small effects. This presentation will focus on a general approach to conducting longitudinal studies on respiratory health and neurodevelopment. Examples from existing cohorts and studies in the planning phase will be used.

S-01A3-3

Impact of Carcinogenic Polycyclic Aromatic Hydrocarbon Exposure to Children Respiratory Morbidity

Radim J. Sram, Miroslav Dostal, Helena Libalova, and Eva Schallerova *Institute of Experimental Medicine AS CR, Prague, Czech Republic.*

Background/Aims: Ostrava Region in the Northern Moravia (Silesia) is the most polluted region in the Czech Republic by carcinogenic polycyclic aromatic hydrocarbons as benzo[a]pyrene (B[a]P). Sources of this pollution are especially industry (steel production, coke oven). In the most polluted district of Ostrava City—Bartovice (OB) in the year 2008 was B[a]P 9.3 ± 14.4 ng/m^3 versus control district of Prachatice (PRA) in the Southern Bohemia, where B[a]P was 1.0 ± 1.3 ng/m^3. We hypothesize that the observed increased incidence of the asthma bronchiale (AB) in children living in OB (30.4% in the year 2007) compared to PRA (5.2%) is partially due to the increased level environmental pollution by B[a]P.

Methods: We studied group of 200 children living in OB (100 asthmatic and 100 healthy children, aged 8–12 years) and a control group of 200 children living in PRA (100 asthmatic and 100 healthy children, aged 8–12 years). As biomarkers of oxidative damage were followed 8-oxodG in urine, lipid peroxidation and protein oxidation in plasma, as biomarkers of effect gene expression profiles in lymphocytes using Illumina HumanHT-12 BeadChip.

Results: AB increased in OB from 10% in the year 2001, as concentrations of B[a]P increased. Comparing OB vs. PRA, AB is diagnosed in OB up to 3 years in 60% versus 25% children in PRA, respiratory morbidity in preschool children in OB is >5 times/yr in almost 100%, versus 30% in PRA. Oxidative damage by 8-oxodG was significantly higher in OB vs. PRA (OR = 2.27).

Conclusion: Results indicate that higher exposure to carcinogenic polycyclic aromatic hydrocarbons may induce specific form of AB in children.

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RE-EVALUATING EXPOSURE SCIENCE FOR 21ST CENTURY

S-01A4-1

Complex, Low Level Exposures—And Then What?

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Background/Aims: Measuring increasingly complex exposures of large population samples at low concentrations is currently only a matter of authority and funds. It requires expertise, is invasive, laborious, and expensive, but by no means impossible. The real challenge begins when the results need to be interpreted and conclusions drawn for health impact assessment and risk management. Laboratory experiments with both artificial and real life exposure cocktails on cell cultures or living organisms have added plenty of highly focused information, but the societal challenge remains.

Methods: A much broader view considering the health risks and benefits of the whole complex and interconnected exposome is, therefore, necessary for health impact assessment and risk management.

Results: The fact that we first evolved as a species, and then were born, grew up, and currently live as individuals, is a consequence of long-term complex exposures. The fact that we get sick and die may also result from exposures, long- or short-term, complex or simple. Complex exposure per se is neither good nor bad. A low level exposure may be too low (lacking essential nutrients) or too high (initiating cancer). We know with certainty that some exposures are harmful—tobacco smoke, methyl-mercury, 2,3,7,8-Tetrachlorodibenzo-para-dioxin—some others beneficial—omega-3, vitamins, "fruits and vegetables." But, we also face exposures, which are at the same time both beneficial and harmful: Sunshine exposure is a source of both vitamin D and skin cancer. Fluoride and wine have U-shaped dose/response functions, a little is good, more is bad. Furthermore, judging a complex exposure by its harmful components—-eg, dioxins in fish—-may deny us the benefits of its other components—eg, omega-3. The latter may far outweigh the former.

Conclusion: Complex exposures cannot be avoided, and are, in fact, essential for life.

S-01A4-2

Exposure Assessment for Improved Air Quality Management

Julian D. Marshall *University of Minnesota, Minneapolis, MN.*

Background/Aims: As new environmental toxins are identified, new research and methods are required to understand and address potential risks. Goals for the field include generating new scientific knowledge, useful integration with environmental epidemiology, and providing decision-makers and the public with relevant and timely information.

Methods: This talk aims to highlight some of the exposure tools that may prove useful for exposure science in coming years.

Results: The "intake fraction" metric has proven to be a useful framework for investigating new environmental health risks. Current concerns regarding particle number concentrations will benefit from mobility-based exposure estimates and from exposure investigations in

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developing countries. Exposure science should to be at the forefront of environmental justice, including proposing and testing solutions to address those concerns, and urban design for environment and health.

Conclusion: Exposure science is uniquely positioned to contribute to, and frame debate about, several important aspects of air quality management.

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S-01A4-3

Persistent Consumer Products in the Indoor Environment: Does Exposure Science Protect Us?

Deborah Bennett *University of California, Davis, CA.*

Background/Aims: Persistence in the outdoor environment has long been recognized as a cause for concern and as such, has been a call to action for society. For example, recognition of persistence in the outdoor environment has lead to policy changes such as international bans on the production of the "dirty dozen" compounds. There are an ever increasing number of compounds such as flame retardants and compounds found in various plastics and surface treatments in our consumer products. Exposure science informs us that when a semi-volatile compound is introduced to the indoor environment, it will be more persistent and a greater fraction will be taken up by an individual than if that same compound was released in the outdoor environment.

Methods: As exposure scientists, we first need to increase our ability to understand and predict resulting exposures. Second, we need to use our findings to further the public's awareness of the potential exposures resulting from consumer products. Perhaps by speaking of the persistence of these compounds in the indoor environment, we can stimulate a call to action for society to reduce the use of semi-volatile organic compounds in consumer products.

Results: The levels and year-to-year consistency of a suite of semi-volatile compounds in California homes will be presented. We will address how exposure scientists are uniquely situated to help understand exposures resulting from consumer products.

Conclusion: The landscape of environmental concerns will be changing as we move through the 21st century, with an increased emphasis on consumer products. As exposure scientists, we must improve our ability to disseminate the knowledge we gain through our studies to help protect society's health.

S-01A4-4

From Servant to Luminary: Transforming Exposure Science for Protection of Public Health

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Background/Aims: For much of its young life, exposure science has served as the eager step-child, forever in need of validation. Humbly, it adopted the role of a support science seeking to demonstrate its ever-elusive relevance. As the field has matured, it has become apparent that exposure information is crucial to elucidating the relationship between the environment and health. Even so, the unit cost of exposure information at times revealed that of gold, and thus its value often relegated to statistical noise. Many a landmark environmental health study has come and gone, populating the exposure field with surrogates of 1 type or another.

Methods: Current techniques used in exposure science have focused on a few chemicals measured in environmental and biological media. In particular, biomonitoring has been publicized as a panacea for exposure science over the last decade because of the rapid emergence of analytical techniques and biomonitoring data.

Results: Although biomonitoring has certain uses, limitations of many of its applications are becoming more apparent, such as lack of specificity, temporal variability, inability to establish exposure routes, and inability to deal with real-world exposure scenarios. However, we have yet to develop alternative strategies to improve exposure science.

Conclusion: As we look forward, there will continue to be a critical need for exposure information to inform chemical design, evaluation, and health risk management. A shift in the framework for design, manufacture, and management of chemicals to address principles of green chemistry requires holistic consideration of integrated environmental, economic, and social factors. The vast quantities of High Throughput hazard data must be translated to assess risks to human health from environmental exposures. Finally, understanding the contribution of environmental factors to etiology of complex disease requires a comprehensive view of exposure and biologically relevant exposure metrics. Meeting these fundamental scientific challenges will require innovation and evolution in exposure science.

PROBLEMS REGARDING SOCIOECONOMIC STATUS AND VULNERABILITY/URBAN PLANNING, GREEN AND SUSTAINABLE DEVELOPMENT

O-01A5-1

How Does Urbanicity Effect on Infants' Wheeze Symptom?

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Background/Aims: We investigated whether the degree of developed land-use near a family's residence is associated with presence of infants' respiratory symptoms.

Methods: Wheeze occurrence was recorded for the first year of life for 680 infants in Connecticut for 1996–1998. Land-use categories were generated using satellite imagery. The fraction of developed land-use near the subject's home was related to presence of wheeze symptoms, using logistic regression. NO_2 exposure, as a proxy for traffic pollutants, was estimated using integrated exposure traffic modeling. Effect modification between developed land-use and income was explored. As a sensitivity analysis, ordered logistic regression was performed using 3 levels of wheeze symptoms (none, mild, severe).

Results: An interquartile range increase in developed land-use within 810 m of infants' residence was associated with 1.61 times higher presence of wheeze (95% confidence interval: 1.12–2.33). When both NO_2 and developed land-use are included in a single model, neither is statistically significant. Developed land-use had a higher association with wheeze for infants from lower income families. Sensitivity analysis also shows similar results.

Conclusion: Our analysis indicates that developed land-use is associated with infants' presence of wheeze symptoms, and that this effect differs by socioeconomic status. Findings indicate that health effect estimates for development incorporate some effect of traffic-related emissions, but also involve other urban factors. These may include differences in the structure of developed land-use, housing characteristics, or baseline healthcare status.

O-01A5-2

Impact of London's Urban Heat Island on Heat-related Mortality

Ai Milojevic,[1] Paul Wilkinson,[1] Ben Armstrong,[1] Mike Davis,[2] Anna Mavrogianni,[2] Sylvia Bohnenstengel,[3] and Stephen Belcher[3] *[1]London School of Hygienen and Tropical Medicine, London, United Kingdom; [2]Bartlett School of Graduate Studies, University College London, London, United Kingdom; and [3]Department of Meteorology, University of Reading, Reading, United Kingdom.*

Background/Aims: To assess the impact of the Urban Heat Island (UHI) on heat-related mortality in London.

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Methods: Air temperatures at 1.5 m above land surface were generated at 1 × 1 km resolution for the early summer period of 26 May to 21 June 2006 by an urban surface energy balance model (the London Unified Model). The number and proportion of heat-attributable deaths were computed by grid square and day using an empirical temperature-mortality relationship for London applied to similarly stratified daily maximum temperatures (the temperature index found most strongly associated with mortality in epidemiological analysis) and observed deaths. Modeled temperatures were calibrated using the mean difference from monitored temperatures at 3 weather stations.
Results: Results are summarized by broadly concentric "UHI zone" defined by tertile of the period mean of daily minimum temperatures relative to a reference location to the west of London. We refer to these tertile zones as "outer London," "inner London," and "central London." Mean differences in daily maximum temperature for these zones were +0.3°C, +0.4°C, and +0.5°C above the reference location, respectively. The overall number of heat-related deaths in London during the period of study was 118.3 (95% CI: 105.8, 130.7). The percentage of heat deaths attributable to the UHI effect, which varies with temperature conditions, was substantial for the non-extreme heat of the study period: 37.7% in "outer London," 46.6% in "inner London," and 47.2% in "central London." In winter, the UHI acts to reduce cold-related mortality.
Conclusion: For the period studied, heat-related mortality in London was appreciably increased by the UHI effect, though the relative importance of such an effect compared with that of building characteristics for individual-level risk remains unclear. The implications for urban design will be discussed.

O-01A5-3

Methyl Mercury Exposure in Tribal Populations From Fish Consumption: Probabilistic SHEDS Model Analyses Using 1996–2006 NHANES and 1990–2003 Total Diet Survey Data

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Background/Aims: Tribal populations have shown higher levels of blood organic mercury than other ethnical groups in the previous CDC National Health and Nutrition Examination Survey (NHANES); however, the reasons for higher levels have not been well studied.
Methods: This research examines dietary exposures to methylmercury (MeHg) through fish consumption in different ethnic populations, focusing on Asians, Native Americans, and Pacific Islanders (A/N/P), by extending previous analyses of observed NHANES blood levels and exploring the causes. Probabilistic exposure modeling for dietary MeHg was conducted with the USEPA's SHEDS-Dietary model, using fish MeHg residue data from the USFDA's Total Diet Survey and dietary consumption data from NHANES. MeHg exposures by ethnicity, age group, and food type were analyzed.
Results: SHEDS model results show that A/N/P populations are exposed to higher levels of MeHg from fish consumption than the general US population, ranging from a factor of 1.1 to 3.17 times higher; blood MeHg concentrations show a similar pattern. For the A/N/P populations, the 5 major food contributors for MeHg are tuna fish (31%), fresh water fish–other (22%), seawater fish–other (20%), salmon (13%), and catfish (9%). The ratio of A/N/P to other populations for NHANES blood MeHg (2.6) and for SHEDS modeled MeHg exposure (3.17) is the highest for 1–2 year-olds. Overall, this age group of the A/N/P population had the highest mean dietary MeHg intakes per body weight: 0.54 and 3.09 μg/kg/d at the 95th and 99th percentiles; these numbers are higher than the Joint FAO/WHO Expert Committee on Food Additives Provisional Tolerable Weekly Intakes, expressed on a daily basis as 0.47 μg/kg/d.
Conclusion: Correlations of modeled dietary exposure predictions with NHANES blood biomarker levels also suggest that fish consumption is a key exposure pathway for these populations.

O-01A5-4

The Sustainable City Project: A Future-oriented Study to Support Urban Policy Development in the Netherlands

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Background/Aims: The Dutch policy ambition of creating sustainable cities needs to be supported with goal formation and strategic pathway specification. Creating future images and perspectives for action is permeated with uncertainty as a result of a high degree of complexity and considerable dissent on what sustainability at the urban level entails. A future-oriented study of the Netherlands Environmental Assessment Agency (running from 2008 to 2010) is designed in a participative way and makes use of foresight methods to capture the plurality of future images and perspectives for action to create healthy, liveable, and energy-neutral city environments.
Methods: Participative backcasting is used as method to develop visions on future sustainable urban environments and road maps with (policy) measures for their realization. A broad selection of scientists, policy makers, and representatives of nongovernmental organizations, interest groups, and private parties is involved in 3 workshop rounds. The workshop findings provided the input for scenario analysis and narrative analysis. Scenario analysis was done by means of urban systems simulation modeling and impact assessment on health, liveability, and energy. Narrative analysis offers insight into normative and institutional perspectives on sustainable urban planning.
Results: The project team assessed the values, beliefs, and knowledge claims on the future orientation of sustainable urban life and their implications for health (disease burden), liveability (liveability score), and energy (emission equivalent). The assessment was done on the basis of 5 criteria of relevance to enhance sustainable urban policy: sustainability potential, social impact, co-benefits and trade-offs, feasibility, and urgency.
Conclusion: The results of the assessment demonstrate that sustainable urban planning requires new and diverse alliances of local citizens, business and governments responsible as producers and consumers of the urban quality of life. Moreover, a different societal attitude towards living and work place conditions, mobility and recreation is needed to create healthy, liveable, and energy-neutral city environments. These findings will feed back into the stakeholder dialogue in mid-April 2010 to be discussed in terms of feasibility and urgency.

O-01A5-5

Hospitalizations Within Low Socioeconomic Status Group and Air Pollution. A Case of a U-shaped Curve in Public Health?

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Background/Aims: Previous studies have reported that socioeconomic status (SES) modifies the association between morbidity and pollution, but few studies have evaluated this effect within low-SES group. This study aims to evaluate the modifying effect within low-SES group on the risk of hospitalizations due to exposure to air pollution.
Methods: Daily counts of cardiovascular (CVD) and respiratory (RSP) hospitalizations between 2002 and 2006, in Santiago were collected. These data were stratified by age group (all-ages, <18, 18–64, and ≥65 years old). Meteorological and air pollution data were provided from the MACAM network. The association was studied for 4 sub-groups with public health insurance (which corresponds usually to low-SES groups), classified according to their annual income (no-income or resource-poor; minimum-wage, low-income, and medium-income), and those with private health insurance (higher-SES). Admission rates were calculated for each group. Statistical analyses used a time-series approach, controlling for

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apparent temperature, day of week, holidays, seasonality, and influenza epidemics. Moving averages from 0 to 28 days were considered.

Results: A total of 281,037 hospitalizations were included. Admission rates were similar by income group, except for RSP for the no-income group, whose rate was higher. A significant association ($P < 0.05$) was observed between CVD and $PM_{2.5}$ for people ≥65 years old belonging to the no-income (hospitalizations increased by 2.6% [0.2%–2.0%] per 10 $\mu g/m^3$, 6-day moving average) and middle-income (4.9% [1.1%–8.8%], 6-day) groups; also between RSP hospitalizations and O_3 for no-income group (3.8% [0.6%–7.1%], 2-day). For adults 18–64 years old, a significant association was observed between CVD hospitalizations belonging to no-income (3.0% [0.5%–5.6%], $PM_{2.5}$, 6-day) and low-income (7.0% [0.7%–13.6%], $PM_{2.5}$, 6-day) groups; for under 18 years and RSP hospitalizations belonging to no-income (0.9% [0.1%–1.8%], O_3, lag 2), minimum-wage (0.6% [0.0%–1.3%], O_3, lag 2) and for higher-SES (2.1% [0.3%–3.8%], O_3, lag 6) groups.

Conclusion: These results suggest that the association between risk of hospitalizations and air pollution is modified within low-SES group, following a U-shaped curve with respect to the income in Santiago, Chile.

EXPOSURE ASSESSMENT AND HEALTH EFFECTS OF SILICA

S-01A6-1

Identification of Factors Influencing the Dust Generation and Their Quartz Content Under Various Concrete Cutting Conditions

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Background/Aims: The objective of this research is to identify and quantify the contribution of 2 determinants of the cutting force (CF) and concrete strength (CS) to resultant quartz exposures during the concrete cutting processes.

Methods: Six cutting conditions were selected with applied CF and CS varied from 9.8 to 49 N and 2500 to 6000 psi, respectively. For each drilling condition, the emitted particles were sampled by using the Marple personal 8-stage cascade impactor. All size segregating samples were further analyzed for their quartz contents by using the x-ray diffraction per NIOSH method 7500. ANOVA model was used to further give parameter estimations that indicate the contribution of the above 2 determinants to the different quartz exposures (including concentrations of total [Ctot], thoracic [Cthora], and respirable [Cres] quartz).

Results: Results showed that (1) the increase in CS (2500 to 6000 psi) would result in a significant increase in the all 3 quartz concentrations; (2) the increase in CF (from 9.8 to 49 N) did not have a consistent effect on Ctot, Cthora, and Cres; and (3) in the all 3 models, from 71.3% to 88.9% of the between-parameter and within-parameter variance were explained by the fixed effect.

Conclusion: In conclusion, by statistical analysis the contribution of the different determinants to the eventual silica exposures has been identified. Therefore, it can be expected that the resultant information can be used to order and prioritize these 2 determinants to their individual contribution on the silica exposures, particularly when conducting effective control options are not feasible in the filed.

S-01A6-2

Analysis of Quartz Content and Elements Compositions of Stones

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Background/Aims: The aim of this study was to analyze stones for exposure assessment to stone dusts in stone processing workers. Quartz is the IARC category "Group 1" carcinogen.

Methods: Two samples of granite rock and 3 samples of marble rock (black, pink, and green) were analyzed. Quartz content was analyzed by XRD and elemental compositions were analyzed by WDXRF.

Results: Quartz contents were 41% and 51% in granite stones, and were 11% in black and 43% in pink marbles, respectively. However, no quartz was detected in green marble. Green marble contained 0.2% of nickel (insoluble inorganic compounds) which is classified as "A1" carcinogen by ACGIH, on the other hand, no nickel was contained in black and pink marbles. Manganese, which is listed on IRIS, was detected in all samples with a range of 0.02%–0.1%.

Conclusion: According to stone types, quartz content and elemental compositions were different. In this study, only 2 types of stone were analyzed. Therefore, further investigations through more sample analyses are needed.

S-01A6-3

Silica Exposure Causes Epithelial-Mesenchymal Transition and Pulmonary Fibrosis

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Background/Aims: Interstitial fibroblasts were thought to be the major effect cells in the development of fibrosis. However, it has been demonstrated that more than one-third of tubular or alveolar epithelial cells in fibrotic loci are colocalized with epithelial and mesenchymal markers, indicating the occurrence of epithelial-mesenchymal transition (EMT) during kidney or idopathic pulmonary fibrotic injury. Silica is capable of causing pulmonary granuloma and fibrosis. However, there has been no study to investigate whether silica exposure causes EMT during the development of pulmonary fibrosis.

Methods: In this study, C57BL6 male mice were intratracheally instilled with silica at 2.5 mg/20 g mouse for 1 day, 1 week, 2 weeks, 4 weeks, and 8 weeks. Bronchoalveolar lavage (BAL) fluids and cells were collected for the measurement of inflammatory cells, cytokines, growth factors, and matrix metalloproteinase activity. Lung tissues were fixed and stained with Trichrome dyes and immunofluorecent probes specific for epithelial and mesenchymal proteins.

Results: Silica caused significant increases in total proteins, lactate dehydrogenase, MMP-9 and MMP-2 activities, TGF-β and PDGF in BAL fluid. BAL desmosine and hydroxyproline were found to be significantly increased in silica group at 1 week after exposure. Alveolar type II cell proliferation started at day 1 and cell hyperplasia were evident starting at week 2. The ensuring formation of granuloma contained proliferating epithelial cells and fibroblasts. At 4 and 8 weeks, Trichrome staining demonstrated the existence of blue bundles of fibrous connective tissues within fibrotic loci. Most significantly, immunofluorescent staining revealed the colocalization of fibroblast specific protein 1 or α-smooth muscle actin with surfactant protein C in hyperplasic epithelial cells.

Conclusion: Our study for the first time demonstrates that silica exposure causes pulmonary epithelial and parenchyma damage, alveolar type II cell hyperplasia, and EMT, contributing to the development of pulmonary fibrosis.

S-01A6-4

From the Lung Epithelial Proliferation and Immune Inflammatory Response Aspects to Assess a Suitable Exposure Metric for Quartz Dusts of Different Particle Sizes

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Background/Aims: The objective of this study was to investigate the relationships between 3 exposure metrics, including mass, surface area, and number concentration for quartz of different particle size and lung epithelia cell proliferation and inflammatory response, and to determine the most suitable exposure metric for quartz exposure.

Methods: The quartz dust was separated into 3 particles size by using a liquid sedimentation system, and separated quartz dust was analyzed by Scanning electron microscope and Transmission electron microscopy to determine their true particle size distributions. The MTT cell proliferation assay was used for the proliferation index of pulmonary A549 cells and ELISA measurement was used for TNF-α and TGF-β production of RAW264.7 cell as the index of acute and fibrogenic response.

Results: The count median diameter (CMD) of 3 particles size of quartz were 0.98, 2.61, and 8.79 μm, and the GSDs were consistently less than 1.62. The quartz content for tested dust was higher than 97.5%. The results show that the smaller quartz particle caused the stronger cell proliferation and inflammatory response, and quartz with particle size 2.61 μm was found with the highest fibrogenic response than the other 2 particle sizes. This study also investigated the biological-based dose response relationship for quartz with different particle size while testing against different exposure metrics. The results show that the EC50 for 3 different quartz particles size, using the mass concentration as exposure metric, were similar in cell proliferation, acute inflammation, and fibrogenic response test. But the other 2 exposure metrics were not had the same trend. The R2 of the mass concentration for 3 different quartz particles size was also high than the other 2 exposure metrics.

Conclusion: The above results clearly suggest that the mass concentration is the most suitable exposure metric for assessing the health-risks associated with the quartz exposures.

OUTDOOR AIR POLLUTION FROM RESIDENTIAL WOOD COMBUSTION AND ASSOCIATED HEALTH EFFECTS

S-01A7-1

Woodsmoke Source Apportionment, Home Infiltration, and High Efficiency Particle Air Filter Intervention Assessment in the Rural Annapolis Valley, Nova Scotia, Canada

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Background/Aims: Woodsmoke has recently received increasing attention as an important source of particulate matter, particularly in rural areas. Indoor woodstoves and outdoor wood boilers are widely used in the Annapolis Valley, in rural Nova Scotia, and the area's topography is conducive to trapping emissions especially during thermal inversions. In an effort to quantify the impact of these factors on local air quality, the source contribution of residential wood burning to ambient particulate matter ($PM_{2.5}$) at 1 fixed site in the Annapolis Valley, was determined during the winters of 2008/2009 and 2009/2010.

Methods: $PM_{2.5}$ filter specimens and associated gases (Volatile organic compound, NOx, O_3) were collected over 50 winter days in 2008/2009 and 90 winter days in 2009/2010. $PM_{2.5}$ chemical species analyzed from these filters included levoglucosan (and other woodsmoke markers), elements, ions, C14, organic and elemental carbon. Running concurrently with the $PM_{2.5}$ ambient monitoring in 2009/2010 was an investigation of woodsmoke home infiltration into 30 homes, together with an evaluation of the effectiveness of high efficiency particle air cleaners at reducing indoor $PM_{2.5}$ concentrations.

Results: Chemical Mass Balance (US Environmental Protection Agency [USEPA] CMB v8.2) modeling conducted to date has yielded an average woodsmoke source contribution to $PM^{2.5}$ of 56.2% (range, 32.6%–73%), versus 12.4% NH_4NO_3 (range, 5.0%–20%), 24.1% SO_4 (range, 11.0%–47%), 9.2% $(NH_4)_2SO_4$ (range, 2%–19.8%), 3.9% unknown mass (range, 0.6%–14%), and no statistically significant input from vehicle emissions. The mean, minimum, and maximum levoglucosan observed to date are 234.2, 154.9, and 274.3 ng/m^3, respectively.

Conclusion: The $PM_{2.5}$ CMB from 2009/2010 will be reviewed together with the $PM_{2.5}$ CMB conducted in 2008/2009 to better understand the ambient woodsmoke source apportionment in this rural environment. Censoring algorithms, multiple linear regression, and recursive mass balance models will be applied to the indoor/outdoor continuous $PM_{2.5}$ data to determine the effectiveness of the high efficiency particle air filters.

S-01A7-2

The Impact of Portable Air Filters on Indoor Air Pollution and Cardiovascular Health in a Woodsmoke-impacted Community in British Columbia, Canada

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Background/Aims: Woodsmoke is a major source of particulate matter (PM) in many communities. Despite evidence that woodsmoke is a respiratory irritant few studies have investigated its cardiovascular impacts.

Methods: Using portable HEPA filters in a randomized, blinded intervention study, we investigated the relationship between PM and cardiovascular health among 56 healthy adults (mean age: 43.0 $\pm$ 9.9 years) in a woodsmoke-impacted community. Each home was monitored for 2 consecutive 7-day periods, and 2 HEPA units were operated indoors with the filters removed for one of the sampling periods. Air pollution was measured indoors and outdoors using nephelometers for continuous $PM_{2.5}$ and Harvard Impactors for $PM_{2.5}$ and the woodsmoke tracer levoglucosan. Microvascular endothelial function, indicated by reactive hyperemia index, was measured after each 7-day period using the Endo-PAT, and inflammatory markers in blood (C-reactive protein, IL-6, IL-10, and band cell counts) and oxidative stress markers in urine (8-isoprostane and malondialdehyde) were quantified. HEPA filtration effects on log-transformed outcomes were assessed using mixed models to account for repeated measures and to adjust for gender, age, BMI, and indoor temperature.

Results: HEPA filters reduced average indoor $PM_{2.5}$ concentrations by 59% (11.2–4.6 μg/m^3). Outdoor concentrations were similar during filtration (10.8 $\pm$ 5.0 μg/m^3) and non-filtration (9.8 $\pm$ 4.2 μg/m^3) periods, and outdoor $PM_{2.5}$ and levoglucosan were highly correlated (r = 0.82). Changes in outcomes were all in the expected directions, and in fully adjusted models, HEPA filtration was significantly associated with a 10% (95% confidence interval: 0.9%–18%) increase in reactive hyperemia index, and a 33% (4%–61%) decrease in C-reactive protein. There was a trend across end points of greater effects among men, those $<$40 years, and those with body mass index $\geq$ 25.

Conclusion: HEPA filters were associated with improved indoor air quality and significant changes in endothelial function and systemic inflammation among healthy residents of a woodsmoke-impacted community.

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S-01A7-3

Changes in Respiratory Symptoms and Infections Following a Reduction in Wood Smoke PM

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Background/Aims: A wood stove changeout program was implemented in a community heavily impacted by wood smoke-derived particulate matter (PM). Approximately 1180 old wood stoves were replaced with new EPA-certified wood stoves or other heating sources.

Methods: Ambient and indoor PM concentrations were measured during the changeout program. Parental reporting of children's respiratory symptoms and infections were captured during 4 winter periods. Generalized estimating equations were used to evaluate the change in prevalence of symptoms and infections per 5 $\mu g/m^3$ reduction in ambient $PM_{2.5}$. Risk estimates were adjusted for age, presence of wood stove in home, and annual flu incidence in the community.

Results: By the end of the changeout program, winter period ambient $PM_{2.5}$ was approximately 20% lower than prechanegout levels. Reporting of wheeze and other asthma-related symptoms were lower in the postchangeout winter compared to the first winter period. Preliminary analysis across the 4 winter seasons found the odds ratio (and 95% confidence interval) for 5 $\mu g/m^3$ reduction in $PM_{2.5}$ and reporting of wheeze was 0.75 (0.56–1.00). Associations were also observed for reporting of cold (0.75 [0.60–0.94]) and bronchitis (0.46 [0.27–0.79]). Elevated risk estimates were also observed for some nonrespiratory symptoms for which there were no a priori associations anticipated.

Conclusion: Winter period ambient $PM_{2.5}$ concentrations were substantially reduced following the community-wide wood stove changeout program. Preliminary analyses found associations between change in winter $PM_{2.5}$ concentrations and reporting of some respiratory symptoms and infections. Findings of reductions in additional nonrespiratory symptoms suggest caution in interpreting these results.

This study was funded by the Health Effects Institute.

S-01A7-4

Woodsmoke and Children's Health: Findings From the Border Air Quality Study

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Background/Aims: Residential wood combustion is an important and relatively unregulated contributor to ambient air pollution in both urban and rural areas of many temperate climates. Despite the importance of this source, little research has evaluated the impact of woodsmoke on health, especially in urban areas. Here, we present findings regarding woodsmoke health impacts from the Border Air Quality Study, a population-based study conducted in southwestern British Columbia, Canada.

Methods: Using a previously described (spatial) land use regression model for woodsmoke particulate matter combined with a temporal model predicting woodsmoke from heating degree days, we evaluated impacts on several measures of children's health including small for gestational age birth, infant bronchiolitis, otitis media, and childhood asthma.

Results: Increased woodsmoke exposure (adjusted for covariates relevant to each specific outcome) was associated with increased risks for clinical care visits for bronchiolitis and otitis media, but not for small for gestational age or incident asthma. Woodsmoke exposure was characterized as the number of days with woodsmoke present for those residing in woodsmoke areas, as specified by the spatiotemporal model. For bronchiolitis, an interquartile range increase (45 days) in the number of woodsmoke exposure days in the first year of life (2–12 months) was associated with an odds ratio of 1.08 (1.04–1.11) for a bronchiolitis outpatient visit or hospitalization. For otitis media, an interquartile range increase (16 days) in woodsmoke exposure days in the 2 months prior to an otitis media outpatient visit was associated with an odds ratio of 1.32 (1.27–1.36).

Conclusion: These observations of associations between woodsmoke exposure and 2 pathogen-mediated diseases may represent causal links consistent with toxicological effects of woodsmoke on respiratory health or may be an artifact due to the strong temporal correlation between woodburning and these highly time-varying diseases whose incidence tends to peak in winter

S-01A7-5

Preliminary Results From the Australian Landscape Fire Smoke Project

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Background/Aims: This work is a part of a larger study to retrospectively identify the cause of extreme particulate matter (PM) air pollution events and to assess the health effects of landscape fire smoke in 6 Australian cities occupying 3 distinct bioregions. Here, we present preliminary results for the effects of landscape fire smoke on daily all-cause, cardiovascular and respiratory mortality in Sydney, located in a subtropical bioregion, and surrounded by fire prone eucalypt forest and heath lands.

Methods: Pollution events for PM_{10} and $PM_{2.5}$ were defined as any day from January 1997 through December 2006 where the 24 hour city-wide average concentration was above 99th percentile. These dates were cross-checked against newspaper archives, government agency records, and remote sensing data to evaluate whether they were related to landscape fire smoke, dust, or other sources. A case-crossover design was used to estimate the effects of PM_{10} on daily mortality for landscape fire smoke event days and nonevent days. Effects were adjusted for temperature, dew point temperature, and flu epidemics. Analyses were stratified by age and sex.

Results: Of the 56 days above the PM_{10} 99th percentile, causes for extreme PM concentrations were identified for 86% of the event days and, of these, 98% were attributed to landscape fire smoke. Landscape fire smoke event days (lag 1 day) were associated with a 4.7% (95% confidence interval: 0.1%–9.5%) increase the odds of all-cause mortality. The magnitude of the effect of PM_{10} on mortality was larger on landscape fire smoke event days compared to nonevent days, but neither was statistically significant.

Conclusion: Landscape fire smoke is the primary source of extreme PM pollution in Sydney. Preliminary results suggest that the magnitude of the association between PM_{10} and mortality may be different on landscape fire smoke event days compared to nonevent days.

S-01A7-6

A Geographical Approach to Assessing the Contribution of Domestic Woodsmoke PM_{10} to Respiratory and Cardiovascular Mortality

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Background/Aims: Parts of New Zealand have significant air pollution problems, specifically particulate matter, with which health effects have been associated. The highest pollution levels are found in areas where woodsmoke from domestic home heating is the main source.

Methods: In this research, we used regression-based estimates of particulate matter (PM_{10}) at census area unit level sub-divided by sources of emissions (domestic, vehicle, industry, and background). We divided these into quartiles and compared mortality rates for respiratory and cardiovascular diseases for these quartiles, controlling for age, gender, socioeconomic status, and ethnicity. Then, the mortality rates for different source components were compared to see what impact these have on mortality rates.

Results: Respiratory and cardiovascular mortalities show different associations with the air pollution estimates. This suggests that the source of PM_{10} is important in understanding the nature of the health effects.

Conclusion: This study has used pollution data subdivided into the relevant emissions sources and has found that the contribution of different emissions sources may result in different dose-response health effects.

AIR POLLUTION - EXPOSURE CHARACTERIZATION AND HEALTH EFFECTS

PP-29-001

Effect of Atmospheric Mixing Conditions on Near-highway Air pollutant Gradients

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Background/Aims: High exposure to traffic-generated air pollution, which varies with both traffic and meteorology, may put communities located near highways at risk for adverse health effects. Measuring the effects of atmospheric mixing conditions on near-highway pollution could yield better estimates of human exposure.

The objective was to characterize hourly variation in vehicular pollutant levels along transects on either side of I-93 in Somerville, Massachusetts, as part of the Community Assessment of Freeway Exposure and Health study. Winter and spring days were studied to characterize periods with both high- and low-expected pollutant concentrations, respectively. Monitoring was done during the hours surrounding peak weekday morning traffic and during varying atmospheric mixing as a function of wind speed and temperature.

Methods: A mobile air monitoring laboratory housing rapid-response instruments was used to measure fine and ultrafine particles (7–225 nm), gaseous CO, NO, NO_x, and polycyclic aromatic hydrocarbons. Spatial and temporal variations were assessed by time and location as reported by global positioning system. Temperature and wind conditions were acquired from a weather station located adjacent to the monitoring site.

Results: Maximum particle number, CO, and NO_x concentrations increased by approximately 50% from periods of low atmospheric mixing to mornings with greater mixing properties. Higher levels of pollutants were found in winter compared with spring, with the greatest concentrations before sunrise and peak traffic volume. Pollutant concentrations downwind of I-93 were approximately 5–10 times greater than upwind concentrations. Particles in the 6–25 nm size range comprised approximately 60% of total particles on mornings with low mixing conditions, and approximately 80% during conditions with greater mixing. Pollutant levels decreased with increased distance from I-93.

Conclusion: The results highlight the importance of vertical mixing on early morning levels of highway-related air pollution. Detailed characterization of temporal changes in near-highway communities may lead to more accurate measures of pollutant exposure.

PP-29-002

Effect of Living Close to Major Roadways on the Development of Asthma and Atopic Dermatitis in Children: Longitudinal Analyses of the Children's Health and Environmental Research (CHEER)

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Background/Aims: The objective in our study is to assess the association between individual-based exposure to traffic-related air pollutants and the development of allergy and related symptoms in a prospective children's cohort study in South Korea.

Methods: We studied 2754 children ages 6–8 years from 16 schools in 7 South Korean cities, who were recruited in 2005 and 2006 as part of the first Children's Health and Environmental Research (CHEER) survey. In 2007 and 2008 all children were invited to participate in a follow-up survey. The prevalence of allergic diseases was assessed by an ISAAC questionnaire completed by the parents. We determined estimated 5-year averaged concentrations of air pollutants using measurements from nearby monitoring stations. Residential distances to the nearest major roadway and road density within a 200-m buffer were used as surrogates for traffic-related air pollutants. Subjects reporting symptoms or doctor-diagnosed allergic diseases at follow-up were considered new onset cases. Analyses of odds ratio (OR) were based on logistic regression models.

Results: Urban living less than 75 m from a major roadway was associated with an increased risk of new onset wheeze and new onset doctor-diagnosed atopic dermatitis, adjusted OR = 2.06 (95% CI: 1.07–3.94) and 1.61 (95% CI: 1.01–2.58), respectively, whereas no association was found for new onset allergic rhinitis. Moreover, road density within a 200 m buffer had a dose-response relationship with new onset wheeze and new onset atopic dermatitis. The adjusted OR per increase of 100 m of total length of major roadways within a 200 m buffer was 1.21 (95% CI: 1.05–1.14) for new onset wheeze and 1.09 (95% CI: 0.99–1.20) for doctor-diagnosed atopic dermatitis.

Conclusion: The results suggest that living in close proximity to a major roadway is associated with an increased risk of asthma and atopic dermatitis in school children.

PP-29-003

The Effects of Volatile Organic Compounds Exposure on Inflammation and Oxidative Stress Among Assistants in Hair Salons

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Background/Aims: The association between volatile organic compounds (VOCs) exposure and cardiovascular health remains unclear. The objective of the study is to investigate whether or not exposure to VOCs was associated with inflammation and oxidative stress among assistants working in hair salons in Taipei, Taiwan.

Methods: We recruited 62 young, healthy assistants working in hair salons in Taipei. We made 4 visits in which we took blood samples from each subject. Occupational exposures to VOCs and particulate matter less than 2.5 μm in diameter ($PM_{2.5}$) were measured at each participant's

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workplace. We used linear mixed-effects models to examine the association between blood markers and exposure to VOCs and $PM_{2.5}$ averaged over 1-hour to 8-hour periods prior to taking the physiological measurements.

Results: We found that occupational exposure to VOCs and $PM_{2.5}$ was associated with increases in high-sensitivity C-reactive protein and 8-hydroxy-2′-deoxyguanosine. The association between total VOC exposure and the health parameters we measured remained in our models after adjusting for exposure to $PM_{2.5}$. The effect of VOC exposure on the health parameters measured in this study was greatest during the days on which the subjects were working.

Conclusion: We concluded that occupational exposure to VOCs in hair salons can lead to increases in high-sensitivity C-reactive protein and 8-hydroxy-2′-deoxyguanosine levels. Time spent away from workplace could modify the effects these exposures have on the health parameters described above in this panel of young, healthy assistants.

PP-29-004

Effect of Hourly Concentration of Particulate Matter on Hospitalized Children's Peak Expiratory Flow

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Background/Aims: There is little information about the possible association between hourly short-term air pollution and peak expiratory flow in asthmatic children. We collected and analyzed hourly air pollution data and peak expiratory flow data from asthmatic children.

Methods: Subjects in this study were 17 patients aged 8–15 years with severe asthma who were hospitalized during 1 October 2000 through 24 December 2000. Measurements of peak expiratory flow and particulate matter (PM) were conducted immediately prior to medication twice a day, at 7 AM and 7 PM, under the guidance of trained nurses. The changes in asthmatic children were estimated according to each 10 $\mu g/m^3$ increment in PM with a 50% cut-off aerodynamic diameter of ≤ 2.5 μm ($PM_{2.5}$) adjusted for sex, age at baseline survey, height at baseline survey, and temperature. Lagged-hour exposures of up to 24 hours were examined.

Results: A decline in peak expiratory flow at 7 AM was associated with the hourly concentration of $PM_{2.5}$ during the period from lag 15 to lag 0. The largest effect size was −3.39 L/min (95% CI: −4.31, −2.46) for 10 $\mu g/$ of hourly concentration of $PM_{2.5}$ between 11 pm and 12 pm on the previous night (lag 7). Some of the significant associations remained even after adjustment for other air pollutants.

Conclusion: There was an association between a decline in peak expiratory flow and increased hourly concentration of $PM_{2.5}$ up to 24 hours before peak expiratory flow measurement, especially in the morning.

PP-29-005

The Effect of Radon Air Pollution on the Incidence of Respiratory Diseases

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Background/Aims: To study radioecological conditions in uranium biogeochemical area.

Methods: The present study was carried out in the town of Mayluusuu, Kyrgyzstan. There was an ore mining and processing enterprise in Mayluusuu, which mined uranium between 1946 and 1966. Approximately 2 million cubic meters of radioactive wastes remain in 23 tailing pits and 13 dumps not far from the town and the namesake river. Charcoal traps were used to detect radon concentration in the air.

Results: A total of 40 premises were examined. An increased radon concentration level was revealed in 34 cases. The results of examination of air radon concentration in the town are as follows: M = 511.23 Bq/m^3, max-3000.0, min-92.50, σ-917.19, m-290.04, $P < 0.001$. Respiratory tract tumors in Mayluusuu account for approximately 19.4% of all tumors, and the morbidity rate in the town is markedly higher (29.1 cases) than average republican rate (6.7 cases). The authors distinguish following 3 areas in the town: Area 1—Sary-Bee, located in the upper part of the town, upstream the tailing pits; Area 2—Southern Kairagach, located close to uranium mine; and Area 3—a center of the town. In Area 1, increased radon levels were revealed in 11 (73.33%) out of 15 examined premises: M = 506.16; max = 1024.90; Min-170.20; σ-269.62, M-85.26. In Area 2, in 6 (85.7%) out of 7 examined premises: M = 904.29; max = 3000.00; Min-170.20; σ-892.68; min-282.29. In Area 3, in 16 of 18 cases: M = 364.04; max-651.20; Min-92.50; σ-176.25; M-55.73. In 2009, cancer morbidity rate in Areas 1 and 2 encountered 288.7 cases (17.3—respiratory tumors, 96.2—asthma). Respiratory tumors were diagnosed in 38.7 cases, bronchial asthma—116.2.

Conclusion: Thus, radon air concentration affects the prevalence of respiratory tumors among the local population.

PP-29-006

Ultrafine Particle Exposure During Transit

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Background/Aims: The exposure of humans to ultrafine (<100 nm) particles (UFPs) is increasingly thought to be implicated in a range of undesirable acute and chronic health effects. Given the proximity to vehicle emissions typical of most transport modes, exposures incurred during transit activities have the potential to constitute a large proportion of daily UFP exposure. We conducted an extensive study aimed at quantifying UFP exposures and their determinants inside automobiles.

Methods: We performed alternate measurements of UFPs outside and inside of the cabin of 5 automobiles during trips through a 4-km road tunnel. These measurements were conducted under 4 ventilation settings, and the outdoor air ventilation rate was determined for each of these on open roadways using sulfur hexafluoride tracer gas methods.

Results: We found that outdoor ventilation rates explained 81% of variation in on-road UFP ingress (measured as I/O ratio) into our group of test automobiles, and were strong determinants of in-cabin UFP exposure. The minimum average UFP concentration measured during tunnel travel (34,000 particles per cm^3) was recorded under a recirculation setting in a new vehicle, while the maximum average recorded (790,000 particles per cm^3) was recorded under an outdoor air take setting in an older vehicle. UFP exposures reported for transit activities were collected from the literature (approximately 40 studies) and grouped by mode. Average exposures incurred during non-tunnel automobile travel were elevated compared to those reported for bus, train/subway, walking, cycling, trams, and ferries by factors of 1.8, 2.4, 1.3, 1.6, 5.9, and 1.5, respectively. These increases were approximately 4 times greater when automobile travel through road tunnels was considered as the reference case.

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Conclusion: These findings suggest UFP exposures incurred inside automobiles during tunnel travel are substantially elevated compared to those in non-tunnel locations, and strongly related to vehicle ventilation setting and age.

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PP-29-007

Effect of Antioxidant Supplementation on Employees' Sick Building Syndrome Frequencies in Jakarta, Indonesia (A Community Trial)

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Background/Aims: Environmental pollution has become a serious problem in many big cities. Indoor air pollutants are produced by ambient pollutants, cigarette smoke, printers, photocopy machines, production machines, and employees. Air pollution and cigarette smoke generates health damaging free radicals and have a negative impact on human health. Nutritional antioxidants can neutralize free radicals, and therefore have the potential to ameliorate the negative effects of pollution on health. This study investigates the effects of intervention with supplement containing antioxidants on the frequency of Sick Building Syndrome (SBS) in employees in Jakarta, Indonesia. The supplement used consisted of vitamins A, D, E, C, B6, B12, folate, selenium, zinc, iron, and copper.
Methods: The research was conducted in 350 employees (30–50 years) in 18 different companies in Jakarta. Of total, 11 companies were picked randomly whose employees were given the supplement to be consumed daily for 3 months. Meanwhile, employees from 7 other companies not consuming the supplement served as the control group.
Results: The results showed that 50% of employees experienced SBS but major differences were seen between the supplement and the control groups. The antioxidant supplement was proven to significantly reduce the frequencies: 49% less headache, 45% less watery eyes, 52% less nasal congestion, 27% less respiratory infection, and 41% less fatigue. Overall, the results showed that those employees who consumed the supplement experienced 50% less SBS frequencies.
Conclusion: In conclusion, 3-month supplementation containing antioxidants resulted in a significant reduction of SBS frequencies in employees working at high buildings in Jakarta.

PP-29-008

Illnesses, Signs, and Symptoms Related to High Levels of Exposure of PM_{10} and Ozone, Guadalajara, México

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Background/Aims: Human exposure to high levels of particulate matter (PM_{10}) and Ozone pollution is related to the presence of certain illnesses, signs, and symptoms (ISS). The aims of this study were to identify ISS shown by the inhabitants of Guadalajara's Metropolitan area, who have been exposed to air pollutants, which frequently exceed the safety levels of Mexican Standards (PM_{10} and Ozone).
Methods: This is an observational, descriptive, and transversal study. Samples were collected from 414 dwellings and a direct survey was applied to identify, by means of self-reporting, the presence of ISS related to exposure to PM_{10} and Ozone. The variables analyzed were (*a*) time of residence, (*b*) a smoker within the dwelling, (*c*) illnesses of a family member, (*d*) month of the year during which the illness was suffered, and (*e*) signs and symptoms related to exposure. A descriptive analysis was conducted, using frequency distributions, percentages, and summary measurements.
Results: In all, 59.7% stated having resided in the area studied for over 20 years. In 48% of the dwellings, at least one family member smoked. The illnesses reported, in order of importance, were bronchitis (41.4%), high blood pressure (37.8%), and rhinitis (32%). Those months of the ear when illnesses occurred more frequently were December with 55.2%, April 28%, and January 25.1%. The signs and symptoms mentioned by the population were teary and burning eyes in 79.2%, throat ache in 74.9%, headache in 70.8%, nose irritation 65.7%, fatigue 51%, skin irritation 28.8%, and aching chest/chest pains 22.3%.
Conclusion: The 2 health conditions most affected were those of the respiratory system and the cardiovascular system, which according the inhabitants, bronchitis and high blood pressure with 41.4% and 37.8%, respectively were the illnesses suffered most frequently. The signs and symptoms they reported, confirms the presence of illnesses and symptoms most frequently mentioned in scientific literature on exposure to PM_{10} and Ozone.

PP-29-009

Health Risk Assessment of Personal Exposure to Volatile Organic Compounds in Tianjin, China

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Background/Aims: Exposure to volatile organic compounds (VOCs) can induce a range of adverse human health effects, and draw considerable concern in exposure science. To date, however, personal VOCs exposure and residential indoor and outdoor VOCs levels have not been characterized in the mainland of China, less is known about health risk of personal exposure to VOCs.
Methods: In this study, a pilot study was conducted to assess personal exposure to VOCs, and US Environmental Protection Agencys unit risk value was used to assess the inhalation caner health risk. To assess uncertainty of health risk estimate, the Monte Carlo simulation and sensitivity analysis were implemented using Crystal Ball 7.2 software. Personal exposure to 10 VOCs was measured, and simultaneously compared with residential indoor and outdoor VOCs concentrations, workplace and vehicle microenvironment concentrations in Tianjin, China. All VOCs samples were collected using passive samplers for 5 days, and were analyzed using Gas Chromatograph-Mass Spectrometer.
Results: As expected for most of the VOC, personal exposures were greater than residential Indoor concentrations, with the exception of carbon tetrachloride. Results of exposure assessment show modeled and measured concentrations are statistically lineally correlated for all VOCs ($P < 0.01$), except chloroform. According to the risk assessment results, benzene, chloroform, 1,3-Butadiene presented the highest cancer risks of 52, 21 per 1 million population based on personal exposure, respectively. The average cumulative cancer risk based on personal exposure was approximately 78 per million, followed by indoor exposure (57 per million).
Conclusion: Accurate exposure estimates are critical inputs to risk assessment in evaluating the severity and probability of health impact. The combination of personal exposure monitoring and risk assessment would possibly reduce some of the current uncertainty associated with risk estimates.

PP-29-010

A Portable Device Capable to Deliver to the Airways Filtered Air With a Submicrometric Particle Removal Efficiency of About 90%

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Background/Aims: Protecting children and respiratory patients from exposure to airborne pollutants is mandatory. The aim of this study is to

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check the efficiency of a portable device designed to deliver filtered air to the airways.

Methods: The device delivers 60 L/min of ambient filtered air via a short pipe to a plastic mask partially covering nose and mouth. Filtered air was delivered at 3 cm from the nose of a head model. Sampling point was fixed inside the model nostrils. The number of particles/L was measured with a particle profiler (Model 212, Metone) with a sampling time of 10. Particle classes sized 0.3–0.5, 0.5–0.7, 0.7–1.0, 1.0–2.0, 2.0–3.0, 3.0–5.0, and 5.0–10 μm were studied.

Results: Mean number of particles 0.3–0.5 μm was 58,856/L and 7321, for background and filtered air, respectively. Overall efficiency rate ranged 87.6%–94.1%.

Conclusion: The efficiency of the device in delivering clean air to the nose in our experimental setting is promising for testing in the real world and in a clinical setting.

PP-29-012

Temperature, Air Pollution, and Mortality During the 2008 Beijing Olympic Games

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Background/Aims: The aim of this study was to analyze temperature, air pollution, and mortality during the period 1 May 2008–20 September 2008, and to test whether source controls imposed prior to and during the Beijing 2008 Summer Olympic Games led to decreased levels of pollution and mortality.

Methods: The daily mortality, temperature, particulate matter (PM_{10}) and ozone observed during the 2008 Beijing Olympic Games source control period (20 July 2008–20 September 2008) were compared with those recorded in the period 1 May 2008–19 July 2008, labeled "baseline." The influence of temperature and air pollution variables, as well as the source control period, on daily mortality was analyzed using Poisson regression models.

Results: During the source control period, average daily PM_{10} concentrations decreased 45.3% (89.5 vs. 163.5 $\mu g/m^3$) compared to baseline. Average daily temperature increased 10.6% compared to baseline (25.1 vs. 22.7°C). Average daily ozone concentrations increased 2.3% compared to baseline (43.6 vs. 42.6 $\mu g/m^3$). During the source control period, daily total mortality was not significantly different as compared with the baseline period (110 vs. 109). Analyzed separately in Poisson regression models controlling for periodic effects, PM_{10}, ozone, and temperature were each significantly associated with daily mortality. An increase in average daily ozone and PM_{10} concentration by 10 $\mu g/m^3$ was associated with the 2.3% and 0.2% increase in total mortality, respectively. An increase in average daily temperature by 1°C was associated with a 1.1% increase in total mortality. However, when all 3 factors were considered simultaneously, only temperature remained associated with mortality, indicating excess mortality of 0.6% per 1°C.

Conclusion: Efforts for source control measures in Beijing during the Olympic Games resulted in decreased PM_{10} concentration. However, daily mortality did not decrease. The large increase in daily temperatures during the source control period, combined with a strong mortality effect of temperature, may be responsible for these counterintuitive findings.

PP-29-013

Health Risk of Air Pollution Exposure to the Elderly in China

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Background/Aims: Declining birth and mortality rates bring more aging population in many countries sooner or later. More than 8.3% of the 1.3-billion Chinese are above 65. About two-thirds of the elderly is not in good health condition. Death in the elderly accounted for 86.71% of the total death population. Prevalence of chronic diseases of the elderly is 3.2 times that of all people. According to the research, air pollution is a big issue and a certain contributing factor to the health of the elderly.

Methods: Outdoor, indoor, and personal particulate matter (PM_{10}) samples of a panel-study (80 old people aged 65–75) were collected on prebaked Teflon and quartz filters in summer and winter 2009 during the Program of Prestudy of Air Quality Criteria for PM at the Tianjin site in China. The mass concentrations were measured under specific temperature and humidity. Organic carbon (OC) and elemental carbon (EC) were analyzed by the thermal optical reflectance method following the IMPROVE protocol. Due to people spending different time in microenvironments, personal exposure was more complicated than expected. So, relationship analysis among outdoor, indoor, and personal PM_{10} and carbonaceous species were made in order to explain the true level of total exposure.

Results: Results come out those concentrations of personal PM_{10} varied between arrange of 50.30–376.52 $\mu g/m^3$. A long-term average concentrations of outdoor, indoor, and personal PM_{10} were 155.27 $\pm$ 61.70 $\mu g/m^3$, 113.11 $\pm$ 47.78 $\mu g/m^3$, and 174.86 $\pm$ 83.37 $\mu g/m^3$ in summer, 178.78 $\pm$ 81.60 $\mu g/m^3$, 173.68 $\pm$ 39.96 $\mu g/m^3$, and 192.37 $\pm$ 128.27 $\mu g/m^3$ in winter, respectively. OC made up the majority of TC and accounted for 12%–30% of mass concentration of PM_{10}. The average OC concentrations of outdoor, indoor, and personal exposure are 18.62 $\pm$ 6.46 $\mu g/m^3$, 24.09 $\pm$ 9.03 $\mu g/m^3$, and 33.83 $\pm$ 8.59 $\mu g/m^3$ in summer, 46.02 $\pm$ 25.06 $\mu g/m^3$, 46.43 $\pm$ 17.54 $\mu g/m^3$, and 64.16 $\pm$ 25.06 $\mu g/m^3$ in winter, respectively. The average OC/EC ratio of outdoor, indoor, and personal exposure are 3.90, 4.65, and 7.03 in summer, 3.25, 4.51 and 5.58 in winter, respectively.

Conclusion: Obviously, PM_{10} pollution in winter was more serious because of heating and insufficient ventilation. It also showed that personal PM_{10} exposure level was higher than others, suggesting the existence of exposure error in the environmental epidemiological study. Indoor source was the dominant contributor to the OC, and the ratio of OC/EC exceeding 2 also suggested the presence of secondary organic carbon.

PP-29-014

Comparison of Peak Expiratory Flow Rate Variability Between Asthmatics and Healthy Individuals of Chennai City, India

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Background/Aims: Peak expiratory flow rate (PEFR), a lung function parameter is a reliable indicator of variability in airway caliber. It follows a specific pattern of variability in asthmatics as well as in healthy individuals. Variability in PEFR (PEFvar) could be due to susceptibility to increased bronchial responsiveness and it may be influenced by external factors. This study was aimed at comparing the diurnal variation in the PEFR of healthy subjects and asthmatics.

Methods: PEFR was measured in 24 healthy subjects and 26 asthmatics using Wright's peak flow meter twice daily for a 4-week period in the month of September. On each day, 3 measurements were carried out at 6

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AM in the morning and at 6 PM in the evening and best of the 3 measurements were taken for calculating the PEFR variability. Amplitude percent mean (A%M), is the index used for expressing the PEFR diurnal variability in this study. A%M is a common index used in several previous studies (Higgins 1997).

Results: The PEFvar was significantly higher in asthmatics (6.67) when compared to healthy individuals (4.39). Similar result was observed in the child panel too. PEFvar of the asthmatic children (11.07) was significantly high when compared with healthy children (5.755). Among the asthmatic panel, males (13.22) had higher PEFR variability than females (8.85).

Conclusion: Measurement of diurnal variability of PEFR serves as a valuable and reliable tool for asthma screening, diagnosis, and prognosis. Daily PEFR monitoring is a useful measure for clinician for providing appropriate dose of the asthma medication. This study results are being used in an ongoing study for evaluating the effects of ozone on exacerbation of asthma. This study has provided the insights required for choosing and sustaining the panel of asthmatics for the ongoing air pollution study.

PP-29-015

Relationship Between PM_{10} Exposure and Time-activity Diary for the Elderly in Tianjin, China

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Background/Aims: Particulate matter (PM_{10}) is the primary pollutant in most parts of China. Epidemiological studies of PM_{10} have associated PM_{10} mass, as well as certain individual components such as secondary particulate (expressed as SO_4^{2-} and NO_3^-) with adverse human health effect. Exposure varied as people had different daily habits, while the relationship between personal exposure and time-activity patterns of the elderly is not clear.

Methods: A pilot study investigating potential PM_{10} exposures of an elderly population was conducted in summer in Tianjin, China. We chose 81 people (older than 65) carrying with 2 samplers with teflon and quartz filters (2 L/min) each to get the samples, meanwhile, indoor and outdoor samples were also collected. PM_{10} mass concentrations were determined by gravimetric analysis, while inorganic chemical speciation was analyzed using ion chromatography.

Results: The PM_{10} mass concentrations (personal exposure) ranged from 60 to 447 $\mu g/m^3$, The ion-analysis results indicated that SO_4^{2-} (personal exposure) presented the first highest level of concentration in PM_{10} (47.85% of the ion mass), while NO_3^-, NH_4^+ and Ca_2^+ are the second highest level of chemicals followed by K^+, Na^+. . ..

Conclusion: By comparing the personal time-activity diary with the PM_{10} mass and water-soluble ions concentrations, we found that tobacco smoking, cooking, outdoor activities taking may affect the elderly exposure.

PP-29-016

Characteristics of $PM_{2.5}$ in Taiwan's 3 Largest Cities During 2006–2009

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Background/Aims: Many studies show that particulate matter ($PM_{2.5}$) is a cause of health problem, especially the respiratory system. We evaluate the air quality standard of $PM_{2.5}$ in Taiwan and also put emphasis on the variation of $PM_{2.5}$ in the 3 largest cities during 2006–2009.

Methods: A single air quality monitoring station is chosen for each of the 3 major cities (Taipei, Taichung, and Kaohsiung) during 2006–2009. The exceedances of $PM_{2.5}$ daily means greater than 35 $\mu g/m^3$, 50 $\mu g/m^3$, and 65 $\mu g/m^3$, respectively, and PM_{10} greater National air quality standard of 125 $\mu g/m^3$ are evaluated in this study.

Results: During 2006–2009, increasing levels of $PM_{2.5}$ concentration were observed in the 3 major cities of Taiwan. $PM_{2.5}$ concentration levels during different seasons showed similar fluctuations between the 3 major cities. Winter season between December and January of the following year yielded the highest concentration levels, and summer between the months of June to August yielded the lowest concentration. Taipei and Taichung were observed to have higher concentration levels during sandstorms occurring in the month of March. The exceedances of $PM_{2.5} > 65$ $\mu g/m^3$ set as a standard were as follows: Taipei 1.93%–7.23%, Taichung 7.29%–9.59%, and Kaohsiung 25%–28.17%. The exceedances of PM_{10} for 125 $\mu g/m^3$ were as follows: Taipei 1.11%–1.69%, Taichung 1.38%–3.93%, and Kaohsiung 10.14%–13.33%. When both standards are compared we see that they are similar.

Conclusion: If a limit value should be set in the future for $PM_{2.5}$, it is suggested that the limit value be set at 50 $\mu g/m^3$ as a standard; 65 $\mu g/m^3$ as a suggested limit value would be too loose, while a 35 $\mu g/m^3$ standard would be too strict and cannot be reached anytime soon.

PP-29-017

Exposure to Particulate Matter, Kathmandu Valley, Nepal

Anobha Gurung and Michelle Bell *Yale University, New Haven, CT.*

Abstract:

Background/Aims: Air pollution, especially from traffic, is a serious problem in Kathmandu Valley. The project compared personal particulate matter ($PM_{2.5}$) exposure and respiratory health based on occupation and roadway proximity. Additionally, temporal and spatial trends for ambient PM_{10} were examined.

Methods: We investigated personal $PM_{2.5}$ exposure and respiratory health for 3 groups: (1) traffic personnel (TP), (2) indoor officer workers near main roads (IOW_NMR), (3) indoor office workers away from main roads (IOW_AMR). At 3 locations (urban, urban residential, and semiurban), we recruited 6 TP, 3 IOW_NMR, and 3 IOW_AMR. For each participant, personal $PM_{2.5}$ monitoring, time activity dairy, respiratory health questionnaire, and spirometer test was performed from 28 June 2009 to 7 August 2009. Traffic count was measured during peak traffic hours. Ambient PM_{10} data (2002–2007) from 6 government monitoring sites was assessed for temporal and spatial variation.

Results: TP had the highest average $PM_{2.5}$ exposure (50.16 $\mu g/m^a$) with 78.3% of study days exceeding World Health Organization guidelines (25 $\mu g/m^a$). The IOW_NMR average $PM_{2.5}$ levels were 46.18 $\mu g/m^a$, with 53.9% of days exceeding guidelines. The IOW_AMR had the lowest levels at 25.23 $\mu g/m^a$, exceeding guidelines on 20.8% of days. Exposure was higher during morning rush hours than evening rush hours for all participant types and areas (71.9% of days for TP; 83.9% for IOW at urban settings). Similar prevalence of respiratory symptoms and lung function was observed across participant types. A weak association was noted between $PM_{2.5}$ and lung function. Government PM_{10} monitors from 2003 to 2007 exceeded Nepal's daily PM_{10} standard (120 $\mu g/m^a$) 48.8%–80.5% of days annually for inner and 3.36%–29.3% for outer city sites.

Conclusion: High $PM_{2.5}$ exposure was observed, with levels differing by location, time of day, and occupation. Findings indicate that air pollution is likely to have substantial health impacts in this region, especially for traffic police. A larger dataset is required to evaluate links between air pollution and health.

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PP-29-018

Measurement Technology of Dry Etching Chlorinated Byproducts and Improvement Strategy in Thin Film Transistor Liquid Crystal Display Production

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Background/Aims: The advanced TFT-LCD processes, dry etching of thin film layers is increasingly preferred instead of conventional wet etching processes for new process. The previous studies are focus on greenhouse gases removal efficiency by scrubber, and indicate potential fluorinated or chlorinated compounds of the material being etched. The environment, safety, and health difficult challenges are lack of information on how the chemicals and materials are used and what process byproducts are formed, additional needs are characterizing and controlling plasma etches gas emissions and byproducts.

Methods: The thermal processing unit consists of an oxide combustion chamber, a wet scrubber, a vacuum pump, and temperature/pressure control system, integrated in an enclosed unit. Determination of dry etching gas and byproducts using an online extractive Fourier transform infrared spectroscopy and canister sampling/gas chromatography-mass spectrometry method. A portable photo ionization detector used to detect total volatile organic compounds after scrubber. We found sulfur hexafluoride etching gas and 3 byproducts, including sulfur dioxide, ethylene, and hydrogen chloride by FTIR. There were 14 unknown and 6 byproducts before TPU, and 13 byproducts after TPU by Gas Chromatograph-Mass Spectrometer.

Results: We found that the scrubber has high destruction removal efficiency for dry etching unknown byproducts at 1000°C. The temperature of partial combustion reactor processing equipment less than 750°C, toxic chlorinated byproducts would be generated after TPU. In this study, we found 34 chlorinated byproducts at abnormal local scrubber. The portable photoionization detector screen method is able to find abnormal scrubber, the concentration of total volatile organic compounds more than normal scrubber after TPU.

Conclusion: We have established the dry etching chlorinated byproducts measurement technology and improvement strategy for local scrubber. When the local scrubber was not well maintained, toxic chlorinated byproducts would be generated. The screen method is able to screen out and modify the abnormal local scrubber for improvement.

PP-29-019

Ambient Air Pollution and Lung Function Among Children in 4 Cities in China (1993–1996)

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Background/Aims: Exposure to ambient air pollution has been associated with decreased lung function among children in many populations. However, few studies have explored the effect of ambient air pollution on lung function at higher exposure levels. The aim of the study was to examine the relationship between air pollution and lung function among children in China (1993–1996) in a prospective study.

Methods: Children (n = 3512) aged 6–13 years were recruited from 8 schools in 4 cities in China. Lung function was measured using Computerized Collins Survey II spirometers 2 times a year for 4 years (1993–1996). Ambient air concentration of NOx, SO_2 were obtained from the nearest municipal air pollution monitoring stations. Dichotomous samplers (model 241; Sierra-Anderson, Atlanta, GA) placed in each schoolyard were used to measure particulate matter ($PM_{2.5}$) and $PM_{2.5-10}$ levels. Multivariable generalized estimating equations, accounting for multilevel structure and longitudinal design of the study, were used to examine explore the association between the quarterly average air pollution levels and lung function (FEV1, FVC, and FEV1/FVC).

Results: Annual average $PM_{2.5}$ levels in the 4 cities ranged from 57.07 to 158.09 $\mu g/m^3$. Other pollutants were also higher than most reported studies and varied largely across the 4 cities. After accounting for age, sex, height, weight, time trend, an increase of 10 $\mu g/m^3$ of $PM_{2.5}$ was associated with a decrease in 1.41 mL of FEV1 ($P < 0.05$) for FEV, FVC, and FEV1-FVC ratio, indicating that each of the air pollutants significantly affect lung function growth rates.

Conclusion: Exposure to ambient air pollution is associated with decreased lung function as well as decreased growth in lung function among Chinese children.

PP-29-020

VOC Concentrations at a Residential Site and at Windsor International Airport, Ontario, Canada

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Background/Aims: An air monitoring study was conducted in Windsor (Ontario, Canada) at 5 outdoor sites in November, 2007.

Methods: Four of the sites were located at the Windsor International Airport. The fifth site (SW) was located in a residential area within 500 m of 2 elementary schools and 800 m of the 2 busiest roads in Windsor. This site was approximately 10 km away from the airport. Summa canisters of 6 L were used to collect air samples in 3 periods of 6 days. The samples were analyzed by a Gas Chromatograph-Mass Spectrometer (GC-MS) to determine the concentrations of 168 volatile organic compounds (VOCs). The average concentrations for each site per VOC were used to calculate a maximum to minimum concentration ratio; the maximum concentration of a specific VOC was divided by its lowest concentration. Based on the ratio for each VOC, the first, third, and interquartile range was determined. The group of 35 high ratio compounds, which exhibited the highest site to site variance of concentration, was further investigated using the National Pollutant Release Inventory to identify major VOC sources.

Results: Of the 35 compounds, 23 were found to be highest at SW. Due to traffic emissions, benzene, toluene, ethyl benzene, and (o-, m-, p-) xylene had the highest concentration in SW. Also, methanol, MEK, MIBK were found to have the highest concentration at the SW site, which is attributed to an industrial facility within 1.5 km. The concentration of styrene was highest at the sampling site between the airport parking lot and the terminals. This was likely the result of the constant movement of vehicles and taxiing of aircrafts, which release styrene through the tires. Jet fuel emissions led to high concentrations of pentane and isobutylaldehyde at the airport.

Conclusion: It was found that the proximity of industrial sources and vehicle-related pollution to the sampling sites was a key factor.

PP-29-021

Ros Generation and Cell Toxicity of BEAS-2B-cell-treated Particulate Matter in Ambient Air

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Background/Aims: The aim of this study was to investigate the in-vitro responses of BEAS-2B after exposure to ambient particulate matter and DEP.

Methods: Accordingly, the damaging effects were analyzed, and the reactive oxygen species of particulate matter and DEP and their extractable water-soluble material and extractable organic material were analyzed on human epithelial cells based on both their size and the season.

Results: The results of this study showed that the toxicity of the small organic material in winter is higher than that of the large water-soluble material in summer. The materials were compared in terms of their cell death rather than their survival rate. The degrees of toxicity were found to be insignificant, but the effect was seen more sensitively by estimating the reactive oxygen species to present the damage on living cells or the result of glutathione reduction. In the estimation of the reduction of glutathione, the generation rate was higher and it gradually decreased as the concentration decreased, so it is advantageous when testing low concentrations of toxicity.

Conclusion: In conclusion, it is expected that the effect can be more accurately analyzed if the toxicity is estimated by merging the aforementioned 2 methods based on survival rate evaluation.

PP-29-022

Air Pollution and Lung-function Growth Among School Children: a 3-year Cohort Study in Taiwan

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Background/Aims: Previous studies on the role of children exposure to ambient air pollution in the deficits of lung-function growth provided suggestive, but inconclusive results. The objective of study was to assess the relation between exposure to air pollution and lung-function growth among school children.

Methods: We conducted a 3-year cohort study among Taiwanese children. The study population consisted of 1565 boys and 1424 girls. Routine air-pollution monitoring data were used for sulfur dioxide (SO_2), nitrogen dioxides (NO_2), ozone (O_3), carbon monoxide, and particles with an aerodynamic diameter of 2.5 μm or less ($PM_{2.5}$). The exposure parameters were calculated using the 3-year average concentration. The effect estimates were presented as difference in annual percent lung function growth rates (%) per interquartile changes for SO_2, NO_2, and O_3, carbon monoxide, and $PM_{2.5}$.

Results: Significant deficits in lung function growth rate for boys were related to O_3 and $PM_{2.5}$. For example, the effect estimates of O_3 per 10.91 ppb average annual lung function growth rates of force expiratory volume in 1 second and maximal midexpiratory flow were −1.42 (95% confidence interval [CI] = −2.38 to −0.46) and −2.34 (95% CI = −4.07 to −0.61), respectively, whereas exposure to $PM_{2.5}$ per 17.52 $\mu g/m^3$ was associated with reduced growth in peak flow rate (95% CI = −7.84 to −2.22) and force vital capacity (95% CI = −3.44 to −1.11). In girls, the declined lung function growth rate was related to NOx, O_3, and $PM_{2.5}$.

Conclusion: Our prospective cohort study provides evidence that children exposure to ambient air pollutants (O_3, $PM_{2.5}$, and NOx) was an important determinant of deficits in lung function growth.

PP-29-023

Characteristics of Metals for Ultrafine Particles From Nearby Traffic in Urban Air in Seoul

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Background/Aims: There has been given increasing attention to atmospheric ultrafine and nanoparticle in recent decade. Several epidemiologic studies have shown that exposure to ultrafine particles can lead to adverse health effects.

The aim of this study was to understand the particle- or mass-size distributions and chemical properties in the urban area in Korea.

Methods: To characterize the mass-size distributions of water-soluble inorganic associated with urban particulate matter (PM), the PM samples were collected by a 10-stage Micro-orifice Uniform Deposit Impactors (Models 110, MSP) from nearby traffic in urban area in Seoul between December 2007 and June 2009. The flow rate was 30 L/min, and ranges of available cut size diameter were 18–10, 10–5.6, 5.6–3.2, 3.2–1.8, 1.8–1.0, 1.0–0.56, 0.56–0.32, 0.32–0.18, 0.18–0.1, and 0.1–0.056 μm of particle equivalent aerodynamic diameter.

Sample preparation method for 18 elements (P, S, Cl, Ti, V, Ni, Cu, Zn, Se, Ba, Pb, Ca, Fe, Na, Al, K) was nitric acid digestion with microwave. The digested samples were then analyzed by inductively coupled plasma mass spectrometry.

Results: Total concentrations of all size fraction ranged from 16.96 to 91.79 $\mu g/m^3$ and average concentration of PM is 42.66 $\mu g/m^3$. The size distribution of PM was bimodal with peaks at 0.18–0.32 and 1.8–3.2 μm. On average, 16.9% and 62.6% of the mass of PM_{10} particles were found to be <0.1 μm (transient nuclei mode). The mass proportions of fine particles (0.1–1.8 μm) for the pollutants related to traffic emission, Pb (74.5%), Cu (48.1%), and Ba (49.1%), were higher than those for other metals.

Conclusion: The results of this study agree with previous reports. The level of fine particles in weekends was smaller than that of weekdays. The ultrafine particles were found to contain more of traffic-related metals (Pb, Cu, Zn, Ba, and Ni) than particles of other metals.

PP-29-024

Seasonal Effect of Ozone Concentrations on Mortality in 9 French Cities

Mathilde Pascal,[1] Edouard Chatignoux,[2] Vérène Wagner,[1] Myriam Blanchard,[1] Magali Corso,[1] Grégoire Falq,[1] Sabine Host,[2] Sophie Larrieu,[1] Laurence Pascal,[1] and Christophe Declercq[1] *[1]French Institute for Public Health Surveillance, Saint Maurice, France; and [2]Ile de France Health Regional Observatory, Paris, France.*

Background/Aims: Many studies have established the relationship between ozone and short-term mortality. In the present study, we used several strategies to control for time trends and temperature, and we explored the interaction between ozone and season in 9 French cities during the 1998–2006 period.

Methods: For each city, the association between daily max-8 hour ozone and daily number of nonaccidental deaths was analyzed using 3 statistical methods: (*a*) a Poisson generalized additive model (GAM) controlling for long-term trends, seasonality, and day of the week, (*b*) a time-stratified case-crossover design, (*c*) a temperature-stratified case-crossover design. The models included ozone lag 0–1, minimum temperature at lag 0, and mean maximum temperature over lags 1–7. The modifying effect of season was studied with ozone–season interaction terms in the GAM models and by stratified analyses in case-crossover models. City specific results were then combined using random effect models.

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Results: Results of the 3 modeling strategies were very similar. In the whole study period, the daily number of deaths increased by 0.64% (95% CI: 0.46–0.82) for an increase of 10 $\mu g/m^3$ in the max-8 hour ozone level in the GAM model. The increase was slightly higher in the time-stratified (0.69% [95% CI: 0.52–0.86]) and in the temperature-stratified case-crossover models (0.73% [95% CI: 0.42–1.04]).

In the 3 models, the effect of the ozone was higher during summer (June-July-August), with an increase by 1.17% (95% CI: 0.81–1.54) in the GAM model, 1.00% (95% CI: 0.73–1.27) in the time-stratified case-crossover design, and 1.22% (95% CI: 0.87–1.57) in the temperature-stratified case-crossover design.

Conclusion: This study provides evidence that the association between ozone and mortality is not sensitive to the way time trends and temperature are controlled. The effect of ozone varies with season and is higher in summer.

PP-29-025

Effects on Neurobehavior for Residents Residing Near Petrochemical Industrial Estate in Rayong Province, Thailand

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Background/Aims: Petrochemical industrial estate located in Rayong Province, Thailand, inhabits more than 60 petrochemical plants with a plan to be the hub for petrochemical industry in Southeast Asia. Air quality monitoring data indicate high levels of benzene, vinyl chloride, chloroform, and ethylene dichloride exceeding US Environmental Protection Agency standards. This study examines the risk of presenting neurobehavior symptoms for residence living near the petrochemical industry.

Methods: We examined a total of 24,980 subjects participating in a population-based study. Of these, 17,515 residents, aged ≥13, living within 10-km radius from the petrochemical industrial estate consented to answer questions regarding presence of neurobehavioral symptoms; and a random sample of 5268 subjects with aged 6–50 years consented to participate in the neuropsychological tests (Wechsler Intelligence Scale for Children-III and Wechsler Adult Intelligence Scale-III, Trail making, and Symptom Checklist-90 Revised). Distance was used as a surrogate exposure measurement. Geocoding addresses were used to measure distance from study subjects' residence to the center point of the petrochemical industrial estate.

Results: After adjusting for confounding factors, consistent effects of living in proximity to the industrial estate on the performance of neuropsychological tests and the presence of neurobehavioral symptoms were found. Those who live closer to industrial estate performed poorer on tests that assessed eye-hand coordination, short-term recall, and hand and eye movement responsiveness. Additionally, those who live less than 3 km from the center of industrial estate were more likely to exhibit forgetfulness, anxiety, depression, loss of concentration, and detection of chemical odor with adjusted odds ratio and corresponding CI of 1.61 (1.37–1.87), 1.35 (1.12–1.61), 1.34, (1.00–1.79), 1.68 (1.33–2.13), and 4.19 (4.16–5.81); respectively. Moreover, these symptoms showed a statistical significant dose-response relationship of residential distance from the petrochemical industrial estate.

Conclusion: In conclusion, this study was the first study to document the health effects of living near petrochemical industry in Thailand.

PP-29-026

Smoking in Car: Monitoring Pollution of Particulate Matter as Mass and as Particle Number, of Organic Volatile Compounds and of Carbon Monoxide. Evaluating the Most Suitable ETS Marker, and the Effect of Opening the Driver's Window

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Background/Aims: Smoking in car results in extremely high levels of pollutants from environmental tobacco smoke (ETS), dangerous for the health of children and sensitive groups. Smokers believe that collecting pollutants inside the car can be prevented by opening the window. The aim of this study is to identify the most sensitive marker for ETS inside a car, and to verify the efficacy of opening the window.

Methods: We used real time analyzers to measure the following: (*a*) particulate matter (PM) as mass (g/m^3), (*b*) as > 0.3 e > 0.4 m particle number, (*c*) number of particles 0.3–0.4 m in diameter, (*d*) total organic volatile compounds, (*e*) carbon monoxide (CO). The recordings were carried out inside a car at the speed of 50 km/h, with controlled conditions of temperature and relative humidity.

Results: After lighting a cigarette, with window closed, the levels of all the pollutants increased dramatically, up to 700 g/m^3 for $PM_{2.5}$ and PM_{10}, and of over 600.000 particles/L, whereas total organic volatile compounds reached values of 6000 g/m^3 and CO up to 6 ppm. When a cigarette was lit with the window open partially, excess pollution was promptly recorded, although less intense. With the window completely open, ETS contributed scantly to all pollutants, except for particle number, which increased dramatically to >300.000/L.

Conclusion: Smoking just a cigarette in car represents an extremely high exposure to ETS. Partially opening the window is useless to prevent the accumulation of pollutants. Complete window opening is helpful to remove coarse PM and volatile pollutants, but is ineffective against submicrometric particles.

PP-29-028

Comparison of Health Effects From Exposure to Air Pollution Derived From Combustion of Fossil Fuels and Biomass Burning in Brazil

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Background/Aims: To analyze the scientific literature for studies about air pollution, especially particulate matter (PM) and their health respiratory effects during the period 2000–2009, in Brazil.

Methods: This paper is a systematic review of the literature, performed in electronic databases about research associated with the emission of air pollution in Brazil, comparing different sources of emissions: combustion fossil fuel and biomass burning. The searches prioritized publications that described the physical and chemical properties of pollutants emitted by burning biomass in relation to those from stationary sources or automobiles. The behavior and physicochemical characteristics were contextualized based on the potential adverse effects in the respiratory system.

Results: Studies that related the physicochemical properties of pollutants emitted by biomass burning were published more frequently, whereas the studies that related health effects have explored more metropolitan

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regions. The maximum levels of PM_{10} and $PM_{2.5}$ in areas with industrial emissions and automobiles were less than those in regions of biomass burning. The particulate mass consists predominantly of organic material and 20% inorganic elements in metropolitan regions and areas of biomass burning. High concentrations of metals (Zn, Pb, Cr, Mn, and Cd) and polycyclic aromatic hydrocarbons were identified in areas with industrial emissions and automobiles when compared with those regions of biomass burning. The relative risk of hospital admissions for respiratory diseases (DAR) in children was higher than in the elderly population.

Conclusion: The physiochemical characteristics of PM from biomass burning are different from those emitted by industries and automobiles. Therefore, studies relating the health effects of air pollution in areas of biomass burning are required.

PP-29-029

Comparison of Multiple Portable GPS Units for Use in Epidemiological Studies

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Background/Aims: People's time-location patterns are important in air pollution exposure assessment because pollution levels may vary considerably by locations. A growing number of studies are using global position systems (GPS) to track people's time-location patterns. Many portable GPS units are available in the market with different claimed parameters. We evaluated the performance of various GPS devices by examining important parameters including positional accuracy in typical locations (indoor, outdoor, in-vehicle) and factors that influence satellite reception (building material, building type), acquisition time (cold and hot start), battery life, and adequacy of memory for data storage.

Methods: We examined the performance of 5 portable GPS data loggers and 2 GPS cell phones in stationary locations (eg indoor, outdoor) and moving environments (eg walking, commuting by vehicle, or bus), and compared GPS locations to highly resolved USGS DOQQ maps.

Results: The battery life of our tested instruments ranged from <10 to 48 hours. The acquisition of location time after startup ranged from 1 second to 30 minutes and varied significantly by building structure type and by cold or hot start. No GPS device was found to have consistently superior performance than the others regarding spatial accuracy and signal loss. At fixed outdoor locations, 65% to 95% of GPS points fell within 20 m of the corresponding DOQQ locations for all the devices. At fixed indoor locations, 50% to 80% of GPS points fell within 20 m of the corresponding DOQQ locations for all the devices except one. Most of the GPS devices performed well on freeway commuting, with >80% of points within 10 m of the DOQQ route, but the performance was significantly affected by surrounding structures on surface streets in highly urbanized areas.

Conclusion: All the tested GPS devices had limitations, but we identified several devices which showed promising performance for tracking subjects' time-location patterns in epidemiological studies.

PP-29-030

Association Between Proximity to Traffic and Type 2 Diabetes: The Multiethnic Study of Atherosclerosis

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Background/Aims: Although particulate matter has been suggested as a possible risk factor for type 2 diabetes onset, few epidemiologic studies and no longitudinal studies, have been reported. We investigated the associations of proximity to a major roadway, which is a surrogate of traffic pollution exposure with incident of type 2 diabetes and longitudinal changes in fasting serum glucose in multiethnic study of atherosclerosis.

Methods: Between 2000 and 2007, we examined 4676 participants free of type 2 diabetes at baseline with a total of 18,479 observations (mean number of exams = 2.5). Type 2 diabetes was defined as fasting glucose of ≥126 mg/dL at any exam or use of antidiabetes medication. At baseline (2000–2002), traffic-related pollution exposure was estimated based on participant's residential proximity to a major roadway (a binary variable based on whether the participant resided within 100 m of the centerline of a highway or within 50 m of the centerline of a major arterial road). Linear mixed models and interval-censored survival analyses were used to model longitudinal changes in fasting glucose (log-transformed) and incident type 2 diabetes, respectively, adjusting for age, gender, race/ethnicity, education, body mass index, waist circumference, cigarette smoking, and physical activity.

Results: Of the participants, 28% were classified as living near a major road. During a median of 5 years follow-up, 403 new type 2 diabetes cases occurred. After controlling for potential confounders, proximity to a major roadway was not associated with fasting glucose at baseline, and there were no associations with changes in fasting glucose over time. No significant association with incident type 2 diabetes was found.

Conclusion: This study does not support the hypothesis that long-term traffic pollution exposure may increase the risk of type 2 diabetes. Additional studies with longer follow-up periods and improved exposure estimates are needed to further investigate the hypothesized association.

PP-29-031

Are Elderly Women Exposed to Particulate Matter More Likely to Suffer From Cardiovascular Diseases?

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Background/Aims: The purpose of this hospital-based study was to investigate whether gender or age modify the short-term effects that particulate matter (PM) have on ischemic heart or hypertensive heart diseases in a subregional scale.

Methods: In this study, we selected hospitals near our monitoring station and used a case-control method to determine whether age, gender, and exposure to PM increase a person's risk of getting cardiovascular heart diseases (CVDs), resulting in emergency room visits. The geographic information system and mapping software were used to determine the distance between each hospital district and the monitoring station based on the centroid of the district. These patients were chosen from 10 hospitals in Taoyuan, Taiwan. We included emergency visits due to ischemic heart diseases (IHD, ICD-9 codes = 401–405) and hypertension

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heart diseases (HHD, 410–414) as outcomes in the model to estimate the effects of temperature and air pollution. Because no other air pollutant's pollution standard index (PSI) exceeded 50, we used the daily PM_{10} PSI to represent a person's exposure to air pollutants.

Results: In all, 2785 emergency room patients with IHD (n = 1881) and HHD (n = 904) were analyzed in the study. The control group consisted of 32,113 emergency room patients suffering from gastrointestinal diseases (ICD-9 codes = 520–579). Our study indicates that PM_{10} PSI levels over 50 increase the risk of women older than 65 suffering from IHD by 34%. An average daily temperature of less than 17°C increases a woman's risk of suffering from HHD.

Conclusion: We suggest that low temperature and air pollution, PM_{10} especially, could increase the risk of CVDs in elder women. The health effect of PM_{10} air pollution cannot be ignored in the prevention of CVDs.

PP-29-032

Inorganic Composition of PM_{10} and $PM_{2.5}$ Fractions, From an Industrial Zone in the Eastern Sicily, Italy

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Background/Aims: A field study aimed to characterize atmospheric pollution in the particulate phases was conducted during 2008 in the eastern area of Sicily. The data reported constitute the preliminary results of the first long-term monitoring campaign of particulate matter (PM_{10}) and $PM_{2.5}$, in an area influenced by anthropogenic sources (power plants, refineries, chemical, and metal industries).

Methods: Glass filter membranes Withman analyzed were collected in the Ogliastro unit station of the industrial Consortium for the Environmental Protection with a SWAM 5a Dual Channel Monitor, a system of sampling and mass measurement of airborne PM on 2 independent sampling lines.

This system is thus able to simultaneously monitor, with high quality standards, the time evolution of the mass concentrations of 2 fractions of PM dispersed PMX. The sampling period was approximately of 18 days for each season. Filters taken from Ogliastro station (Siracusa, Italy) were digested with 2 mL of HNO_3, 2 mL of HCl, and 4 mL of HF in a microwave oven Milestone Ethos TC. The analyses were performed with an ICP-MS Elan DRCe (Perkin-Elmer).

Results: The results of heavy metals expressed as ng/m^3 annual mean respectively for $PM_{2.5}$ and PM_{10} are as follows: Cd (0.7; 2.1); Cr (17.2; 16.6); (Pb (11.1; 16.7); Ni (12.1; 5,7); V (7.1; 8.2); Hg (0.05; 0.004). Among the elements analyzed, only Cd, Pb, and Ni have a regulatory limits set by the Directive 2004/107/CE, and our results are lower.

Data provided by the Consortium for the Environmental Protection for the period of 2008 show that not only the annual value of PM_{10} is within the law limit, but also the heavy metals concentration.

Conclusion: Although obtained data reflect acceptable values, further study are required, to better understand the real provenance of the particulate founded, on the basis of meteorological data, and furthermore to evaluate temporal trend air pollution on a longer period.

PP-29-033

Household and Neighborhood Determinants of Particulate Matter Pollution in 4 Accra Neighborhoods

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Background/Aims: A large percentage of the population in sub-Saharan Africa uses biomass fuels for domestic energy, including those living in urban areas. The aim of this study was to understand the variation of household particular matter (PM) pollution, and to examine the relationships between household PM concentrations, fuel use, ambient PM concentrations, and a set of variables that describe cooking practices and housing characteristics in Accra, Ghana.

Methods: We measured 48-hour integrated $PM_{2.5}$ and PM_{10} concentrations in 80 households in 4 neighborhoods of Accra, Ghana. Questionnaires were used to collect information about housing and cookhouse characteristics, cooking fuel, and practices and household assets. Neighborhood socioeconomic and fuel use statistics were obtained from the 2000 Population and Housing Census of Ghana. Regression analyses were then applied to identify factors associated with household PM levels.

Results: In neighborhoods, where household biomass use was more than the city's median (69%), the geometric means of $PM_{2.5}$ were 49.7 and 45.9 μg/m^3 in households with and without solid fuels, respectively. The corresponding geometric means of household $PM_{2.5}$ in neighborhoods with below median biomass use were 43.3 and 29.7 μg/m^3. Higher household $PM_{2.5}$ concentrations were associated with household biomass fuel use after adjusting for other factors. When neighborhood fuel use was controlled for, the effect of household fuel choice on household $PM_{2.5}$ became smaller and statistically insignificant. Instead, neighborhood fuel use had the largest effect on household $PM_{2.5}$ pollution.

Conclusion: Household $PM_{2.5}$ pollution in Accra neighborhoods is associated with the household's own fuel use as well as the neighborhood's patterns of biomass fuel use.

PP-29-034

Carcinogenic Metals in Airborne Fine Particulates ($PM_{2.5}$), DNA Damages, and Related Lung Dysfunction in Traffic-exposed Worker in Taiwan

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Background/Aims: Between November 2008 and January 2009, the study aimed to assess urinary 8-OHdG and lung function of 28 traffic policemen exposure to ambient fine particulate matter (PM) in Hsinchu area in Taiwan.

Methods: The subjects were monitored for 2 days to assess integrated 10-hour $PM_{2.5}$ breathing zone concentration. Personal $PM_{2.5}$ concentration was collected from personal air samplers, and the metal content was analyzed by inductively coupled plasma mass spectroscopy method. Urinary 8-OHdG was analyzed by liquid chromatography-mass spectrometry.

Results: Mean $PM_{2.5}$ concentration for policemen at the crossroads was 132.9 μg/m^3 (SD = 74.2 μg/m^3). Urinary metal concentrations (Cd, Ni, Pb, Co, Mn, and Cu) in the subjects who were exposed to $PM_{2.}$ were significantly higher than those who were not ($P < 0.078$); concentration in urine was marginally associated with a decrease in forced expired volume in 1 second after adjustment for age, height, weight, and smoking habit.

Conclusion: The results suggest that the carcinogenic metals in $PM_{2.5}$, including Cd and Ni, may induce the production of oxidative stress, DNA adducts, and decreased lung volumes in traffic policemen.

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PP-29-035

The Impact of Yellow Dusts From China on Air Quality in Northern Taiwan From 1994 to 2008

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Background/Aims: Air quality in Taiwan has been improved in recent years, causing significant changes in the yellow dusts from north-west China affecting Taiwan. The objective of this study is to recognize the effect of yellow dust on Taiwan originating from China on a daily basis.

Methods: Between 1994 and 2008, the data are derived from hourly particulate matter (PM_{10}) and CO value taken from the monitoring stations located in the city center, northern and eastern coast, and national park. We determine that a day is affected by dust when PM_{10} concentration increases from both northern and eastern coast, and the National Park monitoring stations simultaneously, and at the same time, the daily average concentration of PM_{10} from the city center monitoring station records values >125 $\mu g/m^3$.

We also distinguish the Asian dust events by measuring decreasing CO levels during the dust period, and increasing CO levels during periods of locally accumulating pollution.

Results: It is estimated that 53 dust events were influenced by yellow dust from China during 1994 to 2008, with the most occurrences during 2000 to 2007 showing an increasing trend, especially during 2000 where occurrences went up to 9. The most frequent times occurred in the months of March and April, totaling at 46%. On average, the concentration of PM_{10} in dust impact day is 4 times higher than its non-dust impact day. In addition, CO is not accumulated in dust impact day.

Conclusion: Taiwan is largely affected by the dust storms from China, even though it is away from the originate area of dust. Increasing PM concentrations in the ambient air causes human health hazards such as respiratory tract and cardiovascular disease. We should enforce our authority to concern this issue and do better in forecast.

PP-29-036

Exposure to Traffic and Its Influence on Birth Outcomes Using a Prospective Cohort

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Background/Aims: There has been much interest in the association between ambient air pollution and birth outcomes, and different methods have been applied. Proximity to traffic is a proxy for traffic-related exposures and can be estimated using geographic information systems. The aim of this study was to assess birth outcomes in relation to the distance of the mother's home to the nearest road and the number of roads surrounding it.

Methods: We investigated the association between traffic exposure and gestational age, birth weight, and birth length of 970 mothers in Logan, Queensland. We used multiple regression models and controlled for mother's age, smoking, parity, and education. We used a spline to control for trends and seasonal patterns. We modeled the effect of distance to road using a nonlinear spine with 3 degrees of freedom to capture the expected exponential-like decay in risk. For the number of roads surrounding the mother's home (main roads, freeways, and highways), we used a parametric approach by fitting either a quadratic or linear model.

Results: There was some evidence of shorter gestations for mothers living closer to a major road and a marginal increase in birth weight and birth length with increasing proximity to a highway. We also found evidence of shorter gestations with greater density of main roads and freeways. Only the association between a shorter gestation and greater road density was statistically significant. Living 2 km from a main road increased gestation by an average of 0.4 weeks compared with being adjacent to a main road. Modeling the effects of wind direction had little effect on the results.

Conclusion: Exposure to traffic had only a marginal negative influence on gestation length in this study. Future studies should include both temporal and spatial variation in exposure to air pollution when assessing its effects on birth outcomes.

PP-29-037

Association Between Air Pollution and Prevalence of Allergic Rhinitis in Ulsan, Korea

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Background/Aims: The effect of air pollution on allergic rhinitis is still not clearly understood. This study aims to investigate relationship between air pollution exposure and the prevalence of allergic rhinitis in young people in the industrial metropolitan area.

Methods: Data on physician-diagnosed allergic rhinitis (past 12 month) were collected in a cross-sectional questionnaire survey of 3722 infants and children (age, 1–18 years) in the Ulsan metropolitan area. All the residences of participants were georeferenced using a geographical information system to investigate the spatial relationship between air pollution and allergic rhinitis. To evaluate the risk of air pollution, annual pollution data obtained from 13 monitoring stations were linked with the prevalence data ($n = 1450$) within a 1.5- or 2-km radius of the stations.

Results: Comparisons of spatial distributions of prevalence rates for allergic rhinitis and annual average pollutant concentrations over the region showed that the relatively high prevalence rate occurred around the coastal industrial area with high particulate matter (PM_{10}) concentrations. A linear correlation analysis demonstrated the positive correlation relationship between PM_{10} levels and prevalence rates of allergic rhinitis ($R = 0.680$, $P = 0.04$). From the multiple logistic regression analysis after mutual adjustment by age, sex, and air-pollutant factors, PM_{10} and SO_2 mainly from industrial-related emissions were found to be statistically significantly associated with physician-diagnosed allergic rhinitis (aOR: 1.06, 95% CI: 1.02–1.11 for PM_{10}; aOR: 1.62, 95% CI: 1.12–2.34 for SO_2).

Conclusion: Exposure to high levels of industrial-related air pollutants can be an important environmental risk factor for allergic rhinitis in young people.

PP-29-038

Characterization of Environmental Factors Inducing the Transformation of Ambient Chromium

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Background/Aims: Hexavalent chromium (Cr-VI) has been listed as one of the core hazardous air pollutants by the US Environmental Protection Agency, whereas trivalent chromium (Cr-III) is an essential nutritional trace element for humans. Thus, it is crucial to investigate the

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environmental factors affecting the transformation between the 2 oxidation states.

Methods: A 24-hour exposure study was undertaken in a controlled environmental facility in the absence of sunlight by pulling clean air or clean air mixed with O_3, SO_2, and NO_2 through filters, which were pre-collected with diesel particles (DPM) or secondary organic aerosol (SOA). Isotope spiking (53Cr-VI and 50Cr-III) was used to monitor the redox change of chromium species within the exposure process. The exposure factors included O_3, SO_2, NO_2, airborne particle type, temperature, and humidity. ANOVA test ($P = 0.05$) was used.

Results: After exposure to clean air, neither significant reduction nor oxidation was found. Compared to control, exposure to 160 ppb SO_2 promoted significant reduction of Cr-VI in DPM ($40.8 \pm 3.5\%$, $n = 3$, $P = 0.0022$) and SOA ($41.9 \pm 6.8\%$, $n = 3$, $P < 0.0001$).

Conclusion: The results suggested SO_2 as a potential reductant for ambient Cr-VI. Our study also suggested that O_3 may promote reduction of Cr-VI while NO_2 may induce oxidation of Cr-III in the presence of ambient organics. Another finding is that Cr-III is easily oxidized in SOA than DPM, probably because of the organic composition and liquid microenvironment of SOA. Further study will be undertaken to understand the mechanisms behind the transformation we found in the controlled environmental facility tests.

PP-29-039

Ambient Particulate Matter Exposure and Hypertension Incidence in the Multiethnic Study of Atherosclerosis

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Background/Aims: Despite evidence of a cross-sectional association between ambient fine particulate matter ($PM_{2.5}$) and high blood pressure, no population-based study has explored the association of fine particle exposure with incident hypertension. This study examined whether ambient $PM_{2.5}$ is associated with hypertension incidence.

Methods: The study included 3006 participants, aged 45–84 years and without hypertension (systolic blood pressure ≥140 mm Hg, diastolic blood pressure ≥90 mm Hg, or on antihypertensive medications) at the baseline examination (2000–2002) of the Multiethnic Study of Atherosclerosis. Annual average $PM_{2.5}$ concentrations at participant residences were calculated for 2001 using a spatio-temporal model and used as a proxy for exposure over the 5-year follow-up period. Incident hypertension was defined by participant's SBP ≥ 140 mm Hg, DBP ≥ 90 mm Hg, or on antihypertensive medications at follow-up visits. Hazard ratios of incident hypertension per 10 $\mu g/m^3$ increment in $PM_{2.5}$ were estimated using interval censored survival analysis, adjusting for age, sex, race/ethnicity, systolic blood pressure, diastolic blood pressure, body mass index, diabetes, smoking, passive smoking, alcohol use, healthy diet index, and physical activity at baseline.

Results: A total of 825 new cases of hypertension occurred over the 5-year follow-up. The mean estimated $PM_{2.5}$ exposure was 17.3 $\mu g/m^3$ (standard deviation, 3.2 $\mu g/m^3$). For each 10 $\mu g/m^3$ increment of $PM_{2.5}$, the adjusted hazard ratio for incident hypertension was 1.22 (95% confidence interval, 0.93–1.59). The point estimate of association remained positive and not statistically significant after further adjustment for study site and socioeconomic status (income and education) at baseline.

Conclusion: Results from our study sample provide only weak support to the hypothesis that exposure to ambient fine particulate air pollution may contribute to onset of hypertension.

PP-29-040

Personal Exposures to Particle-bound Polycyclic Aromatic Hydrocarbons for the Elderly and Elementary School Children

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Background/Aims: Nowadays people spend more than 80% of the time indoors for the daily life, where polycyclic aromatic hydrocarbons (PAHs) is one of the indoor pollutants. It has been reported that PAHs ranked as probable human carcinogens are primarily associated with the particulate phase. Therefore, the characterization of exposure to particle-bound PAHs is critical in assessing the health risks in our daily life.

Methods: The strategic plan of the study has been presented previously. In brief, a panel study was conducted during the years 2003 and 2005 to examine the health effects of particulate air pollution on susceptible populations. The current paper focuses on assessing exposures to particle-bound PAHs for both of school-age children with asthma and elderly people living within the metropolitan Taipei area. During the study, integrated personal exposure samples were collected by a dust monitor (model 1.108, Grimm) for PAHs analysis using gas chromatograph-mass spectrometer. The sampling durations for the elderly population and children were 24 hours and 5 days, respectively. Overall, 23 samples for elderly people and 52 samples for the children were included in the data analysis.

Results: Results showed that geometric mean levels (and geometric standard deviation) of PAHs exposures were 11.98 (27.32) ng/m^3 for the elderly people and 4.44 (3.40) ng/m^3 for children. The top 3 highest proportions of PAHs components were IND (22%), BghiP (18%), and DBA (9%) for children, all of which are 6-ring PAHs. The top 3 highest proportions of PAHs components were Flu (24%), Atlanta commuters exposures (21%), and DBA (11%) for the elderly population, with elderly people showing a higher low-ring PAHs composition, which might be due to the fact that elderly people usually spent more time in indoor microenvironments. On the other hand, results from 8 types of characteristic value (BaA/Chry, BaP/BghiP, IND/BghiP, BghiP/IND, Flrt/Pyr, BaP/(BaP + Chry), FL/(FL + Pyr), and IND/(IND + BghiP)) showed that traffic pollution was one of the major PAHs sources for children. The principal components analysis also found that the factor 1, the contribution of traffic source, could account for 25.54% of their total variation.

Conclusion: In conclusion, traffic pollution sources influenced children's exposures to PAHs apparently, whereas PAHs exposures of the elderly people were mainly affected by indoor pollution sources (such as smoking and incense burning). In addition, elders' PAHs exposures were higher than those of children, whereas the children faced higher percentage of carcinogenic PAHs than the elderly did. Future studies are warranted for further investigation.

PP-29-041

The Exposure to Ozone Is Associated With Asthma, Allergic Rhinitis, and Allergic Sensitization in Schoolchildren

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Background/Aims: Recent increasing trend of prevalence of allergic diseases is at least partly attributable to environmental change. This study

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aims to investigate the effects of air pollution on the allergic diseases in schoolchildren who are vulnerable to air pollution.

Methods: A prospective survey of parental responses to ISAAC questionnaire and allergic evaluations was conducted for 3490 schoolchildren selected from the inner city and industrial area with 2-year interval. Individual exposure to air pollution was estimated by using geographic information system with 5-year mean data. The association of traffic-related estimates with allergic disease was analyzed using multiple logistic regression analysis.

Results: A total of 1340 children (M:F = 51.3:48.7) with a mean age of 6.84 ± 0.51 years was included in the analysis because they were performed for allergic tests in both of start and followed years. The lifetime prevalence of diagnosis of allergic diseases and 12-month prevalence of treatment were 10.1%, 4.7% for asthma, and 26.4%, 21.4% for allergic rhinitis, respectively. After 2 years, lifetime prevalence of diagnosis allergic rhinitis had significantly increased. O_3 exposure was significantly associated with 12-month prevalence of wheeze in start years (OR per 5 ppb = 1.372, 95% CI = 1.016–1.852). O_3 was also associated with all prevalence of allergic rhinitis in children who reside in industrial area. The significant associations of O_3 with total IgE and the number of sensitization to outdoor allergen were found. However, there was no significant association between ozone exposure and the new onset of respiratory allergic symptoms in followed year.

Conclusion: The exposure to ozone was associated with wheeze and allergic rhinitis. Increased number of sensitization to outdoor allergen by ozone may explain the association.

PP-29-042

Lag Structure of the Associations Between $PM_{2.5}$ Components and Hospitalization in Denver

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Background/Aims: In air pollution time series studies, the temporal pattern of the association between the air pollution and health endpoint has been seen to vary by disease category and population sub-group. Few studies investigated the lag pattern of chemical species of particulate matter (PM), largely because daily speciated data were not available. In this study, daily PM chemical speciation data allowed exploration of the lag structure for hospitalization.

Methods: $PM_{2.5}$ speciated data (elemental and organic carbon, sulfate, and nitrate) were measured daily at a central monitoring site in Denver, Colorado, from 2003 through 2007. Daily hospitalization counts and meteorology were also obtained. Hospitalization was classified into subgroups of respiratory and cardiovascular diseases and into 3 age groups. Relative risks of hospitalization were estimated for daily concentration of PM total and speciated mass on concurrent and each of 14 prior days, adjusting for weather, time, and day of week by using generalized additive models.

Results: The relative risks for the 4 PM species were maximized mostly at day lag 0 (concurrent exposure and hospitalization) for cardiovascular admissions, and at lag 3–8 days for respiratory admissions. This pattern was particularly clear for ischemic heart disease and asthma. The largest effects in the elderly population were seen at earlier lags, whereas in children larger effects were seen at longer lags. Different patterns across diseases and age groups were consistent between 4 species and $PM_{2.5}$, but with elemental and organic carbon being higher magnitude of effects.

Conclusion: PM species have more immediate effects on cardiovascular diseases and more delayed effects on respiratory diseases. Immediate effects were larger in the elderly people and adults than in children.

PP-29-043

Inhalation Exposure of the Volunteers to Polycyclic Aromatic Hydrocarbons in Korea

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Background/Aims: Inhalation exposure of the volunteer subjects in Seoul to 15 polycyclic aromatic hydrocarbons was investigated directly through personal monitoring and indirectly through static monitoring combined with personal activity diaries.

Methods: The 180 subjects were divided into 5 groups: toddler (0–6 years), children and teenagers (7–18 years), housekeeper (19–60 years), office worker (19–60 years), and the elderly people (>60 years).

Results: Inhalation exposure (ng/kg/d) through personal monitoring were ranged from 2.69 to 254.01 (median: 7.33) for toddler, 0.10 to 10.29 (2.34) for children and teenagers, 1.17 to 18.90 (3.75) for housekeeper, 0.76 to 51.60 (3.93) for office worker, 0.28 to 14.23 (3.51) for elderly people. The other inhalation exposure (ng/kg/d) through static monitoring method ranged from 0.62 to 18.71 (1.99) for children and teenagers, 0.67 to 11.31 (3.51) for housekeeper, 1.11 to 44.91 (3.73) for office worker, and 0.70 to 10.48 (3.56) for elderly people.

Conclusion: The inhalation exposure in the toddler group was 2–3 times higher as compared with those in the other age groups, and in children and teenager, it was less than those in the other age groups; however, no significant difference was found in the 3 adult groups. Linear regression of direct and indirect exposure estimates for all age groups revealed statistically significant correlation (slope = 0.82, R^2 = 0.75, $P < 0.05$), indicating that personal inhalation exposure to 15 polycyclic aromatic hydrocarbons was higher than that through indirect monitoring.

PP-29-044

Black Smoke as an Additional Indicator to Evaluate the Health Benefits of Traffic-related Policy Measures: A Systematic Review of the Health Effects of Black Smoke Compared to PM Mass

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Background/Aims: Literature suggests that black smoke (BS) or elemental carbon (EC) may be better indicators of health effects compared to PM mass. However, this suggestion is not based on a systematic review of the literature on the effects of the different indicators. We therefore conducted a systematic review, comparing the health effects estimated with PM mass versus BS/EC within the same studies.

Methods: Medline as well as the Air Pollution Epidemiology Database (APED) were searched for studies that included estimates for (a measure of) PM as well as (a measure of) black smoke. Thirty-three suitable papers on time-series studies on daily mortality or hospital admission or emergency department visits were identified. All papers were skimmed through for possible information on results of multi-pollutant models.

Results: Pooled estimates of the percentage change in mortality or hospital admissions per interquartile range (IQR) were generally similar for BS compared to PM_{10}. For example, the pooled estimated percentage change in all cause mortality (9 single-city estimates) was 0.9%

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(0.4%–1.3%) per 20 $\mu g/m^3$ increase in PM_{10} and 0.9% (0.4%–1.4%) per 12 $\mu g/m^3$ increase in BS. Ten papers provided information on multi-pollutant models, 4 of which provided only qualitative information. In all 4 papers, as well as in 3 of 4 papers that provided quantitative results for PM_{10} adjusted for BS (and vice versa), the effect of BS was suggested to be more robust.

Conclusion: Single pollutant effect estimates for daily mortality or hospital admissions were similar for BS and PM_{10} when expressed per IQR. Limited evidence from multi-pollutant models suggests that the effect of BS/EC may be more robust. As traffic-related policy measures will result in larger reductions in BS, relative to reductions in PM mass, estimated health benefits of such measures will be larger when expressed per achievable reductions in BS.

PP-29-045

Effect of Ozone and Nitrogen Dioxide in Mixture on Lead Availability From Lead-based Paints

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Background/Aims: Much research has focused on sources of household lead exposure, but little has addressed the environmental drivers and mechanisms that promote lead paint deterioration and influence environmental lead availability. We report the effects of nitrogen dioxide (NO_2) and ozone, in combination, on surface lead availability from lead paint.

Methods: We performed chamber experiments exposing alkyd low gloss leaded paint to 3 mixtures of ozone and NO_2. Laboratory results were then combined with photochemical air quality modeling to identify areas in the South Coast Air Basin of California (SoCAB) that may have been historically more susceptible to atmospherically driven paint degradation. In addition, the results of the model can be used to prioritize regions currently posing higher deterioration risk.

Results: Relative to unexposed controls, surfaces exposed to 6 ppm NO_2/10 ppm ozone showed a 21.3 ± 12.0 fold increase in lead loading ($P < 0.001$), while experiments of 9 ppm NO_2/11.5 ppm ozone and 10.5 ppm NO_2/5 ppm ozone reported fold increases of 240.1 ± 77.4.0 ($P < 0.001$) and 506.4 ± 168.4 ($P < 0.001$), respectively. Lead availability was strongly influenced by NO_2 concentration, potentially due to the indoor reaction of NO_2 and ozone to form nitrate radicals and promote production of nitric acid which degrades paint binder, the paint constituent responsible for encapsulating the lead. Surface color was also measured and showed systematic lightening and yellowing as a result of exposure. Photochemical air quality modeling was performed using average and extreme pollutant scenarios from the 1970s, 1980s, and 1990's, and suggest that large regions of SoCAB were susceptible to paint deterioration resulting from photochemical atmospheric pollutants.

Conclusion: This deterioration mechanism may be influential in some rapidly industrializing countries where lead paints are still manufactured and high levels of ozone and NO_2 coexist in areas with a high prevalence of leaded paints.

PP-29-046

Longitudinal Lung Function Effects of Particulate Matter in Children With Cystic Fibrosis

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Background/Aims: Chronic exposure to ambient-source particulate matter (PM) is associated with decreased lung function growth in healthy children. Children with cystic fibrosis (CF) have decreased lung function and decreased lung function growth, compared to normal children, and may be highly susceptible to the adverse chronic effects of air pollution exposure.

Methods: Data were obtained from the Cystic Fibrosis Foundation Patient Registry. Included were Caucasian children 6–18 years of age with at least 1 spirometry measure from 1994 to 2006. Ambient levels of PM less than 2.5 μm in diameter ($PM_{2.5}$) and less than 10 μm in diameter (PM_{10}) were obtained from the US Environmental Protection Agency and estimated using year 2000 annual average concentration at the closest population-based monitor within 30 miles of the patient's home zip code centroid. FVC and FEV1 were regressed on age-adjusted height, age, year of birth (cohort effect), and 2-way interactions, using linear spline models including cross-sectional effects at age 6, stratified by gender.

Results: A total of 5204 (54.0%) patients lived within 30 miles of a $PM_{2.5}$ monitor and 2892 (30.2%) lived within 30 miles of a PM_{10} monitor. Annual average $PM_{2.5}$ ranged from 5.5 to 28.2 $\mu g/m^3$ for males and 3.8–28.2 $\mu g/m^3$ for females. PM_{10} annual average ranged from 12.2–52.0 $\mu g/m^3$ for males and 12.2–83.2 $\mu g/m^3$ for females. A 10 $\mu g/m^3$ increase in $PM_{2.5}$ exposure was associated with a 10.10mL/yr (95% CI: −19.93, −0.32) decrement in FEV1 for males and 10.10 mL/yr (95% CI: −18.29, −1.91) in females. 10-year trend due to cohort effect was associated with a 5.91mL/yr (95% CI: −2.20, 14.02) and a 7.02 mL/yr (95% CI: 0.13, 13.90) increase in FEV1 in males and females, respectively. A 10 $\mu g/m^3$ increase in PM_{10} was not found to be significantly associated with reduced lung function growth.

Conclusion: Chronic exposure to ambient $PM_{2.5}$ is associated with decreased lung function growth in children with cystic fibrosis. This effect is greater than the increase in FEV1 and FVC associated with longitudinal treatment trends.

PP-29-047

Air Quality Impacts of Higher Gas Prices in Atlanta, Georgia During 2006–2008

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Background/Aims: Vehicle miles traveled (VMT), a substantial contributor to air pollution in urban areas, has been rising steadily in the United States for several decades. In 2008, gas price increased by 25%–30% across the United States and many urban areas observed VMT reductions of 3%–5% compared with 2006. This study sought to determine if elevated gas prices were associated with reduced traffic-related air pollution in Atlanta, Georgia.

Methods: The daily average gas price (USD/gallon of unleaded gasoline) and ambient concentrations of carbon monoxide (CO), nitrogen oxides (NO_x), and fine particulate matter ($PM_{2.5}$) were obtained for 5 metropolitan Atlanta counties during 2006–2008; daily VMT was obtained during 2007–2008. Generalized estimating equations with an autoregressive correlation structure were used to model gas price as predictor of VMT using different lags and to model gas price as a predictor of pollutant concentrations, controlling for various temporal and meteorological variables.

Results: The association between gas price and VMT was strongest using an 11-day lag. In unadjusted analyses, gas price was negatively associated with CO and NO_x and positively associated with $PM_{2.5}$ ($P < 0.001$). Controlling for year and temperature, a 10% increase in gas price was associated with a 7% decrease in CO ($P = 0.002$) and 8% decrease in NO_x ($P = 0.13$) concentrations 11 days later; adjusted association with $PM_{2.5}$ was not significant. Results varied according to the degree of control for temporal variables. Issues related to choice of the most appropriate model will be discussed.

Conclusion: These preliminary data show an association between higher gas price and lower concentrations of traffic-related pollutants in

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metropolitan Atlanta. The extent to which this association reflects a causal impact depends on the adequacy of control for confounding. If causal, pricing interventions that aim to reduce VMT might have important public health implications, especially for near-roadway exposures.

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PP-29-048

Blood Markers of Inflammation and Exposure to Vehicle-related Particulate Air Pollutants in Trucking Industry Workers

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Background/Aims: Previous studies have suggested an association between particulate air pollution and adverse cardiovascular health effects in adults. In this study, we examined the association between workplace exposure to vehicle-related particles and inflammatory markers related to cardiovascular disease, including high-sensitivity C-reactive protein (hs-CRP), soluble intercellular adhesion molecule-1 (sICAM-1), and interleukin-6 (IL-6), among 338 workers in the United States trucking industry.

Methods: We visited 2 large trucking terminals in 2007 and measured vehicle-related particles, including elemental carbon (EC), organic carbon (OC), and particulate matter with aerodynamic diameter ≤ 2.5 μm ($PM_{2.5}$), for 5 days consecutively at the main work areas. Each participant provided a blood sample and completed a health questionnaire during the sampling period. Individual workplace exposure level was calculated by 12-hour time weighted moving averages based on a worker's work location and work shift. The association between each blood marker and exposure during 0–12, 12–24, 24–36, and 36–48 hours before the blood draw was examined by multiple regression analyses.

Results: The mean ± SD of work location and work shift specific average was 0.30 ± 0.16 $\mu g/m^3$ for EC, 5.21 ± 1.57 $\mu g/m^3$ for OC, and 11.2 ± 3.30 $\mu g/m^3$ for $PM_{2.5}$ among non-drivers. In general, EC and OC had a positive but nonsignificant association with sICAM-1 and IL-6. Stronger effect estimates were observed for the exposure periods >12 hours before the blood draw. No significant effect of $PM_{2.5}$ on inflammatory markers was observed. We found no evidence of any positive association between measured pollutants and hs-CRP.

Conclusion: In this group of healthy workers, we did not find a statistically significant relationship between short-term occupational exposure to vehicle-related air pollutants and blood markers of inflammation.

PP-29-049

Exposure Assessment for Outdoor Air—A Simulation of Exposure Measurement Error on Health Effect Estimates

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Background/Aims: Our objective was to explore, through simulation, the effect of exposure measurement error on health effect estimates when ambient concentrations at subjects' residential locations are used as surrogates for total personal exposure to outdoor air pollutants.

Methods: We used paired residence-based and mobility-based exposure estimates for 26,267 individuals in the South Coast Air Basin (SoCAB). Exposure estimates were based on a transportation survey conducted by the Southern California Association of Governments in 2000, and annual average concentration estimates from the CAMx dispersion model for nitrogen dioxide and hexavalent chromium. Modeled outdoor concentrations at home locations represented residence-based exposures. Mobility-based exposures were developed by geocoding the origin, destination, and likely route travelled for each individual record, extracting associated ambient concentrations, and weighting by time spent at each location and in transit. We simulated affected individuals by random assignment, increasing the proportion of individuals selected from the lowest to the highest quartile of mobility-based exposure. We then assigned a new quartile to each individual, using the residence-based exposure estimate. The ratio of the residence-based odds ratio and the mobility-based odds ratio indicates the amount of attenuation associated with the measurement error introduced by using a residence-based exposure estimate.

Results: The odds ratios produced using the residence-based exposure estimates were between 30 and 50 percent lower than those produced with the mobility-based estimates. We repeated the random assignment of health effects using different proportions than in the first simulation, producing attenuation in the range of 10 to 60 percent.

Conclusion: The use of a residence-based estimate as a surrogate for total personal exposure to outdoor air pollutants can produce substantial attenuation in health effect estimates. Careful consideration of geographic mobility is recommended when developing exposure estimates for mobile populations. Further simulation may aid in identifying factors determining the potential level of attenuation.

PP-29-050

Effect of Living Close to Major Roadway on Allergic Diseases: Results of the Children's Health and Environmental Research (CHEER)

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Background/Aims: The prevalence of allergic diseases has increased during past decades in Korea, with an increasing tendency of exposure to traffic-related air pollutants being a potential risk factor of allergic diseases in children. The objective of our study is to assess the relationship between living near major roadways and allergic diseases in Korean children.

Methods: We studied 2754 children aged 6–8 years from 16 schools in 7 South Korean cities as part of the first Children's Health and Environmental Research (CHEER) survey. The prevalence of allergic diseases (asthma, allergic rhinitis, and atopic dermatitis) was assessed by an International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire completed by the parents. Residential distance to the nearest major roadway and road density within a 200 m buffer were used as surrogates for traffic-related air pollutants. We used a GIS to measure distance to and density of roadways. We used logistic regression to assess the association between living close to major roadways and allergic diseases.

Results: Inverse associations were found between distance to the nearest major roadway and allergic diseases. The highest adjusted odds ratios (ORs) for children living less than 75 m from major roadway were found for lifetime wheeze (OR = 1.39; 95% confidence interval [CI]: 1.06–1.83), past year wheeze (OR = 1.46; 95% CI: 1.02–2.08), doctor-diagnosed allergic rhinitis (AR) (OR = 1.31; 95% CI: 0.99–1.74), lifetime atopic dermatitis (OR = 1.32; 95% CI: 1.03–1.70), doctor-diagnosed atopic dermatitis (OR = 1.46; 95% CI: 1.12–1.89), and current atopic dermatitis (OR = 1.46; 95% CI: 1.06–2.00). Moreover, distance to major roadway had an inverse dose-response relationship with asthma, AR, and atopic dermatitis. Adjusted OR per 100 m decline in distance

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were elevated for past year wheeze (OR = 1.16; 95% CI: 1.04–1.30), doctor-diagnosed AR (OR = 1.10; 95% CI: 1.01–1.20), current AR (OR = 1.09; 95% CI: 1.00–1.20), and current atopic dermatitis (OR = 1.10; 95% CI: 1.00–1.22).
Conclusion: We found that residential distances from major roadways and road density near homes are associated with the prevalence of allergic diseases in school children.

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PP-29-051

The Prevalence of Allergic Diseases in Urban and Rural Residents

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Background/Aims: Allergic diseases (allergic rhinitis, asthma, allergic eye disease, atopic dermatitis) are a major public health problem in the world, especially industrialized cities. This study was carried out to understand the prevalence of allergic disease in urban and rural residents.
Methods: The author conducted a questionnaire survey of 1043 persons divided into urban and rural residents group, and analyzed the skin prick test of 1033 persons for 13 days from 28 July to 9 August, 2008. Skin prick tests performed with 14 antigens included saline and histamine.
Results: The study subjects contained 385 males (35.0%) and 716 females (65.0%), and the major age group was the fifth decade (361 cases, 32.8%). The prevalence of allergic symptom (wheezing was experienced) was significantly higher in urban adolescent group (20.0%) than rural group (0.0%). In adult group, the prevalence of allergic symptoms (practice of asthma therapy within 1 year, sneezing/nasal congestion experienced within 1 year, itching eye symptom within 1 year, eczema diagnosed, positive diagnosed if at least 1 disease of asthma, allergic rhinitis, eczema, allergic eye disease) were significantly higher in urban group than rural group. The positive rate of skin prick test was 19.5% in all age group, and the positive rate in child, adolescence, and adult group were 33.3%, 43.9%, and 17.3%, respectively. The positive rate of skin prick test in adolescence group was significantly higher than other age groups. But, the positive rate of skin prick test between urban (18.8%) and rural group (22.3%) were no difference.
Conclusion: This study shows that the prevalence of allergic disease by questionnaire in urban group was higher than rural group, but the positive rate of skin prick test was no difference between urban and rural area. Therefore, more epidemiological studies are expected.

PP-29-052

Wood Smoke Exposure and Respiratory Health With and Without an Improved Chimney Stove in Rural Guatemala

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Background/Aims: The smoke produced from the use of household biomass fuels for cooking contains many toxic compounds. Worldwide, as many as 1.6 million deaths annually can be attributed to exposure to smoke from cook stoves. Stoves with a chimney reduce smoke in the kitchen. To quantify the health benefits of an improved chimney stove in young children we have been conducting the Chronic Respiratory Effects of Early Childhood Exposure to Respirable Particulate Matter study (CRECER) in the highlands of Guatemala.
Methods: CRECER is a longitudinal follow-up of the cohort of children who participated in the earlier Randomized Exposure Study of Pollution Indoors and Respiratory Effects (RESPIRE), a study of the efficacy of an improved chimney stove on acute lower respiratory infection in infants. The primary aim of CRECER is to assess the chronic effects of exposure to wood smoke during the critical time window of infant lung development on respiratory health. Of the 557 children enrolled in CRECER, 393 from the RESPIRE cohort were from homes with an improved chimney stove; an additional 166 children from homes cooking with open fires were enrolled. Health status of participating children (reported by mothers) was evaluated every 3–6 months. At the time of the health status interview, 48-hour integrated CO exposures were measured with a passive diffusion tube worn by the participating child. The association of either 48-hour mean CO or stove type (chimney stove vs. open fire) with reported symptoms was investigated using multivariable regression models that adjusted for age, season, and SES (maternal education, electricity, latrine, dirt floor) and accounted for repeated measures.
Results: Symptoms were not significantly associated with 48-hour mean CO, but the improved chimney stove was protective for dry cough (OR = 0.67, 95% CI: 0.48–0.94), frequent cough (OR = 0.48, 95% CI: 0.29–0.80), and runny nose (OR = 0.51, 95% CI: 0.35–0.76).
Conclusion: Stove type may be a better marker for level of peak exposure in the past 3–6 months than personal 48-hour cumulative CO.

PP-29-053

Cerebrovascular Disease Hospitalizations are Associated With Increased Levels of Ozone, and Modified by Socioeconomic Status in Santiago, Chile

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Background/Aims: Cerebrovascular diseases are the second leading cause of cardiovascular morbidity in Chile. Many studies have reported the association between cerebrovascular diseases and air pollution, but few have examined the modifying effect by socioeconomic status (SES) and age group. The study purpose was to investigate whether the SES modifies the association between air pollution and hospitalizations for cerebrovascular disease in adults.
Methods: Daily figures of hospitalizations for cerebrovascular disease (CIE-9: 430–438) in Santiago, period 2002–2006, were obtained from DEIS. The data were stratified by age group: all-ages, 18–64 and ≥65 years old. The meteorological and pollution (PM_{10}, $PM_{2.5}$, and O_3) data were provided from MACAM monitoring network. The associations between pollutants and hospitalizations were studied independently by annual income according to health insurance: private (higher-SES), and public (low-SES) and within this, by 4 sub-groups: no-income or resource-poor; minimum-wage workers; low-income; and medium-income. A time-stratified case-crossover design was applied, controlling for temperature, dew point using natural splines (3 degree of freedom each). Lags 0–7 and moving averages 0–28 days were evaluated.
Results: A total of 23,532 hospitalizations for cerebrovascular disease by SES were available (84% total period). The mean ozone was 33.2 ppb (8-hours daily mean). A significant association ($P < 0.05$) was observed in hospitalizations by an increase in 10 ppb of ozone levels, for adults 18–64 years old belonging to minimum-wage workers (admissions increased by 11.1% [1.2%–21.9%], 2-day moving average) and low-income (20.8% [6.1%–37.5%], lag1) groups. For adults, ≥65 years old belonging to low-income admissions increased by 20.9% ([0.2%–45.9%], 3-day moving average with increased risk for 5-day) and higher-SES income (7.9% [0.1%–16.3%], lag4 and 17.9% [0.4%–38.5%], 12-day moving average, with increased risk for 14-day). No significant association was observed for particulate matter by SES.
Conclusion: Therefore, this study suggests that hospitalizations for cerebrovascular disease are associated with increased levels of ozone; this association is modified by SES and age group in Santiago, Chile.

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PP-29-054

A Meta-analysis of Association Between Short-term Ambient Ozone Exposure and Respiratory Hospital Admissions

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Background/Aims: Tropospheric ozone is an air pollutant common in urban areas, associated with many adverse human health impacts, including increased risk of respiratory symptoms. Many studies have found significant positive associations between ozone and risk of respiratory hospitalizations; however, other studies found contradictory results. We conducted a meta-analysis of ozone and respiratory hospital admissions, which combines results from multiple studies accounting for their statistical uncertainty.

Methods: A systematic review of the literature based on our protocol identified 136 estimates from 96 time-series and case-crossover studies. We stratified main estimates extracted from previous literature according disease categories (eg, total respiratory disease, chronic obstructive pulmonary disease), hospitalization types (eg, emergency hospital admission, emergency room visit), and age groups (eg, all-ages, children). We investigated how the concentration-response relationship was affected the ozone metric used (eg, 1-hour maximum), age of study population, season, and region of study. Results were compared with those from multicity studies. In addition, we examined publication bias and calculated a summary effect adjusted for publication bias.

Results: Results indicate significant associations between ozone exposure and hospital admissions for various disease categories. The estimates were elevated by publication bias, but some associations remain statistically significant after adjustment of this bias. For instance, results indicate that risk of emergency hospital admissions for total respiratory disease increased 4.47% (95% interval 2.48%, 6.50%) per 10 ppb increment of 24 hours average ozone among the elderly. After adjusting for publication bias, the estimate becomes 2.97% (1.05%, 4.94%). Results reveal that different ratios to convert among ozone metrics did not greatly change results. The relationship between ozone and hospital admissions was affected by different study characteristics (eg, lag selection, age group).

Conclusion: This meta-analysis can provide a better understanding of ozone exposure's influence on human health and guide future studies. Findings can also provide quantitative evidence for environmental policy decision making.

PP-29-055

Measurements of Fine Particles and Smoking Activity in a Statewide Survey of California Indian Casinos

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Background/Aims: Despite California's 1994 statewide smoking ban, exposure to secondhand smoke continues in California's Indian casinos. Few data are available on exposure to airborne fine particles ($PM_{2.5}$) in casinos, especially on a statewide basis. We sought to measure $PM_{2.5}$ concentrations in Indian casinos widely distributed across California, exploring differences due to casino size, separation of smoking and nonsmoking areas, and area smoker density.

Methods: A selection of 36 out of the 58 Indian casinos throughout California were each visited for 1–3 hours on weekend or holiday evenings, using 2 or more concealed monitors to measure $PM_{2.5}$ concentrations every 10 seconds. For each casino, the physical dimensions and the number of patrons and smokers were estimated. As a preliminary assessment of representativeness, we also measured 8 casinos in Reno, NV.

Results: The average $PM_{2.5}$ concentration for the smoking slot machine areas (63 $\mu g/m^3$) was 9 times as high as outdoors (7 $\mu g/m^3$), while casino nonsmoking restaurants (29 $\mu g/m^3$) were 4 times as high. Levels in nonsmoking slot machine areas varied: complete physical separation reduced concentrations almost to outdoor levels, but 2 other separation types had mean levels that were 13 and 29 $\mu g/m^3$, respectively, higher than outdoors.

Conclusion: Elevated $PM_{2.5}$ concentrations in casinos can be attributed primarily to secondhand smoke. Average $PM_{2.5}$ concentrations during 0.5–1 hour visits to smoking areas exceeded 35 $\mu g/m^3$ for 90% of the casino visits.

PP-29-056

Exposure to Black Carbon and Cognitive Function in a Cohort of Older Men

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Background/Aims: Limited experimental and epidemiologic evidence suggests an association between ambient air pollution and cognitive function; however, only 1 epidemiologic study has considered this association in older adults. The objective of this study is to consider the relationship between long-term exposure to traffic-related air pollution and cognitive test performance in a population of older men.

Methods: Long-term exposure to traffic-related air pollution was assessed using a validated spatiotemporal land-use regression model for black carbon exposure. Estimates of black carbon exposure at each participant's residence in the year prior to the first eligible cognitive assessment were used to provide a measure of long-term exposure. Cognitive function was assessed for each participant using a battery of cognitive tests administered every 3–5 years. All cognitive test scores were z-transformed to promote comparability and combination in analyses. Linear mixed models were used to estimate the association between black carbon and (*a*) performance on each individual cognitive test and (*b*) global cognitive performance.

Results: On average, age at the first eligible cognitive assessment was 71 (range, 51–97). For all 8 of the cognitive test scores, point estimates from multivariate-adjusted models suggest an adverse effect of traffic-related air pollution on cognitive test performance. When considering effects of black carbon exposure on global cognitive performance, a 1 standard deviation increase in log black carbon exposure was associated with a decline of 0.042 standard deviations in cognitive test score (95% CI: −0.002, −0.081) in multivariate-adjusted models, an effect size similar to the difference observed with a increase in age of approximately 1 year. There was no evidence of heterogeneity by cognitive test.

Conclusion: This study provides evidence that ambient traffic-related air pollution may have adverse effects on cognitive function in older men.

PP-29-210

Investigating the Short-term Effects of Air Pollution on Daily Mortality Among the Elderly Using Generalized Additive Distributed Lag Modelling

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Background/Aims: Melbourne, Australia, with a population of nearly 4 million, is a city that typically experiences low levels of air pollution. Despite having low annual levels of air pollution, air quality events such as bushfires, dust storms, and smog do occur. Moreover, these events typically occur in combination with periods of extreme heat, compounding the environmental stress on the local population. We aim to quantify the short-term associations between air pollution and mortality in Melbourne across 2 dimensions—-the range of the pollutant and its distributed lag effect.

Methods: The concentration–response relationship between daily ambient air pollution and daily all-cause mortality in the elderly in Melbourne over the period of 2002–2006 has been assessed using generalized additive distributed lag modelling. After controlling for long-term trends, seasonality, day-of-the-week, and weather single-pollutant models were fit, using a distributed lag of 5 days for ozone (O_3), particulate matter ≤ 10 μm (PM_{10}), and nitrogen dioxide (NO_2).

Results: We found the overall increase of 1.13% in DACMORT65+ over 5 days of lag for a 10 $\mu g/m^3$ increase in PM_{10} above the mean during the period of 2002–2006. A 10 ppb increase in O_3 above the mean resulted in an increase of 1.25% and a 10 ppb increase in NO_2 above the mean resulted in an increase of 1.54%. The maximum positive effect for each pollutant was experienced within a window of 2 days following exposure.

Conclusion: The effect of PM_{10} on mortality had the longest duration followed by O_3 and NO_2, respectively. These findings indicate that the effects of air pollution in Melbourne are quite modest and of relatively short duration.

PP-30-002

Modeling the Distribution of Highway-generated Air Pollution in a Residential Urban Neighborhood

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Abstract:

Background/Aims: Exposure to highway-generated air pollution is associated with elevated risk for adverse health effects. As part of a study to determine whether people who live near highways express measurably higher risk factors for cardiovascular disease, we have measured and modeled near-highway air pollution in an urban residential neighborhood. The goal of this research is to develop a model to predict hourly pollutant concentrations in an urban environment 20–500 m from a highway using measured pollutant concentrations for calibration. The study was conducted in a residential neighborhood of Somerville, MA near Interstate 93 (>100,000 vehicles per day).

Methods: A mobile laboratory housing a suite of rapid-response instruments was used to monitor particle number concentration (7–225 nm), CO, and other pollutants in an 8000 m^2 area bisected by the highway. Monitoring was done from July 2009 to August 2010 at different times (morning, evening, weekdays, weekends) so as to capture temporal as well as spatial variations in pollutant levels. A line-source Gaussian dispersion model (CALINE4) was used to predict particle number and CO concentrations in the study area. ArcGIS was used (1) to create a model-input grid of receptor points within the 8000-m^2 area and (2) to produce contour maps of predicted pollutant concentrations. Particle emission factors were estimated by fitting the contour plots to a subset of the monitoring data because available emission factor programs (eg, MOBILE6.2) address particles by mass rather than number.

Results: Visual comparison indicates generally good agreement between modeled and measured results for particle number concentration and CO. The estimated emission factor for particle number concentration (7–225 nm) was on the order of 10^{14} particles/(vehicle-mile).

Conclusion: An estimated emission factor for particles was found to be in agreement with the literature. The results of this work could yield more accurate estimates of exposure in near highway health studies.

PP-30-003

Validation of Traffic Exposure Surrogates Against a Biomarker of Internal Dose Among Nonsmoking US Population

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Background/Aims: Epidemiological studies investigating the association between traffic exposure and asthma morbidity have used various surrogates to estimate personal exposures. Little work has been done to validate such surrogate measures of traffic exposure against a gold standard. We validate various indices of traffic exposure against a biomarker of exposure in a large and representative US sample from the National Health and Nutrition Examination Survey.

Methods: We linked data for 21,161 National Health and Nutrition Examination Survey respondents from 2001 to 2004 with traffic data from the National Highway Planning Network. We used Geographic Information Systems (GIS) to calculate the distance between the geocoded home address and the closest high-traffic road, and annual average daily traffic. We developed a traffic density index (DensitIndex) and a composite measure of exposure (CompExp) within buffers of various radii (100, 300, and 500 m). We used multivariate survey regression to estimate the association between the biomarker of exposure (1-hydroxypyrene 1-OHP) and the various surrogate measures of exposure to traffic exhaust among nonsmokers, adjusting for demographic characteristics and serum cotinine levels.

Results: A total of 3279 nonsmoking adults (30% of adults in the study population) and 1983 children and adolescents (9% of study population) had biomarker data. Our results show moderate but statistically significant correlations between 1-OHP and DensityIndex and CompExp, but not distance. Respondents in the lowest quartile of CompExp have higher 1-OHP levels compared to respondents in lowest quartile of distance.

Conclusion: The new surrogate indices of exposure to traffic-related air pollution are associated with the biomarker of exposure, suggesting that the new developed indices are better suited to approximate individual-level exposure traffic exhaust. The exposure surrogates that have been validated against the biomarker will be useful in minimizing the impact of measurement error in future epidemiological studies of exposure to traffic-related air pollutants.

PP-30-005

Impact of Emissions From Aluminum Electrolysis Plants on Ambient Air Pollution and Children's Health

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Background/Aims: We studied 2 aluminum-producing plants located in the cities of Kamensk-Uralsky and Krasnoturinsk (Middle Urals), emitting pollutants that lead to multicomponent environmental contamination. The change from Soderberg to prebaked anodes implemented early this century for some of the electrolyzers in Kamensk-Uralsky has allowed total atmospheric emissions to be reduced 3.5 times. The purpose of our study was to compare the levels of ambient air pollution and the health status of children exposed to such pollution in these towns.

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Methods: We studied ambient air pollution with particulates, fluorides, benzo(a)pyrene, aluminum, alkali, and nitrogen dioxide during the warm and cold seasons of 2004 at a distance of up to 3 kilometers from the aluminum plants. Information on the health status of children aged 3–7 dwelling in the same areas was obtained from official child development histories over 2003–2006. The association of health with ambient air pollution was analyzed using linear multiple regression models.
Results: The maximum daily average concentrations in Krasnoturinsk and Kamensk-Uralsky were (in mg/m^3) respectively 0.0295–0.0666 and 0.012–0.041 for HF, 0.0451–0.1043 and 0.02–0.06 for low soluble fluorides, 0.0000201–0.0000438 and 0.000005–0.000018 for benzo(a)pyrene, 0.0216–0.0477 and 0.009–0.014 for NaOH, and only for daily average concentrations of particulate matter 10 (35.8, standard error 16.4 μ/m^3 and 45.4, standard error 21.75 μ/m^3). The difference had an opposite sign being statistically nonsignificant. The incidence of acute illness in children was higher in Krasnoturinsk than in Kamensk-Uralsky, due, mainly, to respiratory diseases: 1080.3%–1192.9% and 833.7%–887.0%, respectively. Acute respiratory disease was associated with concentrations of HF (β = 106715.1, 95% confidence interval [CI]: 38597.6–174832.5) and TSP (β = 776.14, 95% CI: 569.3–982.9), whereas chronic respiratory disease with particulate matter 10 (β = 6360.90, 95% CI: 2247.9–10473.8).
Conclusion: Industrial emissions from aluminum electrolysis plants contaminate the environment of adjoining residential areas (particularly where the use of Soderberg anodes continues) demonstrating association with considerable impairment to children's health.

PP-30-006

Association Between Ambient Air Pollution and the Hospital Emergency Room Visits for Respiratory Diseases: A Case-crossover Study

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Background/Aims: Using case-crossover design to explore the association between ambient air pollution and the hospital emergency room visits for the respiratory diseases (International Classification of Diseases, the 10th vision ICD-10:J00-J99) in Beijing, China.
Methods: The daily data of the hospital emergency room visits of the respiratory diseases (ICD-10:J00-J99) and ambient air pollution were obtained for the period between 1 January 2004 and 31 December 2005 from Peking University Third Hospital and Beijing Municipal Environmental Monitoring Center, respectively. The relevant meteorological data were collected from China Meteorological Data Sharing Service System. Time-stratified case-crossover analysis was used to evaluate the association between the exposure to air pollution and related respiratory health outcomes with both unidirectional and bidirectional control sampling approach. The results of the bidirectional control sampling approach have been compared with unidirectional approach.
Results: In the unidirectional control sampling approach, the analysis results of a conditional Logistic Regression Model (multipollutant model) showed that each 10 μg/m^3 increment in the ambient particulate matter (PM_{10}), SO_2, and NO_2, the corresponding odds ratio of emergency room visits for the respiratory diseases in the hospital were 1.010 (95% confidence interval [CI]: 1.005–1.014), 1.010 (95% CI: 1.001–1.018), and 1.001 (95% CI: 0.983–1.009), respectively, after controlling for the meteorological variables. In the bidirectional control sampling approach, the ORs were 1.002 (95% CI: 0.998–1.005), 1.011 (95% CI: 1.003–1.018), 1.012 (95% CI: 1.001–1.022). The result almost remains stable within both approaches.
Conclusion: The study provides evidence that higher levels of ambient air pollutants increase the risk of hospital emergency admissions for respiratory diseases.

PP-30-007

Air Pollution and Survival Within a Cohort: Risks of Criteria and Other Pollutants

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Background/Aims: Epidemiological studies most often make use of air pollution measurements undertaken for other purposes, most often regulatory purposes. The number of pollutants measured is limited; in the United States, only 6 pollutants are measured widely and regularly, and even these are not measured daily. A smaller network of monitors measures several particulate matter components (ions, sulfates nitrates, elemental carbon [EC]/organic carbon), again not on a daily basis. These limitations limit the statistical power for times series analyses of acute health effects, but they do allow estimates of the longer-term exposure to specific pollutants in several communities. In addition to these monitored pollutants, there is a list of 188 hazardous substances for which a detailed emissions inventory is obtained. The US Environmental Protection Agency uses this inventory to model ambient concentrations of these substances.
Methods: This study attempted to relate the mortality experience of a cohort of about 70,000 male veterans to the levels of the various pollutants in their communities. In single pollutant models, several particulate matter components were related to mortality after adjustment for personal and community risk factors. These included EC, nitrate, vanadium, and nickel.
Results: When these variables were included in a model with a measure of traffic density, their significance disappeared; only EC remained near significance. When the exposure estimates for the hazardous substances were related to mortality and remained significant in the presence of a traffic density variable. These included benzene, formaldehyde, nickel, polycyclic organic compounds, none of which are routinely measured.
Conclusion: These results suggest the importance of monitoring and studying these compounds further and raise the possibility that currently monitored pollutants could be serving as indicators or surrogates for some of the unmonitored compounds.

PP-30-008

Receptor Modeling of Particulate Matter Personal Exposure for an Elderly Population in Tianjin, China

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Background/Aims: Personal exposure to particulates has been proved to have a major impact on human health. For the elderly as vulnerable population, personal exposure and sources assessment are especially needed.
Methods: In this study, a total of 81 elderly participants are selected and monitored during summer and winter of 2009. 24-hour average particulate matter personal exposure, and simultaneously compared with residential indoor and outdoor particulate matter (PM_{10}) concentrations were measured in Tianjin, China. Participants were asked to carry 2 personal samplers, one was loaded with a Teflon filter and the other with a quartz filter. All filters were analyzed for mass, organic carbon/elemental carbon, selected elements, and ions. CMB and PCA-MLR receptor models were implied to analyze related sources and contributions.
Results: Motor vehicle emissions were the largest external sources, and cooking was the largest internal source in this study. External factors contributed 63% to personal exposure with the largest contribution from motor vehicle emission (38%).
Conclusion: In all, 4 external sources (motor vehicle emission, soil, sulfate, and sea-salt) and 3 internal sources (environmental tobacco smoking and its mixture, personal care/activity, and cooking) were resolved.

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PP-30-010

Mass Calibration and Relative Humidity Compensation Requirements for Optical Portable Particulate Matter Monitors: The IMPASHS (Impact of Smoke-free Policies in Eu Member States) Wp2 Preliminary Results

Ario Alberto Ruprecht,[1] Giovanni Invernizzi,[1,2] Bertrand Dautzenberg,[3] Luke Clancy,[4] Josè Precioso,[5] Cinzia De Marco,[1] Roberto Boffi,[1] Roberto Mazza,[1] Maria Josè Lopez,[6] and Hanns Moshammer[7] *[1]Istituto Nazionale Tumori, Milan, Italy; [2]SIMG, Milan, Italy; [3]OFT, Paris, France; [4]Research Institute for a Tobacco Free Society, Dublin, Ireland; [5]Universidade do Minho, Braga, Portugal; [6]Agencia de Salut Publica, Barcelona, Spain; and [7]Medical University, Wien, Austria.*

Background/Aims: Better knowledge of particulate matter concentrations needs portable, reliable, user friendly, low cost, real time mass analyzers of particulate matter ($PM_{2.5}$) and PM_{10}. Optical particle counters (OPC) measuring mass have manufacturer calibration specific gravity "K" factor referred to polystyrene latex particles, which are completely different than those of the real world; therefore, they require specific calibrations. Measurements are also subject to relative humidity (RH) heavy interference. The aim of this study is to evaluate, within the Impact of Smoke-free Policies in Eu Member States WP2 Project, the performance of 4 different OPC's in environmental tobacco smoke and background urban pollution and to find the new "K" factors using 1 Model BAM-1020 with certificate number EPQM-0798-122 for comparison.

Methods: All instruments have been operating in parallel measuring $PM_{2.5}$ generated by cigarettes (ETS) indoor and by urban pollution outdoor, and the data were replicated 3 times.

Results: "K" factors were widely different between manufacturer's model, instrument serial numbers, ETS, and urban pollution, ranging from 0.5 to 2.27. Correlation with BAM-1020 was ranging from 0.7500 to 0.9800 and Student *t* test from 0.3000 to 0.9500. RH interference resulted mathematically compensable up to 75% RH, but above becomes uncontrollable and sample drying becomes compulsory.

Conclusion: OPCs are very reliable and accurate, but need specific calibration and special care in handling and elaboration of the measurements.

PP-30-011

Study on the Status and Distribution of Ultrafine Particles During Beijing Olympics in 2008

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Background/Aims: The air quality during Beijing Olympics in 2008 had been dramatically improved. The aim of this study is to explore characteristics of the size distribution and ambient behavior of fine and ultrafine particles (UFPs) during the Beijing Olympics and the influential factors to number concentration of UFPs.

Methods: The monitoring has been performed in Beijing, China during 31 July 2008–8 September 2008. Using Ultrafine Particle Monitor Model 3031 produced by US TSI incorporated to monitor the daily number concentration of 20–500 nm particle matter, then use Excel 2003 and SPSS 13.0 to arrange and analyze the data of the monitoring.

Results: During the Olympics, the mean value of the 20–100 nm particulate matter's number concentration is 5920.43/cm^3. The 30–50 nm particles contributed to the largest portion of all size resolutions. There are 2 peaks showed on the curve of 24 hours' number concentration of 20–100 nm particles, which are at afternoon and at evening, respectively.

Conclusion: This paper indicates that the number concentration of ultrafine particles showed considerable reduction in the 2008 Olympics compared to the pre-Olympics years. In Beijing and in the developed country, the different size resolution of the particles, which contributed to the largest portion of 20–500 nm particle matter, indicated that the sources of the particles may be different in these 2 places. And the observations of the curves indicated that the number concentration of the UFPs is related to the traffic volume and photochemical reaction. Also there are significant correlations between number concentration and temperature as well as relative humidity.

PP-30-013

Spatial Distribution of Nitrogen Oxides and Particulate Matter Concentrations in Taipei

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Background/Aims: Spatial patterns of nitrogen oxides (NOx) and particulate matter (PM), 2 major traffic-related air pollutants in urban environments, have not been characterized in most cities. The purpose of this study is to characterize horizontal and vertical distributions of NOx, PM concentration distribution, and investigate factors affecting their distributions in Taipei.

Methods: We used a population density based sampling strategy to select 40 locations as our sampling sites in Taipei, including 20 urban background sites at small alleys with limited traffics and 20 traffic background sites neighboring roads with 4–6 lanes. Among these monitoring sites, 11 sites were used to characterize vertical profiles of NOx in Taipei. We used Ogawa passive samplers to measure NOx and NO_2, and Harvard impactors to measure PM_{10}, $PM_{2.5}$ simultaneously for 2 weeks per season for 2 seasons during 2009–2010.

Results: NOx concentrations at traffic sites (46.6 ppb) were significantly higher than the urban background sites (31.1 ppb). And $PM_{2.5}$ concentration at traffic sites is 2.72 $\mu g/m^3$ higher than at urban sites. PM_{10} concentration at traffic sites is 9.05 $\mu g/m^3$ higher than at urban sites. Seasonal difference was significant for both NOx and PM concentrations. On the aspect of the vertical profile of NOx, the NOx and NO_2 concentrations at 4th–6th floors were 0.79 times and 0.75 times lower than the concentrations at first—third floors, the NOx and NO_2 concentrations at seventh—eighth floors were 0.64 times and 0.67 times lower than the concentrations which at first—third floors, respectively. There is a significant difference between our sampling results and the monitoring data from fixed-site stations nearby.

Conclusion: Our study indicates that traffic pattern is an important factor for influencing the spatial distributions of both NOx and PM in urban environments.

PP-30-014

Ambient Exposure to Criteria Air Pollutants and Risk of Death From Bladder Cancer in Taiwan.

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Background/Aims: To investigate the relationship between air pollution and risk of death from bladder cancer, the authors conducted a matched case-control study using deaths that occurred in Taiwan from 1995 through 2005.

Methods: Data on all eligible bladder cancer deaths were obtained from the Bureau of Vital Statistics of the Taiwan Provincial Department of Health. The control group consisted of people who died from causes other than cancer or diseases associated with genitourinary problems. The controls were pair matched to the cases by sex, year of birth, and year of

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death. Each matched control was selected randomly from the set of possible controls for each case. Classification of exposure to municipality air pollution was based on the measured levels of nitrogen dioxide and sulfur dioxide.

Results: The results of the present study show that there is a significant positive association between the levels of air pollution and bladder cancer mortality. The adjusted odds ratios (95% confidence interval) were 1.37 (1.03–1.82) for the group with medium air pollution level and 1.98 (1.36–2.88) for the group with high air pollution level when compared to the group with the low air pollution level. Trend analyses showed statistically significant trend in risk of death from bladder cancer with increasing air pollution level.

Conclusion: The findings of this study warrant further investigation of the role of air pollutants in the etiology of bladder cancer.

PP-30-015

The Trend of Atmospheric Ozone Concentration in Taiwan, 1996–2009

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Background/Aims: Taiwan's small landmass and dense population, coupled with increasing numbers of motor vehicles caused all sorts of respiratory problems in Taiwan's population. In 1995, the Taiwan government established a limitation policy on the amount of primary pollutants; however, secondary pollutants such as ozone were still on the rise.

Methods: To utilize the statistical values taken during 1996–2009 from the monitoring stations in the downwind regions of the Northern, Central, and Southern parts of Taiwan, operated by Taiwan's environmental protection agency, and doing an analysis.

Results: From 1996 to 2009 monitoring stations situated in the North, Central, and South of Taiwan showed increasing ozone concentration, and significant difference ($P = 0.7 \times 10^{-3}$, $P = 1.73 \times 10^{-5}$, $P = 0.4 \times 10^{-2}$). During April–May and October, noticeable peaks were observed in the maximum hourly and maximum 8 hours moving average ozone concentration in a day. From 1996 to 2009, the maximum hourly value of ozone concentration did not show significant difference, with the maximum value being in the range of 55–62 ppb, 64–83 ppb, 71–87 ppb in the North, Central, and Southern parts of Taiwan. From 1996 to 2009, a decrease in the concentration of NOx has been observed.

Conclusion: The decreasing concentration of NOx and increasing concentration of ozone could be a result of decreasing NO titration effect. The ozone concentration is increasing yearly, especially during the spring and autumn seasons. Ozone causes respiratory health problems, and by reducing motor vehicle pollution, we can lower the concentration of ozone in our air and bring better health to the citizens of Taiwan.

PP-30-016

Spatial Estimation of Industrial Sources Allocation for Improved Exposure Assessment in the Human Health Risk Assessment Studies

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Background/Aims: Modeling and prognosis of human exposure to ambient air pollution are dependent on a number of factors among which industrial sources correct location, and their proximity to the residential area is not the least. In human health risk assessment studies on the stage of exposure estimation, Ukrainian scientists use the inventory papers (official and obligatory document for the plants in Ukraine) as the initial source of input data for the identification of sources geographical coordinates. The aim of the study is to analyze the industrial sources location and the difference between the real positions and coordinates provided in inventories.

Methods: Satellite data for the period 2008 and plant schemes were used to define the exact location of the sources of industrial enterprises in Zaporizhia. Within the urban area of the city, coordinates of the 544 sources of 5 industrial enterprises were identified on the satellite map of the city, compared with inventory data and corrected with the help of ArcGis 9.x tools. Difference between source coordinates provided in source inventory papers, and real position was revealed and calculated for the 114 sources.

Results: The location of the 21% of the studied sources was false and needed to be corrected. The average value of the shift for X-coordinate of the point sources is ΔX average = 32.65 meters and ΔY average = 28.37 meters for the Y-coordinate. Therefore, before the ambient air pollution modeling, the sources position was changed. The shift was done predominately in the western and northern directions bringing the sources of emission closer to the densely populated residential areas.

Conclusion: The source location analysis showed a frequent failure in the sources coordinates provided in inventory papers. Source allocation correction should be conducted for each studied enterprise or area before the population exposure estimation of the human health risk assessment study.

PP-30-017

Peculiarities of Exposure Assessment for the Population Living in the Zones of Chemical Pollution of Ambient Air

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Background/Aims: Estimation of the pollutant concentration in the ambient air is one of the key stages of human exposure assessment for the population that is living on the territories with high levels of air pollution. Exposure assessment requires calculation of concentrations for different averaging periods depending on the acute or chronic and prolonged effects. The study was aimed at analysis of the pollutant concentration calculation approaches described in OND-86 methodology that is applied for emission regulations in Ukraine and methods introduced by United States Environmental Protection Agency and program complex AERMOD View.

Methods: The comparison was done on the results of the calculation that included 27 industrial enterprises with low point sources of cold emissions. The average height of the stacks is 16.5 ± 1.8 meters (median = 18.2 meters, maximum = 23 meters, minimum = 2 meters), average temperature of the emissions equals 36.6°C ± 1.8°C (median = 55.1°C, maximum = 89°C, minimum = 25°C). Calculations were done for 17 polluting substances in the uniform polar receptors grid that was divided into 5 intervals according to 8 direction radials.

Results: Maximum 20-minutes concentrations were calculated according to the OND-86 approach. Average 1 hour, 24 hours, and annual concentrations were modeled in AERMOD view. The comparison shows that maximum 20-minutes concentrations are applicable for the estimation of acute effects. Analysis of the chronic effects can be done if the concentration averaging period equals at least 24 hours. The correlation analysis of the maximum 20-minutes and 1-hour concentrations, as both samples comply with requirements of the linear dependence, proved statistically the hypothesis of absence of the correlation between maximum 20-minutes and 1-hour concentrations.

Conclusion: This study proves the necessity of changes in the Ukrainian air quality regulating legislation and orientation on the official application of ambient air pollution modeling programs that allow to receive not just maximum concentrations for 20 minutes interval but wider diapasons of meanings for longer averaging periods.

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PP-30-018

Identifying Cities for Enhanced Fine Particulate Matter Speciation Monitoring

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Background/Aims: Epidemiologic studies have demonstrated adverse human health effects of particulate matter ($PM_{2.5}$); $PM_{2.5}$ constituents; and gaseous criteria air pollutants including CO, NO_2, SO_2, and O_3. The current monitoring network covers most major US metropolitan areas. However, most PM constituents collected at Speciation Trend Network monitors are measured only 1 in 3 days or 1 in 6 days, complicating time-series analyses. Since limited resources will support daily monitoring at only a few locations, the major metropolitan areas selected should maximize the pollutant concentration levels and variances, and minimize the covariance between pollutants.

Methods: We focused on 48 cities with Speciation Trend Network monitors from 2001 to 2005. We examined the concentration and variability for the gaseous criteria air pollutants and fine particle components, determined their correlations with $PM_{2.5}$ mass, and evaluated regional and seasonal patterns. We chose $PM_{2.5}$ species based on their potential to be markers for a particular source including coal combustion, residual oil fly ash, wood smoke, mobile sources, crustal elements, and road salt.

Results: Regardless of season or region, markers of coal combustion (S and SO_4) were strongly (>0.7)-to-moderately (>0.5) correlated with $PM_{2.5}$ mass. Strong correlations with wood smoke (K, Br, and Ca) were seen in some cities, usually in the western part of the US during the winter. Elements associated with mobile sources (EC, OC, Zn, and NO_3) were at least moderately correlated with $PM_{2.5}$ in most cities, exhibiting different geographical and seasonal patterns. The correlations between $PM_{2.5}$ and O_3 were negative in the winter and positive in the summer, and showed some regional differences. Finally, markers of residual oil fly ash, crustal sources, and road salt were moderately correlated with $PM_{2.5}$ in a small percentage of cities.

Conclusion: Concentrations, variability, and relationships with $PM_{2.5}$ differed by pollutant, region, and season. These factors can help identify the metropolitan areas for daily speciation monitoring.

PP-30-019

Spatiotemporal Patterns of Ultrafine Particle Counts and Fine Particle Mass in Neighborhoods Surrounding an Airport

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Background/Aims: Previous studies have demonstrated significant contributions from aircraft to ultrafine particle counts near airports, but studies to date have not characterized spatial patterns in residential settings near airports and have not formally isolated the contribution of aircraft from other local sources. In this study, our objective was to determine the contribution of landing and takeoff (LTO) activity to concentrations of ultrafine particles as well as fine particulate matter ($PM_{2.5}$) near TF Green Airport in Warwick, RI.

Methods: A mobile monitoring protocol was implemented in 2 one-week campaigns in the spring and summer of 2008. Field teams were outfitted with backpacks containing water-based condensation particle counters to measure ultrafine particle levels, continuous monitors for $PM_{2.5}$, and a GPS. Mobile sampling routes captured neighborhoods in all compass directions and were implemented to ensure sufficient spatiotemporal coverage. Regression models included as predictors of concentrations meteorological characteristics, source terms, and distance variables. To better pinpoint the timing in the LTO cycle most contributing to elevated concentrations, and to capture variability across aircraft and the spatiotemporal complexity of our data, we used distributed lag models for flight activity and incorporated emissions proxies for all individual aircraft.

Results: Results suggest significant positive associations between ultrafine particle concentrations and both departures and arrivals, with departures having larger effects and the distributed lag modeling indicating the strongest association with predeparture taxing and the take-off process. Causal linkages with the LTO cycle were further enhanced by generalized additive models for wind speed and direction, which demonstrate an enhanced signal from LTO activities at higher wind speeds with a greater indication of local traffic contributions at low wind speeds.

Conclusion: Our analysis allows for quantification of the marginal contribution of airport sources and characterization of spatiotemporal concentration patterns, providing insight for urban communities regarding the impact of airport activities on local air quality.

PP-30-020

Symptom Severity of Atopic Dermatitis and Indoor Exposure to Air Pollutants in a Child Day Care Center

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Background/Aims: The aim of the present study is to determine the effect of climate factors and indoor air quality on triggering symptoms in children with atopic dermatitis.

Methods: The study subjects were 21 children (mean age of 4.8 ± 1.4 years) from a Public Child Day Care Center over a 7-month period beginning on May 2009. Each teacher recorded an atopic dermatitis diary, which consisted of scores on daily pruritus index, daily activity schedule, and 10 questions on indoor environmental characteristics. Daily pruritus index was scored using a 0–10 grading scale. We measured 24 hours daily indoor air quality; particulate matter (PM_{10}), $PM_{2.5}$, $PM_{1.0}$, NO, NO_2, NOx, and volatile organic compounds (VOCs) (benzene, toluene, ethyl-benzene, xylene, styrene, and total VOCs). We have analyzed a correlation between environmental factors and symptom severity.

Results: We found a strong correlation between pruritus index and temperature, humidity, PM_{10}, NOx, toluene, and benzene. The children's pruritus index consistently negatively correlated with temperature and humidity increased ($P < 0.05$), but had a positive correlation with PM_{10} and $PM_{2.5}$. Concentration of VOCs had a varying degree of positive correlation with symptom on each child.

Conclusion: It is suggested that climate factors and indoor air pollutants play a significant role in triggering symptom of atopic dermatitis. Further studies are required to ascertain the relationship between atopic dermatitis severity and daily activity, and indoor environmental characteristics.

PP-30-021

Indoor Air Quality and Allergic Disease in Elementary School Children

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Background/Aims: The purpose of this study is to investigate allergic diseases related to allergy caused by the exposure to indoor and outdoor sources of air pollution in elementary schools.

Methods: The symptoms questionnaire of allergic diseases based on the International Study of Asthma and Allergies in Childhood was completed by the participants. The past and present status of asthma, allergic rhinitis, eczema, and allergic conjunctivitis were investigated by providing a questionnaire to all the participating children. Questionnaires were sent to a total of 61,350 children from 438 elementary schools.

Results: A total of 40,522 children responded to the questionnaire, which represents a 66.1% return rate. Volatile organic compounds, aldehydes, and particulate matter (PM_{10}) were measured and analyzed from October to December 2006, in 82 elementary schools. Based on the survey, the level of indoor air contamination did not appear to be high, but 27.2% of the schools evaluated have exceeded the PM_{10} levels specified by the school health guidelines.

Conclusion: Statistically significant relationships have been observed between the prevalence rate of allergic rhinitis and conjunctivitis and indoor air quality of primary schools in Korea. In addition, the prevalence rate of allergic diseases demonstrated a relationship depending on the regional outdoor environment.

PP-30-022

Intake Fractions for Vehicle Emissions in 88 Worldwide Urban Areas

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Background/Aims: Among the major sources of outdoor urban air pollution, vehicular emissions have especially high associated intake fractions (iF), owing to the emissions occurring at ground level in close average proximity to people. We model iF to primary motor vehicle emissions for 88 urban areas worldwide. The study extends for the first time the coverage of existing vehicle iF research to a large set of high-population developing world cities.

Methods: We use a single-compartment Eulerian model to estimate iF for a global sample of urban areas that span a large range of population size (range, 140,000–12.4 million), population density, and income levels. We develop demographic and meteorological model inputs for each city using publicly available datasets with global coverage. We test the sensitivity of modeled iF to a range of assumptions about urban form, meteorology, and diurnal variability in emissions.

Results: For emissions of a conserved pollutant, the median, population-weighted mean, and inter-quartile range of intake fractions (units: ppm) are 24, 71, and 8–54, respectively. Intake fraction is strongly influenced by low nighttime mixing heights; averaged over all cities, iF is approximately 7 times greater at night than during the day. The median iF for cities in Asia and Africa (30 ppm) is approximately 3 times greater than for cities on other continents. Cities with population >10 million have very high median iF (91 ppm). We find that modeled iF is sensitive to the choice of meteorological interpolation technique and the assumed diurnal emissions profile.

Conclusion: The population-weighted mean iF for our global sample of urban areas is approximately 5 times larger than previous estimates of vehicle iF based on US and European cities. Our results suggest that emissions reductions in certain contexts—such as in large developing world cities, or during winter nights—may lead to especially high exposure benefit per ton of avoided emissions.

PP-30-023

Automobiles and the Deterioration of Environmental Health in the City of Guadalajara, México

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Background/Aims: Jalisco is the second most populated state in Mexico, showing a 28% growth in population from 1990 to 2010, while the number of automobiles increased by 142%. The aim of this study is to analyze whether this increase in the state's vehicle fleet has also brought an increase in ozone pollutants, to what degree, and whether this increase is linked to the increase in deaths due to respiratory illnesses.

Methods: This is a descriptive and longitudinal study taking into account the period from 1996 to 2006, which variables include the number of automotive vehicles, the days on which ozone levels surpassed 0.11 ppm, and the number of deaths due to acute respiratory illnesses.

Results: In 1996, vehicles not equipped with a catalytic converter provoked an increase in pollution. Thereafter, vehicles equipped with catalytic converters were incorporated to the fleet, replacing half of the vehicles without converters; this brought about a decrease in pollution. Nevertheless, the benefits of the new technology were neutralized when the number of vehicles exceeded 600,000 and pollution again began to increase as of 2001. The determination coefficient found in this study shows that, approximately, the number of days per year with exposure levels above 0.11 parts per million/h of ozone, accounts for 64% of the total variation in deaths due to acute respiratory infection.

Conclusion: The number of private cars doubles every 7 years, which has resulted in the burden of pollutants to surpass the ecosystems regulatory capacities regarding air quality, despite 66% of the cars being equipped with a catalytic converter; this has brought about an increase in the frequency of days exceeding exposures to 0.11 ppm of ozone per hour. The number of days per year on which the safety norms for ozone are exceeded can be associated to the increase in deaths due to acute respiratory infections ($r = 0.80$).

PP-30-024

Characteristics of Volatile Organic Compounds: Concentrations and Source Identification for Indoor and Outdoor Hospital Waiting Areas in China

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Background/Aims: Volatile organic compounds (VOCs) may result in adverse health effects and are regarded as important indoor air pollutants. Although there are many studies about indoor VOCs, little is associated with VOCs pollution in the hospitals, especially waiting areas. This study is aimed to investigate the pollution status and explore the sources of VOCs in hospital waiting areas.

Methods: Samples were collected from 9 waiting areas of 3 hospitals in Beijing. According to the prevalence, abundance, and toxicity, 65 target compounds were detected and quantified by preconcentrator-GC/MS system. Indoor/outdoor ratios, correlation analysis, and principal component analysis (PCA) were performed to investigate the characteristics of emission sources.

Results: More than 100 VOCs species were detected in indoor and outdoor air. The average VOCs concentration was 123.64–713.22 $\mu g/m^3$. Toluene, xylenes, ethylene, and benzene were the most abundant aromatics with indoor concentrations significantly higher than that of outdoors except benzene. High levels of toluene and xylenes were found exceeding the indoor air standard of China (2003) in some waiting areas.

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Strong correlation between indoor and outdoor air for benzene, n-hexane, and toluene was observed in indoor air with low indoor–outdoor ratio values. VOCs like n-nonane, decane, undecane, m/p-xylene, and tetrachlorethylene were about 3–4 times the concentration of outdoor air with weak correlation. Three factors were extracted by PCA from outdoor samples and accounted for 62.03%, 17.70%, and 10.23% of the variance, respectively. For the indoor samples, the PCA identified 4 factors that explained 36.24%, 21.86%, 18.01%, and 9.05% of the variance, respectively.

Conclusion: This study present a clear picture of the characteristics of VOCs in different waiting areas of hospitals. The major components were aromatics, alkanes, and alkenes that accounted for 61%–98% of the total contents. The indoor–outdoor values of most VOCs exceeded 1, indicating that indoor sources existed. Variability in indoor waiting areas was dominated by compounds associated with construction materials and furnishings followed by diesel emission, cleaning products, and industrial emission.

PP-30-025

Emergency Room Visits Due to Cardiovascular Illness From a Major Hospital of Chennai, India

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Background/Aims: Cardiovascular disease is one among the leading causes of hospitalization. Air pollution exacerbates the condition of people with cardiovascular disease and causes measurable increase in the visits to the hospital. Emergency room visits (ERV) can be a direct result of short-term exposure to air pollution. The objective of this study was to collect the ERV because of cardiovascular illness from a major government hospital of Chennai for a period of 3 years and to evaluate the feasibility of using the available particulate matter (PM_{10}) data so as to examine the association between PM_{10} and ERV.

Methods: Hospital data of ERV for the years 2006, 2007, and 2008 because of cardiovascular illness were collected from the Medical Records Department of a major government hospital of Chennai and was categorized by gender and age. PM_{10} data were collected from the Tamilnadu Pollution Control Board.

Results: A 60% increase in ERV because of cardiovascular disease from 2006 to 2008 was observed. The number of males reported for ERV was higher than females. The maximum number of visits among the adults was in the age group of 45 to 65 years. From the perspective of seasonal variation, the maximum number of ERV was observed between January and March. The PM_{10} level has shown a 50% increase from 2006 to 2008. It was also observed that the PM levels were highest during January to March, suggesting that air pollution plays a role in increasing the morbidity due to cardiovascular illness.

Conclusion: There is a need for further investigation on the negative effects of air pollution overcoming the challenges of data quality from developing countries. Efforts are underway to carry out time series analysis over the same period. This will allow generation of coefficients for multiple pollutants and multiple acute health outcomes, which is not well established in India.

PP-30-026

Characteristics of Surface and Bulk Elemental Composition of Ambient $PM_{2.5}$ in 5 Chinese Cities During Spring of 2008

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Background/Aims: To study the characteristics of bulk and surface elemental composition of ambient $PM_{2.5}$ in 5 Chinese cities, which are differently affected by sand-dust events.

Methods: Between 16 April and 17 May, 2008, ambient $PM_{2.5}$ were sampled in sand-dust source terrains (Hotan city) and in sandstorm-affected zones (Korla, Dunhuang, Lanzhou, and Beijing). X-ray photoelectron spectroscopy and x-ray fluorescence were used to analyze surface elemental composition, chemical states, and total elemental composition of $PM_{2.5}$, respectively. The elemental data were also processed using factor analysis to identify their sources.

Results: The surface and bulk elemental composition of ambient $PM_{2.5}$ among different cities varied significantly. In Beijing and Lanzhou, the percentages of surface elements (carbon-containing compounds, nitrogen-containing compounds, and sulfate), as well as bulk elements (zinc, sulfur, copper, and lead), were much higher than those in the other 3 cities. In Hotan and Korla city, the surface and bulk element contents (sodium, iron, calcium, potassium, chlorine, silicon, aluminum, and magnesium) of $PM_{2.5}$ were significantly higher than those in Beijing and Lanzhou; zinc, iron, and magnesium were found to be enriched on the surface of $PM_{2.5}$. Following are the results of factor analysis:

1. Bulk and surface elements such as sodium, iron, calcium, potassium, chlorine, silicon, aluminum, and magnesium came from natural sources, whereas zinc and sulfate came from anthropogenic sources;
2. Surface elements including aliphatic carbon, carbon combined with nitrogen, carbonyl carbon, organic nitrogen, and ammonium salt were anthropogenic pollutants;
3. Of bulk elements, manganese came from natural sources, whereas copper and lead came from anthropogenic pollutants.

Conclusion: In the areas that were seriously affected by sandstorm, the bulk and surface elemental composition of $PM_{2.5}$ had greater proportion of natural sources, whereas in the areas less affected by sandstorm, the elemental compositions had greater proportion of anthropogenic sources.

PP-30-027

Observed Smoking in Car: Results of a Study From the National Health Prevention Service of Veneto, Northern Italy

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Background/Aims: Smoking in car represents an exposure to extremely high levels of environmental tobacco smoke (ETS). The aim of this study is to evaluate the frequency of people smoking inside cars or duty vehicles and the presence of children exposed to passive smoking on board.

Methods: Prevention technicians had to record, at crossings and roundabouts, driver's or passengers' sex and presumed age, to verify whether drivers or passengers were smoking, and whether there were children on board.

Results: A total of 5928 cars were examined, males accounted for 61% of drivers, smoking in car was reported in 409 (7%) cases, the smoker being mostly only the driver in 88% cases, only the passenger was the smoker in 8% of cases, and both the driver and a passenger in 4% of cases. Cars with observed smoking with children were 7 (1% of overall 762 with children on board).

Conclusion: Despite the efforts to limit the dangers of ETS among people, smoking in car is still a common behavior. Although observed

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smoking in car in the presence of children was found to be infrequent, too many children are still exposed everyday to ETS in cars.

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PP-30-028

Vertical Gradients of Residential Indoor and Outdoor Polycyclic Aromatic Hydrocarbons, Black Carbon, Particulate Matter in New York City

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Background/Aims: Proximity to major roadways has been associated with adverse health effects. However, characterization of the vertical gradient of traffic-related air pollutants in residential setting has been conducted rarely.

The objectives were the following: (1) characterize the seasonal vertical gradient of residential indoor and outdoor levels of polycyclic aromatic hydrocarbons (PAH; gas + particulate phase; dichotomized into Σ 8PAHsemivolatile (MW 178–206), and Σ8PAHnonvolatile (MW 228–278)), black carbon (measured as absorption coefficient [ABS]), particulate matter <2.5 μm ($PM_{2.5}$) by floor height; and (2) assess the relationships between traffic-related airborne pollutants, stratified by floor height.

Methods: Residential indoor and outdoor air levels of PAH, ABS, and $PM_{2.5}$ were measured over a 2-week period in a cohort of 5–6-year-old children (n = 261) living in New York City's Northern Manhattan and Bronx. These airborne-pollutant levels were analyzed by floor height. There were classified into 3 groups: ground level, floors 2–6, and floors 7 and higher.

Results: During the nonheating season, the median outdoor Σ8PAHnonvolatile concentration at ground level was 3–4 times higher than at floors 2–6 or floors 7 and higher. Regardless of season, indoor and outdoor ABS decreases as floor height increases. In indoor air, the correlations between Σ8PAHnonvolatile and ABS or $PM_{2.5}$ seem to be stronger at ground level compared with the higher floor heights.

Conclusion: Preliminary results suggest that young inner-city children living in apartment buildings may be exposed to different levels of air pollutants, depending on floor level and season.

PP-30-029

Quantification of Exposure by $PM_{2.5}$ From the Biomass Burning in the Brazilian Amazon: Estimative of Potential Dose

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Background/Aims: To assess exposure to particulate matter ($PM_{2.5}$) from the burning biomass in children aged between 6 and 15 years in Tangara da Serra, a municipality of Subequatorial Brazilian Amazon.

Methods: Descriptive study of exposure assessment to $PM_{2.5}$ in children, according to estimate of potential dose expressed by unit body weight (mg/kg/d). To calculate the dose of exposure to $PM_{2.5}$ inhaled by the children, the variables were used according to the recommendation of Risk Assessment Methodology (US Environmental Protection Agency, 1997): concentration of $PM_{2.5}$; rate of inhalation; frequency, time and duration of exposure; deposition and absorption of $PM_{2.5}$; and the child's body weight. The potential dose was described by age, gender, asthma, and seasonal climate. Exposure scenarios were carried out using the average concentrations of $PM_{2.5}$ during the dry and rainy season (9.55 and 46.70 $\mu g/m^3$), average concentration in the 10th percentile (13 $\mu g/m^3$), and 90th percentile (103.60 $\mu g/m^3$), both for dry season.

Results: During the dry season, children were exposed to potential doses of $PM_{2.5}$ 5 times more than those in the rainy season. The male children, aged 9–15 years and nonasthmatic, were exposed to the highest doses. During the dry season, male children showed a potential dose of 0.38 mg/kg/d of $PM_{2.5}$, whereas the girls showed an average of the dose of 0.32 mg/kg/d ($P = 0.007$). Nonasthmatic and asthmatic children were exposed to a potential average dose of 0.35 and 0.31 mg/kg/d, respectively ($P = 0.13$). The children aged 9–15 years were exposed to a potential average dose of 0.39 mg/kg/day of $PM_{2.5}$, with statistically significant differences in relation to children aged 6–8 years.

Conclusion: The male children aged more than 8 years residing in Tangara da Serra received the highest potential average dose of $PM_{2.5}$ independently of the presence of asthma.

PP-30-030

Development and Transferability of Land-use Regression Models For NO_2 and NOx in Southern California

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Background/Aims: Many studies have used land-use regression (LUR) models to estimate nitrogen dioxide (NO_2) and nitrogen oxides (NOx) pollution surfaces. However, the transferability of LUR models across geographic regions and time has received little attention except for a few recent studies. This work focused on LUR development, validation, and transferability on the basis of measured NO_2 and NOx concentrations in 2 adjacent regions in southern California, Orange County (ORA), and Los Angeles County (LA), and in different periods.

Methods: At approximately 50 sites in the ORA as well as in south LA, NO_2 and NOx concentrations were simultaneously measured 2 times in the summer and 2 times in the winter of 2009. On the basis of our 2009 measurements, LUR models are being developed by season and annually using meteorology, roadway network, traffic, point emission sources, population density, and land-use pattern data. These models will be compared with the LUR models developed previously based on NO_2 and NOx measurements taken between September 2006 and February 2007 at approximately 200 locations in LA.

Results: Preliminary models based on 2009 summer measurements in ORA and in south LA had R^2 values ranging from 0.6 to 0.8 and they shared common parameters, including wind speed, traffic counts close to (eg, within 100 m) and moderately away from (eg, within 1900 m) the sampling sites, and coordinates of the sites. Poor correlation was found between our LUR model outputs (summer) and the previously developed LUR model outputs (annual average) based on 2006–2007 measurements in LA. LUR models for winter and annual average will be developed and more comprehensive transferability will be examined spatially and temporally for the 2 sets of measurements and subsequent LUR models.

Conclusion: We expect that the transferability of LUR models will be poor if we do not take into account meteorology parameters and geographical differences between regions.

PP-30-031

Investigation on the Health Status of Coal Miners in Shanxi Province

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Background/Aims: Shanxi province is the main coal region in China. There were a great deal of coal miners in Shanxi Province, and the health status of coal miners should be caught our attention. The study could explore the occupational health status of the coal workers in Shanxi Province.

Methods: A total of 500 male coal miners working on coal digging and 250 male office workers in the same coal mine for 1 year were selected as exposure and control group, respectively. The personal health information, including the demographic status, occupational status, and diet, were collected with face-to-face interview conducted by the trained technician. We also monitored the concentration of the coal dust in the coal mine and reviewed the exposure history to the dust and symptoms for related occupational disease of the subjects.

Results: The average age of the subjects was 38.47 ± 10.47 years old (range, 19–59 years). The age distribution, working years on the mine, and food style were not significant difference between exposure and control groups. The range of total dust concentrations were 0.5–69 mg/m^3 (national criterion is 8 mg/m^3) and range of respirable dust concentrations were 0.2–5.0 mg/m^3 (national criterion is 5 mg/m^3) in the working environment. The symptom-related dust exposures such as cough, sputum, tired, memory letdown, joint ache, and audition descending were obviously increased in the miners who were over 35 years and in miners who had worked in the mine over 5 years ($P < 0.05$).

Conclusion: The health status of coal miners were obviously not good and associated with the working years for coal digging in the mine.

PP-30-032

Comparison of Particles in Exhaust From Swedish Environmental Classified Diesel Fuel (MK1) and EcoPar (Fischer-Tropsch Diesel Fuel)

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Background/Aims: Introduction of exhaust emission (particles and gases of diverse size and composition) from diesel vehicles contribute to environmental pollution.

Diesel particles are implicated in health effects such as eye irritations, respiratory disease, lung cancer, asthma, and cardiovascular disease; therefore, reduction of particles in exhaust are of primary importance.

The aim of this study was to evaluate the potential differences between 2 types of fuel with respect to particles and health symptoms.

Methods: Particles in the cab or lorry during driving were measured. Two types of fuel (MK1 environmental diesel and EcoPar) were evaluated for 2 weeks each.

Airborne particles (particulate matter [PM_{10}]) were measured with Dust-Trak and particles ranging from 0.02 to 1 μm (mainly ultrafine) were measured with P-Trak.

Relative air humidity, temperature, and CO_2 were measured with Q-Trak.

Health-related symptoms in drivers were monitored by assessment of questionnaire.

Results: The MK1 diesel contained petroleum distillate >99%, lubricating additives 500 ppm, rape methyl ester <5 volume %. EcoPar is C12–C26 alkanes >99%.

Ultrafine particles were 8% lower (4927 pt/cm^3) for EcoPar in comparison with MK1 diesel (5362 pt/cm^3). Diesel exhaust contained 50% to 90% ultrafine particles. The mean particle mass PM_{10} in the cab during driving was 0.023 mg/m^3 for MK1 diesel and 0.028 mg/m^3 for EcoPar. CO_2, temperature, and relative humidity were similar. Reported health effects were comparable between the 2 types of fuel.

Conclusion: The study was more of a pilot study and a small reduction of ultrafine particles with EcoPar was shown, and other published data have shown a reduction in nitrogen oxides, carbon monoxide, aromatic hydrocarbons, and particle mass for synthetic fuels.

The increased interest in development of synthetic fuel will likely have important implications in the future from an environmental perspective.

PP-30-033

Quantifying Changes in Population Exposures to Air Pollution in Great Britain From the 1960s to 1980s

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Background/Aims: The Chronic Health Effects of Smoke and SO_2 in the United Kingdom aims to establish whether long-term air pollution exposure in adult life is associated with cardiovascular and respiratory disease. A major component of this project is modeling the historical concentrations of black smoke (BS) and SO_2 in the United Kingdom from 1962 onwards. The resulting concentration maps serve as a basis for exposure assessment in the epidemiological investigations of the chronic health effects.

Methods: Land use regression techniques were used to model concentrations of BS and SO_2 at a 1 × 1 km grid for 1962, 1971, and 1981. Validation with an independent 10% subset of monitoring stations for these respective years gave an R^2 of 0.44, 0.42, 0.31 for BS and 0.71, 0.61, 0.28 for SO_2. Matching 1 × 1 km population grids were created using Census data (compiled in the United Kingdom for 1961, 1971, and 1981) using area weighting. Population was then linked to the land use regression maps to estimate exposure distributions for BS and SO_2.

Results: Percentiles were computed, and the trends in population exposure to the pollutants were explored over the study period. The concentration at the 50th percentile dropped more than five-fold for BS (from 93 μg/m^3 in 1962 to 16 μg/m^3 in 1981), whereas SO_2 dropped slightly more than half (from 107 μg/m^3 in 1962 to 43 μg/m^3 in 1981). The decline in SO_2 over the 2 decades was more linear than that for BS, which showed an exponential decrease. Changes in population exposure by socioeconomic status and variability between different geographical areas are also explored.

Conclusion: This work will ultimately inform development of an appropriate metric for cumulative population exposure for use in epidemiological studies, similar to the "pack-years" approach used in studies of chronic exposure to cigarette smoke.

PP-30-034

Time-series Analysis of Association Between Gaseous Air Pollutants and Daily Mortality in Urban Residents in Tianjin

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Background/Aims: Numerous epidemiological studies have reported the association between ambient pollutants in North American, European, and Asian cities. However, few studies explored the effects of air pollutants on daily mortality in Tianjin city. The aim is to study the association between sulfur dioxide and nitrogen dioxide and daily mortality in urban population in Tianjin.

Methods: We collected daily concentration of inhalable particulate matter, sulfur dioxide and nitrogen dioxide, daily mean temperature and relative humidity, and daily cause-specific death counts. We used generalized additive models to explore the relationship between sulfur dioxide and nitrogen dioxide and daily mortality, after adjusting the effects of long-term and seasonal trend, and weather conditions, and analyzed the

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potential effect of particulate matter and model parameters on relative risk estimates.

Results: Daily concentrations of SO_2 and NO_2 were significantly associated with daily nonaccidental and cardiovascular mortality, and not associated with daily respiratory mortality. An increase of 10 $\mu g/m^3$ in SO_2 was associated with 0.56% (95% CI: 0.23%–0.89%) nonaccidental morality and 0.49% (0.06%–0.93%) cardiovascular morality. An increase of 10 $\mu g/m^3$ in NO_2 was associated with 0.94% (95% CI: 0.17%–1.70%) nonaccidental morality and 1.29% (0.29%–2.30%) cardiovascular morality.

Conclusion: The findings suggest that exposure to SO_2 and NO_2 was significantly associated with daily cardiovascular and respiratory mortality in urban population in Tianjin.

PP-30-035

Retrospective Assessment of Exposure to Air Pollution in the GAZEL French Cohort Study

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Background/Aims: Long-term exposure air pollution has been associated with an increase in all-cause and specific-cause mortality and morbidity using cohort studies. Assessment of the past exposure to air pollution is a key issue in such studies. We present a method to assess the exposure to air pollution of participants of the French GAZEL Cohort Study between 1988 and 2008.

Methods: The GAZEL cohort is a prospective cohort of more than 20,000 adults recruited in 1989 and followed every year. To assess the exposure of the participants, the ambient background air concentration of PM_{10}, $PM_{2.5}$, O_3, SO_2, and NO_2 will be modeled for each year of the study period and for the whole continental France. A multi-scale model for air quality simulation (CHIMERE dispersion model) on the basis of emissions, meteorological, and land cover data will be used in association with a downscaling model based on traffic roads or density data. Monitored data will be integrated by a geostatistical model.

Results: GAZEL comprised 20,625 individuals: 15,011 men aged 40–50 years in 1989, and 5614 women aged 35–50 years. Participants were located everywhere in continental France, including urban and rural areas. In 2007, nonspecific mortality and cardiovascular mortality represented 1190 and 173 deaths, respectively. Emissions and meteorological data required for the multi-scale model have been identified, and a preliminary study in Haute-Normandie for the year 1995 showed that data were available.

Conclusion: For the first time in France, retrospective annual ambient air concentrations of pollutant will be modeled on a 20 years period for the continental France to assess the exposure of the participant of the French GAZEL Cohort Study. Associations between air pollution and health outcomes will be evaluated using standard and random-effects Cox proportional-hazard models.

PP-30-036

A European Exposure Modeling Approach: Impact of Sociodemographic Factors on Time-use

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Background/Aims: Human time-activity patterns and their relationship to environmental factors are an important part of exposure assessment for environmental contaminants. In Europe, a database of time-use patterns developed for social science research, the Multinational Time Use Survey (MTUS), provides data that can potentially be used for exposure studies and covers a wide range of countries. In Health and Environment Integrated Methodology and Toolbox for Scenario Assessment, an EU FP6 project on integrated health assessment, MTUS is used for modeling exposures to outdoor air pollution on a European level.

Methods: MTUS provides aggregated daily diary data for 41 activity categories, which were reclassified into the microenvironments (MEs) home, work, travel, outdoor, and other (unspecified locations which might occur both indoors and outdoors). The population was stratified into 8 subgroups, distinguishing between gender, age groups (<15, 15–64, 64), and employment status for the middle age group.

For each country, descriptive statistics for time spent in the MEs per day were calculated using diaries from 1990 to 2005. Linear regression was used to assess the effect of a set of sociodemographic and environmental factors on time spent at home, work, and travel.

Results: Among employed persons per country, men spent on an average 56% to 61% of their daily time at home and women 63% to 68%. The average daily time spent at work is 14% to 19% and 19% to 28% for women and men, respectively. On average, time spent on travel is slightly higher for men (3%–7%) than women (2%–6%).

On the basis of regression analysis, variables like higher education level, weekends, living in rural areas, being female reduces the average time spent at work for all countries.

Conclusion: The findings indicate that although the average time spent in each ME does not vary greatly between countries, there seemed to be a significant variability in the effect of the sociodemographic factors on time-use.

PP-30-037

Exposure to PM_{10} of the Elderly Related to the Mass Concentration and Time-activity in Tianjin, China

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Background/Aims: This study focuses on the exposure and the health effect of particulate matter (PM_{10}) on the cardiovascular system of the elderly patient who are particularly sensitive. Time-activity patterns largely influence personal exposure to PM_{10} as individuals move across different microenvironments.

Methods: PM_{10} samples were collected in non-heating season and heating season in a community of approximately 400 elderly people, living in Tianjin. Residential indoor and outdoor PM_{10} concentrations were measured and compared simultaneously with the personal exposure for each of the total 80 participants. PM_{10} samples were collected for total 24 hours at each site, and repeat them once more to reduce the accidental error. Time-activity patterns were investigated in questionnaire form, which included information about personal activities, commuting behavior of participants, heating type, exposure to tobacco smoke, ventilation, and traffic volume, and so on.

Results: Statistic of questionnaires showed participants spent more than 85% of their time indoors. In non-heating season, the average concentration of indoor PM_{10} was 0.116 mg/m^3, and that outdoor PM_{10}

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was 0.176 mg/m^3. The personal exposure to PM_{10} was higher than both indoor and outdoor, that was 0.190 mg/m^3. Average female concentrations of PM_{10} (0.188 mg/m^3) was less than average male concentrations of PM_{10} (0.191 mg/m^3). In heating season, average concentrations of PM_{10} followed the general pattern indoor (0.174 mg/m^3) was less than outdoor (0.179 mg/m^3) which was less than personal exposure (0.192 mg/m^3) across. The average concentrations for the male (0.192 mg/m^3) are less than that for the female (0.193 mg/m^3).

Conclusion: By comparing the PM_{10} mass concentration of 2 seasons, it was higher in heating season as a result of heating appliance and lacking of ventilation. Obviously, different gender differed in the time-activity patterns: In non-heating season, female elderly patient spent more time in the kitchen and doing cleaning activities, on the contrary, male elderly patient spent more time outside and in traffic microenvironment. Although in heating season, male elderly reduced outdoor activity and spent more time in home than the females. The result indicated that mass concentration of PM_{10} was negatively correlated to the time people spent indoors.

PP-30-038

A Case-control Study of Ambient NO_2 and Hemorrhagic Stroke in Edmonton, Canada

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Background/Aims: Increased risks of cerebrovascular events from long-term ambient air pollution have been documented in a few studies. These studies have had limited ability to assign pollution levels at a high spatial resolution. Land-use regression (LUR) can predict small-scale spatial variations of air pollution that is not captured by fixed-site monitors. Previously, we documented positive associations between long-term measures of ambient NO_2 from fixed-site monitors and hemorrhagic stroke, but not transient ischemic attacks (TIA) in Edmonton, Alberta. In this study, we investigate the relationship between longer term measures of NO_2 from an LUR model, on hospitalization for hemorrhagic stroke.

Methods: LUR estimates for NO_2 in Edmonton were calibrated against data collected at 50 sampling locations during two 14-day sampling sessions in 2008. Predictor variables included the following: proximity to city center, industrial areas, major roads, highways, and water. The model R^2 was 0.81. Cerebrovascular outcomes were identified on the basis of discharge diagnoses for hemorrhagic stroke (ICD-10 160–162) and TIA (G45) from Edmonton area hospitals between 2003 and 2007. Patient data included the following: age, sex, and residential postal code. We estimated the risk for hemorrhagic stroke that corresponded to an interquartile range (IQR) increase in NO_2 with TIA patients as the control group.

Results: In total, there were 1362 hemorrhagic stroke patients and 2651 controls. The mean (IQR) NO_2 exposure for the study population was 15.4 (4.00) ppb. After adjustment for age and sex, an IQR increase in NO_2 was associated with an increase of 12.3% (95% CI: 2.1%–23.6%).

Conclusion: Our findings suggest that traffic pollution, as indicated by ambient NO_2, increases the likelihood for a presentation with hemorrhagic stroke relative to TIA, although residual confounding by socioeconomic or other spatially variable factors cannot be ruled out. Further investigation needs to explore possible effect modification from other risk factors.

PP-30-039

In-vehicle Correlations Among Particle Number, Organic, and Inorganic Species for a Cohort of Car Commuters in Atlanta

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Background/Aims: It is possible that daily automobile commuters comprise a vulnerable subpopulation to air pollution health risks because of their in-vehicle exposures to pollutant mixtures during commutes. To date, identifying potential causal agents in in-vehicle pollutant concentrations has been difficult given methodological challenges of measuring chemically resolved exposures over short durations. Moreover, little is known regarding the correlation of these pollutant species within automobiles, resulting in uncertainty about the potential for confounding or synergistic responses. To address these concerns, we are presenting results from a correlation analysis from the Atlanta Commuters Exposures Study, which uses novel methods to measure in-vehicle particulate matter (PM) concentrations and corresponding biomarkers of acute cardiorespiratory response for 40 adult automobile commuters.

Methods: In-vehicle real-time measurements of size-resolved particulate concentration, elemental carbon, and particle-bound polycyclic aromatic hydrocarbons (PAHs) were conducted over a 2-hour scripted commute. Time integrated filter samples were also analyzed for particulate mass concentration, organic and elemental carbon, and a range of elements and ions. This study includes correlations among these particulate components.

Results: In-vehicle concentrations were moderate to high for many of the particulate distributions. Initial results from 6 commutes integrating the measurements over the entire commute indicate weak correlations ($r < 0.2$) between total fine PM concentrations and any of its chemical components or particle number concentrations. Strong correlations ($r > 0.8$) existed, however, between in-vehicle particle number, black carbon, and PAH concentrations, with a noticeably strong correlation between particle number and PAH concentration.

Conclusion: The initial findings of strong correlations among several PM components during typical automobile commutes provide indication of identifiable PM physical and chemical mixtures among the various commutes. Complete correlation analysis results, including specific organic and elemental species, will also be presented.

PP-30-040

Canada Wide Land-use Regression Models Created From Fixed Site Monitors and Validated With Independent City-specific Measurements

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Background/Aims: We explored the feasibility of creating national land-use regression models that capture between and within-city pollution variation across Canada. This research is part of the Carex Canada initiative to produce estimates of national environmental carcinogen exposure.

Methods: Models were created from National Air Pollution Surveillance and provincial fixed-site air pollution monitors operating during 2006 for

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$PM_{2.5}$ (n = 224), NO_2 (n = 136), as well as for benzene, ethylbenzene, and butadiene (n = 53). Models were created with 3 components to capture background, local, and microscale variation. Background levels were determined from Satellite Data ($PM_{2.5}$, NO_2), local variation from geographical predictor variables, and microscale variation from deterministic gradients. Model validation was conducted using independent field monitoring data from previous land-use models developed for 5 Canadian cities.

Results: The $PM_{2.5}$ model (satellite estimates, large scale emissions within 5 km, percent industrial land-use within 1 km) resulted in an R^2 = 0.44, root mean square estimation [RMSE] = 1.57 and was driven largely by satellite predictions. The NO_2 model (satellite estimates, percent industrial land-use within 2 km, length of major roads within 5 km, total summer rainfall) resulted in an R^2 = 0.66, RMSE = 6.08. The benzene model (length of major roads in 10 km, large emitter in 10 km) resulted in an R^2 = 0.62, RMSE = 0.29. Similar predictions were found for ethylbenzene and butadiene. Validation against independent measures, without deterministic gradients, resulted in a wide range of predictions. It is important to note that city-specific measurements were taken for different years, using different monitoring and averaging methods. NO_2 validation with all 5 cities combined (n = 378) resulted in an R^2 = 0.32, RMSE = 3.49; however, results varied when stratified by city: Montreal (R^2 = 0.23), Vancouver (R^2 = 0.34), Edmonton (R^2 = 0.35), Winnipeg (R^2 = 0.45), and Sarnia (R^2 = 0.55). Models consistently overpredicted pollutant concentrations.

Conclusion: National land-use regression models hold promise for improving exposure assessment, yet more work is needed to account for between-city differences and specific localized pollutant gradients that are not captured in models created from fixed-site monitors

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PP-30-041

Personal Exposure of 80 Retired Elders and Their Residential Indoor, Outdoor PM_{10} Concentrations Measured in Tianjin, China

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Background/Aims: The primary goal of this study was to find the relationship between indoor/outdoor particulate matter (PM) concentrations and actual human PM exposures within a susceptible (elderly) subpopulation.

Methods: Between August and December 2009, concurrent 24-hour average indoor, personal, and a limited number of outdoor-at-home PM_{10} concentrations were assessed based on an exhaustive study performed in Tianjin. A group of 80 elderly person (33 females, 48 males; age: 55–75 years) living in the metropolitan areas continuously carried a rucksack contained an active PM_{10} sampler. Data about home indoor sources and time-activity pattern were collected by questionnaires. In parallel, continuous daily ambient PM_{10} mass concentrations at a central community site were also measured.

Results: For each home in most case, personal (arithmetic mean, AM = 193 $\mu g/m^3$; SD = 107 $\mu g/m^3$; n = 150; range: 16–651 $\mu g/m^3$) and outdoor-at-home (AM = 204 $\mu g/m^3$; SD = 211 $\mu g/m^3$; n = 151; range: 9–1124 $\mu g/m^3$) PM_{10} concentrations were higher than the corresponding indoor level (AM = 116 $\mu g/m^3$; SD = 76 $\mu g/m^3$; n = 160; range: 16–630 $\mu g/m^3$). In homes without environmental tobacco smoke (ETS) sources, PM_{10} indoor to outdoor ratios amounted to approximately 0.56 while the average indoor–outdoor ratios influenced by ETS were 0.49. The participants (14.8%) that were exposed to ETS at any time during the 24-hour sampling period had a little higher personal exposures (AM = 203 $\mu g/m^3$) than nonsmoking participants (AM = 195 $\mu g/m^3$). Larger variations were found in outdoor than personal and indoor, probably because of the relatively intense variations of environment conditions. On days with paired samples (n = 20), the difference between outdoor and outdoor-at-home (mean difference: 29 $\mu g/m^3$; P = 0.503) exposure was ambiguous.

Conclusion: More than 24% of study subjects were affected by high level of PM_{10} pollution (>250 $\mu g/m^3$). Across all households and individuals, the personal-outdoor, personal-indoor, and indoor-outdoor Pearson correlation coefficient were 0.12, 0.20, and 0.37, respectively. The result was consistent with the time-activity pattern studies. On average, these elderly persons spent 85.2% of their time indoors, so the personal-indoor correlation coefficient was a little higher than the personal-outdoor correlation coefficient.

PP-30-042

$PM_{2.5}$ Prediction Modeling Using MODIS AOD and Its Implications for Health Effect Studies

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Background/Aims: Epidemiological studies investigating particulate matter ($PM_{2.5}$) air pollution and its health effects are susceptible to exposure measurement errors because they may use limited number of $PM_{2.5}$ monitors in their study regions. Satellite data can help to expand spatial coverage to places which are remotely located from $PM_{2.5}$ monitors and enhance our ability to estimate subject-specific exposures to $PM_{2.5}$. The objective of our study was to estimate the daily $PM_{2.5}$ concentrations in a statistical model using Moderate Resolution Imaging Spectroradiometer (MODIS) aerosol optical depth (AOD) data in the region of New England.

Methods: In 2003, MODIS AOD and $PM_{2.5}$ concentrations measured at 26 US Environmental Protection Agency $PM_{2.5}$ monitoring sites were collected in Connecticut, Massachusetts, and Rhode Island. We developed a statistical model presenting daily-specific $PM_{2.5}$-AOD relations using a mixed effects model. In addition, we tested to see whether the high (daily) correlations of $PM_{2.5}$ within the region could predict $PM_{2.5}$ for those particular days when AOD data could not be retrieved.

Results: The average correlation coefficients between $PM_{2.5}$ concentrations measured at our $PM_{2.5}$ monitoring sites and those estimated for the corresponding grid cells were high (mean R^2 = 0.85). However, the average correlation coefficients of the annual averages of the observed and predicted were similar (mean delta = 0.47 $\mu g/m^3$). As expected, highly populated areas such as New Haven, Hartford, Springfield, Providence, and Boston demonstrated higher $PM_{2.5}$ levels, and the spatial pattern of $PM_{2.5}$ levels also reflected high traffic density.

Conclusion: Using our approach with daily-specific relations to MODIS AOD data provides improved predictability for $PM_{2.5}$. Considering probable misclassification of exposure in the current epidemiological studies, our study will help to clarify the association between both short- and long-term exposures to $PM_{2.5}$ and its health effects.

PP-30-043

Fine Particle Air Quality Levels of Sri Lankan Households and Associated Respiratory Conditions: Preliminary Findings of an Ongoing Longitudinal Study

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Background/Aims: Data on fine particle ($PM_{2.5}$) air pollutant levels in Sir Lankan households are scarce. A high proportion of households are

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known to use unclean fuels for cooking, without proper ventilation.

The aim of the study was to determine the respiratory health status of children and $PM_{2.5}$ levels in a sample of home environments (indoors and outdoors).

Methods: A total of 612 children (aged 7–10 years) were selected from 2 study settings (setting 1, n = 408; setting 2, n = 204) for a prospective study. Study "setting 1" was selected from a high outdoor air-polluted area of the Colombo Municipal Council, and "setting 2" from a low-polluted area. The study commenced in March 2009. Measurements were made in the main living room using UCB particle monitors for 24 hours with minute logging. The outdoor 24-hour $PM_{2.5}$ levels were measured using gravimetric air samplers in 3 selected outdoor locations in each setting at monthly intervals.

Results: On the basis of the 124 household measurements, the median $PM_{2.5}$ levels in households of settings 1 and 2 were 66.6 $\mu g/m^3$ (mean = 104.0, range = 25.5–644.8) and 50.0 $\mu g/m^3$ (mean = 142.0, range = 5.9–749.5), respectively. The highest $PM_{2.5}$ concentrations were reported from houses using wood as cooking fuel (mean = 145.2, median = 66.8, range = 5.9–749.5 $\mu g/m^3$). The prevalences of wheezing during the past 12 months (at least one episode during the last 12 months) were 20.8% (n = 85) and 10.8% (n = 22) (odds ratio = 2.2, confidence interval = 1.3–3.6) in setting 1 and 2, respectively. The prevalences of children ever having asthma were 18.9% (n = 77) and 12.7% (n = 26) in settings 1 and 2, respectively.

Conclusion: Most of the households had $PM_{2.5}$ levels exceeding the upper limit recommended by the World Health Organization. Children living in setting 1 had a higher risk of experiencing respiratory ill health than children living in setting 2.

PP-30-044

Contributions of Aircraft Activity, Local Sources and Meteorology to Ultrafine Particle Counts Near a Large Airport

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Background/Aims: Airport activities can potentially contribute to pollutant levels in nearby communities, but it is challenging to isolate the contributions of aircraft emissions from other sources near airports. As part of the Air Quality and Source Apportionment Study (AQSAS), ambient air pollutant and meteorological data were collected for 42 days during July and August of 2008 at fixed sites surrounding Los Angeles International Airport (LAX). In this analysis, we present the results of regression modeling that examines the association between one-minute average size-binned ultrafine particle concentrations and runway-specific Landing and Take-off (LTO) operations data and meteorology.

Methods: In our regression models, wind speed and direction were included as a nonparametric smooth spatial term, using thin-plate splines applied to wind velocity vectors and fitted using linear mixed models. To better pinpoint the timing in the LTO cycle most contributing to elevated concentrations, we used distributed lag models for flight activity, ranging from 5 minutes before to 5 minutes after take-off or landing. Given the short-term measurements, we account for temporal autocorrelation by computing standard errors using a moving-block bootstrap.

Results: Generalized additive models for wind speed and direction suggest that ultrafine particle levels are associated with airport activities and local traffic sources, with a significant effect of wind direction only given high wind speeds. Model predictors varied significantly by size fraction, with smaller particle sizes demonstrating a greater signal from airport sources and larger particle sizes demonstrating a greater signal from local traffic. Distributed lag modeling suggests that departures contribute more significantly to ultrafine particle concentrations than arrivals, with the time patterns of contributions varying across monitors in a manner consistent with taxiways and flight paths.

Conclusion: Our analytical approach allows for an enhanced understanding of ultrafine particle contributions from both aircraft and other sources proximate to large airports.

PP-30-045

NO_2 Vertical Gradient Monitoring Along a Street Canyon by LP-DOAS in the Framework of the Escape Air Pollution and Health Study

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Background/Aims: A major aim of the European study of cohorts for air pollution effects (ESCAPE) is to characterize the long-term spatial distribution of air pollutants. In all areas, NO_x saturation monitoring was done at ~40 locations over 3 seasons. In cities where only NO_x (no PM) monitoring was done (eg, Heidelberg), passive Ogawa NO_x samplers were mounted at approximately 3 meters above the street. Naturally, the main question is whether measurements made at this height are a good measure of exposure for individuals living and working at other heights. A second question is whether passive time-integrated samplers are adequate for capturing exposures or whether there are significant diurnal and weekday/weekend differences.

Methods: To examine these questions, a long-path differential optical absorption spectrometer (LP-DOAS) was used in Heidelberg to monitor the vertical profile of NO_2 along a street canyon in parallel with passive 2-week NO_x measurements in April 2009. The real-time NO_2 measurements were made by a blue-light LP-DOAS along 4 beampaths at heights ranging from 5.4 to 15.5 m above the street. The beampaths were ~575 m long (1-way). Four NO_x Ogawa samplers were located at 3-m height along 1 side of the street canyon.

Results: Only 3 of the 4 Ogawa sampler data could be used. Two (on drain-pipes) indicated average NO_2 concentrations around 22.6 ppb, while the third (at an open intersection) indicated a much lower concentration of 16.9 ppb. The average 2-week LP-DOAS NO_2 concentrations at higher elevations ranged from 14.6 to 17.7 ppb (DL = 0.62 ppb, error = ±0.32 ppb) and showed an average vertical gradient of −0.43 ppb/m for the spring season. This vertical gradient estimated average NO_2 concentrations to be around 20 ppb at 3 m. The 10-minute resolved vertical profile data showed clear diurnal levels of NO_2 with peaks at 8:30 and 19:30 when the NO_2 mixing ratio was 13–18 ppb above off-peak times. It was also observed that the vertical gradient increased at peak times.

Conclusion: Along a street canyon, a significant 2-week NO_2 vertical gradient was found. Therefore, further exploration of long-term vertical gradients of air pollutants is recommended to reliably use measured concentration data for exposure estimation.

PP-30-046

Intake and Exposure Effects of Reducing Diesel PM in the South Coast

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Background/Aims: Air quality management in the South Coast must reduce particulate matter from diesel engines (DPM), which is estimated to be responsible for a majority of the outdoor air pollution lung cancer risk in California's South Coast. Policies must reduce ambient pollution and also population-wide intake. Our research aims to quantify how changes in exposure distributions would depend on where emissions reduction strategies are located spatially in the air basin.

Methods: To estimate air pollution exposures, we combined the CAMx air dispersion model with Census demographic. We modify the emissions inventory to explore the effect of DPM emissions from various locations

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throughout the South Coast. We compare several exposure metrics, including intake per person, environmental equality (variations among individuals), and environmental justice (variations among socioeconomic groups).

Results: In the entire South Coast Air Basin, the spatial extent of DPM air pollution is determined by various sources (eg on-road mobile, off-road mobile, ships, trains, and stationary sources). While reductions to different sources results in different effects for the population, so too will reductions in different areas of the basin. The annual intake benefit depends on the dispersion of the pollution and the population affected. For example, the total intake benefit summed across the population of the Basin from reducing emissions in a location near the ocean in Los Angeles is 5 mg/d, but more than half of that benefit is to the population within 20 km of the source location.

Conclusion: Air quality management needs to include objectives beyond reducing ambient pollution levels. Effective management will reduce intake which will improve human health and also will seek to ameliorate environmental injustice. These concerns depend on knowing who is affected by potential pollution-reducing policies. Our results show the extent of spatially targeted policies and the impact on metrics such as intake and environmental justice.

PP-30-047

Modeling the Variability in Kitchen Time-activity and Its Effect on Exposure to $PM_{2.5}$ From Biomass Cooking

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Background/Aims: The dissemination of high efficiency cooking/heating systems is among the most cost-effective interventions to reduce the burden of disease caused by the exposure to indoor air pollution (IAP). Measuring the population dynamics of time-location and personal-activity behavior that affect IAP exposure is critical to quantify the effectiveness of such interventions. We obtained marginal estimates by age, sex, and stove type (improved/open fire) of time spent in the kitchen and personal exposure to $PM_{2.5}$. We estimated the variance components of individual and shared time budgets and calculated the probabilities of exceedance and overexposure for the population.

Methods: We used 2 novel sensor technologies developed at UC Berkeley to collect minute-by-minute samples of personal exposure: the Time-Activity Monitoring System (TAMS) and the Particulate-and-Temperature System (PATS). We deployed the devices on 61 homes (36-open fire, 25-stove) of the CRECER Guatemala study and collected quarterly measurements over 2-years on each adult women, baby, and younger child. We obtained marginal estimates using GEE model, and estimated the variance components using a random effects model. The probabilities of exceeding air quality guidelines were calculated from the population distributions.

Results: For adult women, median 24-hour kitchen concentrations of $PM_{2.5}$ for the fire and stove groups were different at the 5% level, but the differences in kitchen time-activity were not significant (4.1 and 3.6 hours for fire and stove, respectively). Intraclass correlation coefficients for time-activity were: 18% for the fire group and almost 0% for stoves. The probability that a randomly selected measurement in the stove group exceeds the $PM_{2.5}$ 24-hour EPA-NAAQS (0.035 mg/m^3) is 48.8%, while the probability that a typical person in the stove group would be overexposed is 93.0%.

Conclusion: Our results highlight the importance of behavioral differences between groups and within subjects to assess the impact of IAP interventions and to determine sample size requirements for effective monitoring.

PP-30-048

Structural Equation Modeling of Traffic Pollution and Inflammation: Modification by Diabetes and Smoking in the Normative Aging Study (NAS)

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Background/Aims: Acute exposure to single ambient air pollutants has been associated with acute changes in biomarkers of inflammation. Using structural equation modeling (SEM), we examined the effects of traffic pollutants on individual biomarkers of inflammation (soluble vascular cell adhesion molecule-1 [sVCAM-1], and soluble intracellular adhesion molecule-1 [sICAM-1]), and latent-inflammation. We also examined whether these associations were modified by participant characteristics.

Methods: We examined traffic-pollutant mediated impacts on sVCAM-1, and sICAM-1 for 786 men from the NAS using structural equation models. A latent pollution model of traffic that included fine particulate matter ($PM_{2.5}$), black carbon (BC), nitrogen dioxide (NO_2), and carbon monoxide (CO) pollutants was fit to estimate the effect on sICAM-1, sVCAM-1 separately and together using a latent variable of inflammation. We also examined if diabetes status, obesity, and smoking status modified these associations. For all analyses, we used exposure periods averaged over the 24-, 48-, and 72-hour pre-visit.

Results: Latent traffic pollutant concentrations were related to sICAM-1, sVCAM-1, and latent inflammation. A 1% increase in traffic pollutant, 24-hour preceding the visit, was associated with a 0.093% change (95% CI: 0.040−0.146) in sVCAM-1 and a 0.017% change (95% CI: −0.036 to 0.070) in sICAM-1. Similarly, 24-hours preceding the visit, statistically significant change in inflammation was found for a 1% increase in traffic pollutant (0.088% [95% CI: 0.029−0.147]). The association between traffic pollutant and inflammation was stronger in diabetics and smokers.

Conclusion: Traffic pollutants are associated with latent inflammation and its biomarkers; being a diabetic or a smoking elderly increases this effect.

PP-30-049

In-vehicle Exposures to Traffic and Biomarkers of Airway Oxidative Stress Among Healthy Humans

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Background/Aims: Traffic-related air pollution has been associated with increased pulmonary and cardiovascular morbidity and mortality. Evidence from human, animal, and in vitro studies suggests that oxidative stress may mediate the adverse effects of traffic-related air pollutants. We hypothesized that exposure during passenger vehicle rides simulating a rush-hour commute on a highway would cause measurable acute changes in biomarkers of airway oxidative stress among healthy human volunteers.

Methods: Twenty nonsmoking subjects aged 18−45 years will be passengers in a Ford Taurus sedan for two 2-hour car rides at least 1 week apart. To date, 4 subjects have each completed 1 ride with the air intake vent open and 1 ride with the vent closed (recirculation mode) in random order. The route was primarily on the New Jersey Turnpike, a

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major highway with heavy duty diesel truck traffic. In-vehicle exposure measurements included total particle count, particulate matter less than 2.5 microns ($PM_{2.5}$), nitrogen dioxide and carbon monoxide, temperature, and humidity. We collected exhaled breath condensate (EBC) using an Ecoscreen device before and 0, 6, and 24 hours after the car rides. We measured the concentration of EBC nitrite, a marker of nitrosative stress, using chemiluminescence detection, and EBC malondialdehyde, a marker oxidative stress, with HPLC with fluorescence detection.

Results: Mean particle counts were significantly higher during the vent open rides compared to recirculation mode rides (43,653 vs. 26,362 p/cc, $P = 0.03$). Among these 4 subjects over 8 car rides, we have observed a 22% increase in EBC MDA from pre- to 0 hour post-ride (95% CI: −24%, 68%), which did not persist at 6-hour post-ride.

Conclusion: Having the vent closed substantially reduced total particle counts in the vehicle. To date, these short-term, on-road exposures in traffic were associated with increased oxidative stress in the respiratory tract of healthy humans.

PP-30-050

Ambient Nitrogen Dioxide Prediction by Land Use Regression Modeling in Incheon

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Background/Aims: The purpose of this study was to examine the distribution of ambient concentrations of nitrogen dioxide (NO_2) in Incheon, Korea by a land use regression modeling.

Methods: We measured NO_2 with passive diffusion samplers at 97 sites in Incheon city in December 2008. At each sample location, we constructed circular buffers in a geographic information system and captured information on roads, traffic flow, land use, and population. Linear regression and multivariate analysis was used to assess the association between concentrations of NO_2 and the variables using the ArcGIS (version 9.3, ESRI).

Results: In univariate analyses, NO_2 was associated with the distance to nearest major roadway, traffic density on nearest roads, population density, and land use type. Using multiple linear regression, we were able to predict 60% of the variation in NO_2 levels with these variables.

Conclusion: These analyses confirm the value of land use regression modeling to assign exposures in epidemiologic studies, and these models may be useful tools for assessing health effects of long-term exposure to traffic-related pollution.

PP-30-051

Ultrafine Particles Inside Cars in Busy Traffic—Developing an Empirical Model

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Background/Aims: NIWA has developed a mobile monitoring platform that includes the capability for indoor/outdoor measurements while driving. We have begun an iterative campaign of measurements with the aim of creating a generalizable model of in-vehicle exposure.

Methods: Initial trials were used to build a simple first-order model to predict in-vehicle particle concentrations from measured external concentrations as a function of speed and ventilation settings. This model was prone to over-estimation following sudden jumps in external concentration, suggesting the lack of aerosol dynamics and variable sink terms in the model as a weakness. Extra sink and lag terms were empirically added based on drive-throughs of a busy road tunnel in Wellington. In August 2009, an improved experimental platform, incorporating CPCs with different size cuts (TSI 3007 and TSI PTrak) and measurements of carbon monoxide, made multiple peak-time journeys over 3 busy routes between suburban and central Auckland. Instrument sampling locations were varied to investigate internal aerosol mixing and sink processes within the vehicle. An additional campaign capturing measurements of CO and PNC (using a TSI 3007) in a car, on buses, and on a bicycle was conducted at peak-time over 20 days along one of the study routes.

Results: These campaigns identified that external concentrations varied largely with the proximity of road junctions and congested traffic, with certain intersections providing consistent "hot-spots." Interior PNC principally responded to exterior PNC in a manner indicative of the cabin acting like a buffer, smoothing external variability.

Conclusion: The "trapping" phenomenon was very apparent, with brief encounters with a single gross-emitting vehicle leading to extended high interior exposure lasting many minutes after the encounter. Concentrations at the back seat were lower than and, lagged those in the front indicating either inhomogeneous mixing or deposition processes—or a combination of the 2.

PP-30-052

Residential Proximity to Main roads and the Risk of Allergic Diseases

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Background/Aims: The present cross-sectional study examined the relation between proximity of the home to the nearest main road, which was used as a surrogate for traffic-related air pollutants, and the prevalence of allergic disorders in Korean children in an urban area.

Methods: A total of 1644 children were recruited from 3 cities: Ansan-city (AS), Siheung-city (SH), and Seongnam-city (SN), which are located in the mid-western portion of the Korean Peninsula. Residential distance to the nearest main road and length of main roads within a 200-m buffer were used as surrogates for traffic-related air pollutants. We used a Geographic Information System (GIS) to measure distance or length of roads. The prevalence of allergic diseases was assessed by the ISAAC questionnaire completed by the parents. We used logistic regression to assess the association between living close to a main road and allergic diseases.

Results: A shorter distance of the residence from the nearest main road was associated with an increased prevalence of allergic rhinitis and atopic dermatitis. The adjusted odds ratios (ORs) for comparison of <100 m with 200 m or more were found for lifetime allergic rhinitis (AR) (OR = 1.59; 95% CI: 1.19–2.12), past year AR symptom (OR = 1.54; 95% CI: 1.18–2.01), doctor-diagnosed AR (OR = 1.59; 95% CI: 1.19–2.12), lifetime atopic dermatitis (AD) (OR = 1.38; 95% CI: 1.05–1.81), past year AD symptom (OR = 1.43; 95% CI: 1.05–1.94), doctor-diagnosed AD (OR = 1.32; 95% CI: 1.00–1.75). No evident relationships were observed between the distance to the nearest main road and the prevalence of wheeze or asthma based on the ISAAC criteria.

Conclusion: The results of this study suggest that residential distances from main roads and length of main roads around homes are associated

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with the prevalence of allergic rhinitis and atopic dermatitis in school children.

PP-30-053

Indoor Air Quality at Restaurants and Bars in Evening Hours in Korea

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Background/Aims: The development of civilization has caused the environment in which humans live to become increasingly critically polluted. Indoor air quality (IAQ) for microenvironments has increasingly received a lot of public concerns. The information about time spent in microenvironments plays a critical role for personal exposure to air pollutants. It is useful to determine the precise times of the day that the subjects are in certain locations or engaging in specific activities because exposure to some air pollutants can depend on temporal trends. Korean population spent less time at home after the working hours, comparing to Western countries. To say, Koreans may stay in other indoors after 6 PM such as workplace, school classroom, restaurant, and bar. More information about the other indoors is critical for exposure and risk assessment in Korea.

Methods: We investigated time activity pattern data for 8778 workers in weekday, which were provided by the Korean Statistical Office. The activity pattern was initially collected for social and economical purposes in 2004. Restaurants, bars, internet cafés, billiards, karaokes, and coffee shops were selected in order to characterize the current indoor air quality. Target air pollutants were formaldehyde (HCHO), VOCs, NO_2, and $PM_{2.5}$.

Results: The residential indoor time and other indoor time were 12 and 8.7 hours. Considering shorter than those in other countries, Korean workers spent less time at home after the working hours. Time activity was different by gender and the mean times stayed at home in weekday were 12.9 hours in female and 11.42 hours in male, respectively. The major factors on residential indoor time and workplace time were age, monthly income, occupation and industry type, work position, education, and gender. Relatively high concentrations of HCHO, VOCs, NO_2, and $PM_{2.5}$ were measured in the bars and restaurants. The average levels of $PM_{2.5}$ at bars and restaurants were as high as 2000 $\mu g/m^3$ when there were smokers. At present, this study is on going measurements.

Conclusion: Determinants of time activity pattern need to be taken into account in exposure assessment, epidemiological analyses, exposure simulations, as well as in the development of preventive strategies. Since there are substantial difference of Korean worker activity pattern, this information can be critical for exposure assessment in Korea.

PP-30-054

Contribution of Outdoor Nitrogen Dioxide on Indoor Air Quality in Roadside Commercial Shops

Jianfei Shuai, Hyunsoo Lee, Byung Ryung Woo, Hogi An, and Wonho Yang *Catholic University of Daegu, Kyongsan-si, Republic of Korea.*

Background/Aims: With the development of trandportation rapidly, human health and environmental atmosphere have been affected more seriously by exhaust gas of motor vehicles. NO_2 is an important pollutant that is produced by vehicles exhausts. This study aims at investigating of effects of motor vehicles exhaust gas on the indoor air quality of commercial shops roadside using multiple NO_2 measurements.

Methods: Indoor and outdoor NO_2 concentrations of commercial shops beside a 2-lane road in Kyongsan city of Korea will be measured by NO_2 passive samplers for 21 consecutive days in 3 campaigns, respectively. The first campaign will be hold in April, the second campaign in July, and the third in November of 2010. During campaigns, 15 commercial shops were chosen. A visual classification of vehicles into 4 vehicle categories (motorcycles, passenger cars, buses and trucks) was carried out. The flows of the traffic will be counted at 8:00–9:00 AM, 1:00–2:00 PM, and 8:00–9:00 PM of Wednesday, Friday, and Sunday. The microenvironment questionnaire will be used to collect information about indoor air quality, air exchange circumstances, buildings characteristics, smoking circumstances and the potential sources of NO_2 that may exist.

Results: Because this study is in progress now, the result of measurements in spring will be obtained in May, and summer result in August of 2010. The indoor, outdoor NO_2 concentrations and the correlation between them will be analyzed by linear regression analysis through SPSS and a mass balance model.

Conclusion: Contribution of outdoor NO_2 on indoor air quality in roadside commercial shops will be estimated using of multiple measurements.

PP-31-001

Physical, Chemical, and Oxidative Characterization of Particles From Locations With Contrast in Local Source Emissions: Exposure and Health Assessment in the Raptes Study

Maciej Strak,[1,2] Maaike Steenhof,[2] Krystal Godri,[3,4] Ilse Gosens,[1] Flemming Cassee,[1] Gerard Hoek,[2] Ian Mudway,[3] Frank Kelly,[3] Roy Harrison,[4] Erik Lebret,[1,2] Bert Brunekreef,[2] and Nicole Janssen[1] *[1]National Institute for Public Health and the Environment (RIVM), Bilthoven, Netherlands; [2]Institute for Risk Assessment Sciences (IRAS), Utrecht University, Utrecht, Netherlands; [3]King's College London, London, United Kingdom; and [4]University of Birmingham, Birmingham, United Kingdom.*

Background/Aims: Numerous epidemiological studies demonstrated the adverse health effects of ambient particulate matter (PM); however, it is not clear which specific components or sources of PM are responsible for the observed effects. The aim of the RAPTES study is to characterize physical, chemical, and oxidative properties of PM and to establish which of these determine or predict the negative health effects.

Methods: Air pollution was extensively characterized on 8 different sites in the Netherlands: 3 different traffic sites, an underground, harbor, farm, steelworks, and urban background site. The sites were selected based on predicted high contrast and low correlation between major PM components. Sampling took place on 59 days from June 2007 until October 2009 (2 campaigns). Air pollution at each site was quantified during 5–6 hour sampling periods, and physical, chemical, and oxidative properties were investigated. In the second campaign, 30 volunteers were exposed multiple times at 5 of these locations including a fixed exercise protocol and an array of respiratory and cardiovascular health parameters was measured before and after exposure.

Results: The average particle number concentration (PNC) ranged from 11,000 particles/cm^3 (farm)–80,000 particles/cm^3 (traffic site). PM_{10} concentrations ranged from 28 $\mu g/m^3$ at the urban background to −395 $\mu g/m^3$ at the underground. At the underground, total oxidative potential and metal content (dominated by iron and copper) were orders of magnitude higher than measured outdoors. Volunteers' exhaled NO was positively associated with PNC and soot content during the 5-hour exposure period (22% and 15% increase over baseline per 60,000 particles/cm^3 increase in PNC and 15 $\times$ 10^{-5}/m increase in soot, respectively, 2 hours after exposure).

Conclusion: PM mass concentrations and soot content were consistently high at the underground train station. High PNC was measured on traffic sites, indicative of diesel emissions. Five-hour exposure to high PNC and soot concentrations increased exhaled NO in healthy volunteers.

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PP-31-002

Secondhand Smoke Exposure and Coronary Artery Calcification Among Nonsmoking Adults

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Background/Aims: Exposure to secondhand smoke (SHS) is an exposure to air pollution of fine particulate matter, carcinogens, and various toxins, affecting large parts of the population. SHS increases the risk for acute cardiovascular events and may contribute to the development of atherosclerosis. We investigate the association of SHS with coronary artery calcification (CAC).

Methods: In the present cross-sectional analysis, we used baseline data (2000–2003) of 1891 never smokers, aged 45–75 years, from an ongoing, prospective, population-based cohort study in Germany. Frequent SHS at home, at work, and in other places was assessed by questionnaire. CAC was measured by electron-beam computed tomography. We conducted multiple linear regression analysis using exposure to SHS (any location) as the explanatory variable and ln(CAC+1) as the response variable, adjusting for gender, age, socioeconomic status, and cardiovascular risk factors.

Results: Frequent exposure to SHS was reported by 21.7% of respondents. After adjustment for age, gender, and socioeconomic status, (CAC+1) was 25.9% (95% confidence interval [CI]: −1.0% to 60.2%) higher in the exposed than in the unexposed. Inclusion of further cardiovascular risk factors (diabetes, cholesterol, body mass index, physical activity) reduced the estimate (19.7%; 95% CI: −5.4% to 51.5%). Highest effects were seen for exposure at home (35.8%; 95% CI: −2.8% to 89.8%). The effect of SHS was comparable to up to 3 years of older vascular age, depending on age range and sex.

Conclusion: Our study provides first suggestive evidence of an association between exposure to SHS and coronary atherosclerosis. Considering the widespread exposure and the clinical relevance of coronary atherosclerosis, this result, if confirmed, is likely to be of high public health importance.

PP-31-003

Association of Exposure to Fine Particulate Matter Constituents and Sources With Birth Weight

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Background/Aims: Exposure to fine particles (particulate matter [$PM_{2.5}$]) during pregnancy has been linked to lower birth weight; however, the chemical composition of $PM_{2.5}$ varies widely. We investigated whether $PM_{2.5}$ mass, constituents, and sources are associated with birth weight.

Methods: $PM_{2.5}$ filters were analyzed for over 50 elements for the period August 2000 to February 2004 for 3 counties in Connecticut and 1 in Massachusetts. Source apportionment techniques were used to estimate the daily contributions of $PM_{2.5}$ associated with the sources of traffic, road dust/crustal, oil combustion, salt, and regional (sulfur). Gestational exposure to $PM_{2.5}$ mass, constituents, and sources were examined in relation to birth weight and risk of low birth weight (<2500 g) for 76,788 infants.

Results: Road dust and associated constituents, silicon and aluminum were associated with lower birth weight, as were the motor vehicle-related species such as elemental carbon and zinc, and the oil combustion-associated elements vanadium and nickel. An interquartile range increase in exposure was associated with low birth weight for zinc (12% increase in risk, 95% confidence interval [CI]: 3%–21%), elemental carbon (13%, 95% CI: 3%–24%), silicon (10%, 95% CI: 3%–13%), aluminum (11%, 95% CI: 3%–20%), vanadium (8%, 95% CI: 2%–15%), and nickel (11%, 95% CI: 3%–19%).

Conclusion: Findings indicate that higher levels of certain chemical constituents of $PM_{2.5}$ are associated with lower birth weight and increased risk of birth weight <2500 g. Evidence on the sources or constituents of particles that are most harmful is valuable to decision-makers in establishing public health policies.

PP-31-004

Exposure to Traffic-related Air Pollutants in Taxi Drivers Around the Beijing 2008 Olympic Games

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Background/Aims: Around the Beijing 2008 Olympic Games, a series of air pollution control measures was implemented by the Beijing municipal government to improve the air quality. This study was conducted to evaluate the taxi drivers' exposure to traffic-related air pollutants around the Beijing 2008 Olympic Games.

Methods: Exposure to in-vehicle particulate matter with an aerodynamic diameter ≤2.5 μm ($PM_{2.5}$), carbon monoxide, nitrogen oxides (NO_X, including NO_2 and NO), and microclimate variables (temperature/relative humidity), was conducted in a group of nonsmoking taxi drivers for a separate work shift in following 4 time periods: before, during, and after the Beijing 2008 Olympic Games, and in a subsequent heating-season. The organic carbon (OC), elemental carbon (EC), and 27 airborne elements in the $PM_{2.5}$ samples were analyzed in laboratory.

Results: Most of the traffic-related air pollutants inside the taxicab, including $PM_{2.5}$, OC, EC, airborne elements, and carbon monoxide showed higher levels before the Olympic Games and lower levels during non-Olympic periods, with the most remarkable changes in the $PM_{2.5}$ and its compositions. The carbonaceous compositions (OC and EC) accounted for 60.9% of the $PM_{2.5}$ mass, and the average OC/EC mass ratios ranged from 4.7 to 7.0 across the 4 time periods. Correlations of OC with $PM_{2.5}$ and EC were much weaker during the Olympic Games than non-Olympic periods. Four sources of in-vehicle $PM_{2.5}$ were identified by factor analysis, including motor vehicle emissions, road dust, metallurgical emission, and a mixed combination of coal combustion, biomass burning, and industrial emissions.

Conclusion: Taxi drivers' exposure to traffic-related air pollutants showed major reduction during the Olympic Games and minor reduction after the Olympic Games and during the heating season, which might have reflected the impact of air pollution control measures.

PP-31-005

Analysis of Pollution Characteristics of $PM_{2.5}$ and PM_{10} in Beijing

Rong Cui, Xinbiao Guo, and Furong Deng *Peking University, Beijing, People's Republic of China.*

Background/Aims: To investigate the pollution characteristics of $PM_{2.5}$ and PM_{10} in Beijing.

Methods: $PM_{2.5}$ and PM_{10} samples were collected in March and June, 2006 in Beijing. Eight kinds of water-soluble ions, 17 kinds of polycyclic aromatic

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hydrocarbons (PAHs), organic carbon (OC), elemental carbon (EC), and several kinds of elements in $PM_{2.5}$ and PM_{10} have been analyzed.

Results: The total concentration of 8 kinds of water-soluble ions and the total concentration of OC and EC accounted for 29.8% and 17.5%, 21.0% and 14.6% of mass concentration of $PM_{2.5}$ and PM_{10} in March, accounted for 12.2% and 15.6%, 12.1% and 16.1% in $PM_{2.5}$ and PM_{10} in June, respectively. SO_4^{2-} and NO_3^- were the main water-soluble ions, accounting for 27.3% and 25.6%, 27.3% and 24.8% of the total ion concentration in $PM_{2.5}$ and PM_{10} in March, 30.2% and 26.5%, 29.7% and 25.6% in $PM_{2.5}$ and PM_{10} in June, respectively. The main components of 17 kinds of PAHs were 4–5 rings PAHs, accounting for 84.9% and 86.3% of the total concentration of PAHs in $PM_{2.5}$ and PM_{10} in March, 81.1% and 80% in $PM_{2.5}$ and PM_{10} in June, respectively.

Conclusion: The results showed that the pollution characteristics in $PM_{2.5}$ and PM_{10} were similar for March and June in Beijing. Water-soluble ions and the total carbon (OC + EC) were the main components of $PM_{2.5}$ and PM_{10} in Beijing.

PP-31-006

Relationships of Outdoor and Indoor Ultrafine Particles at Residences Downwind of a Major International Border Crossing in Buffalo, NY

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Background/Aims: This aim was to assess the penetration of ultrafine particle (UFP) into homes and the resulting change in particle size distributions as particles move indoors near a major diesel traffic source. Because people spend most of their time in their homes, exposure estimates for epidemiological studies are generally determined using ambient concentrations. The findings of this study will contribute to improved size-resolved UFP exposure estimates for near roadway exposure assessments and epidemiological studies.

Methods: During winter 2006, indoor and outdoor UFP size distribution measurements for particles with diameters from 5.6 to 165 nm were made at 5 homes in a neighborhood directly adjacent to the Peace Bridge Complex, a major international border crossing connecting Buffalo, New York to Fort Erie, Ontario. Monitoring with 1-second time resolution was conducted for several hours at each home. Participants were instructed to keep all external windows and doors closed and to refrain from cooking, smoking, or other activity that may result in elevating the indoor UFP number concentration.

Results: Overall, particle concentrations indoors were lower and less variable than particle concentrations outdoors, with average indoor-outdoor ratios ranging from 0.1 to 0.5 (mean 0.34) for particles between 5.6 and 165 nm in diameter.

Conclusion: With no indoor sources, the average indoor/outdoor ratios were lowest (0.2) for 20 nm particles, higher (0.3) for particles less than 10 nm, and highest (0.5) for particles 70–165 nm.

PP-31-007

Association Between Blood Pressure and Particulate Air Pollution in School Children of Lahore, Pakistan

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Background/Aims: There is no general agreement as to whether particulate air pollution increases arterial blood pressure (BP) in adults and no studies so far have been conducted in children. We examined the relation between blood pressure and particulate air pollution (particulate matter [$PM_{2.5}$]) in healthy school children of Lahore (Pakistan). We recruited 179 subjects (mean age, 9.8 yr; 45% girls) from 2 urban schools in a low (n = 79) and a high (n = 100) pollution area.

Methods: BP was measured, after 5 minutes of sitting rest, 5 times consecutively using an automated device placed around the left arm. Particulate air pollution was measured at the school sites with a laser-operated device (Metone Aerocet 531), which was standardized against European air pollution monitoring stations. Spirometry was also performed.

Results: Mean systolic/diastolic BP was 108.2/67.1 mmHg in children living in the less polluted area (mean, 24 hours $PM_{2.5}$ 28.7 [SD 9.7] $\mu g/m^3$] vs. 115.6/70.7 mm Hg) in the high polluted area [mean, 24 hours $PM_{2.5}$ 163.0 (SD 34.5) $\mu g/m^3$]. The mean differences in systolic BP [7.4 mm Hg; $P = < 0.0001$] and in diastolic BP [3.6 mm Hg; $P = 0.002$] were independent of age, gender, body mass index, socioeconomic status and the urinary concentrations of sodium, potassium, and calcium. There were no differences in spirometric indices.

Conclusion: Urban school children living and going to school in an area with high levels of particulate air pollution had substantially higher systolic and diastolic BP than those from a less polluted urban area. These findings might have clinical relevance for their future cardiovascular health.

PP-31-008

The Effect of Asian Dust Aerosol on Emergency Visits

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Background/Aims: Recently, more attention has been given to the health effects of Asian Dust (AD) events, the phenomenon in which mineral dust originating from the Gobi and Taklamakan deserts is transported to East Asia. We examined the association between suspended particulate matter (SPM) with a diameter less than 10 μm and emergency visits on AD days and non-AD days.

Methods: We obtained data on AD events and weather variables from Japan Meteorological Agency and air pollutants from National Institute for Environmental Studies. Data on emergency visits from October 1997 to March 2008 were collected from Nagasaki Emergency Visit Survey. We used a time-stratified case-crossover design to evaluate the association between each exposure and emergency visits. A case period was defined as the day of the emergency visit. As control periods, we chose the same day of the week in the same month of the same year as the case period. We calculated odds ratios of emergency visits using conditional logistic regression to obtain estimates of relative risk. We controlled for ambient temperature and relative humidity.

Results: During study period, 104 AD events were observed in Nagasaki. There were 94,247 emergency visits excluding injuries from October 1997 to March 2008. The 24-mean SPM during March–May was significantly higher on the AD days (60.7 $\mu g/m^3$) than non-AD days (31.4 $\mu g/m^3$). We observed a significant increase in risk of emergency visits from the same day and 2-day after the AD day (4.59%, 95% confidence interval [CI]: 0.71, 8.61). A 10 $\mu g/m^3$ increase in SPM concentration (mean of lag0–lag2) was associated with increase in risk on AD days (2.75%, 95% CI: −0.32, 5.92) and non-AD days (0.27%, 95% CI: −0.41, 0.96). The difference in the effects between AD days and non-AD days was not significant.

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Conclusion: The study suggested that the risk of emergency visits increased at AD days.

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PP-31-009

Increased Risk of Acute and Chronic Conjunctivitis Associated With Ambient Air Quality in Taiwan

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Background/Aims: This study evaluated whether the daily hospital admission of conjunctivitis was associated with ambient air conditions in Taiwan.

Methods: We used the 2000–2007 reimbursement data obtained from Taiwan's National Health Insurance program for a randomly selected cohort of 1 million insured individuals to identify daily hospital admissions for acute and chronic conjunctivitis (ICD9 CM 372.0 and 372.1). The Environmental Protection Administration provided daily monitored data of air pollutants (CO, NOx, SO_2, O_3, and PM_{10}) and weather status in 2 metropolitans (Taipei and Kaohsiung) and 2 rural areas (Yulin and Yilan). Incidences of conjunctivitis in these areas and relative risks (RRs) associated with air pollution and weather status were assessed.

Results: The risk of hospital admissions for acute and chronic conjunctivitis was higher for population residing in rural areas. Females, elderly, and young children were also at higher risk. Hospital admission for the diseases was also temperature and NOx concentration associated. The RRs of hospital admissions for acute and chronic conjunctivitis, associated with the temperature increase of 10°, were 1.05 (95% Confidence Interval [CI]: 1.03–1.08) and 1.06 (95% CI: 1.05–1.07), respectively. A 10 ppb increase in NOx also increased the risk of acute conjunctivitis (RR = 1.06, 95% CI: 1.05–1.06) and chronic conjunctivitis (RR = 1.10 (95% CI: 1.09–1.10).

Conclusion: The ambient temperature and NOx predict independently the risk of conjunctivitis. The risk is higher for rural people, females, elderly, and children.

PP-31-010

Environmental Factors and Lung Cancer: Polycyclic Aromatic Hydrocarbon Content of Traffic Airborne $PM_{2.5}$ and AhR Gene Expression

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Background/Aims: Recent studies have provided increasing evidence that lung cancer incidence in different countries is associated with exposure to airborne $PM_{2.5}$ of environmental motorcycle emitted particulates. Traffic-related airborne pollutants include polycyclic aromatic hydrocarbons (PAHs), are known activators for nuclear receptors like AhR and PPAR. The aim of this work is to investigate if exposure to PAHs from traffic $PM_{2.5}$ would induce changes in expressions of related genes.

Methods: We collected blood from traffic police officers in Northern Taiwan before and after they went on duty at the road cross-sections. We asked them to carry personal air samplers during the day of work, to collect $PM_{2.5}$ particles to which they would be exposed. Afterwards, PAHs were extracted from these particles and analyzed with Gas Chromatograph-Mass Spectrometer. mRNA was extracted and converted into cDNA for gene expression analysis with Taqman systems. Expression of AhR, CYP1A1, CYP1A2, CYP1B1, TNF, IL-1, IL-6, IL-8, PPARα, and IL-10 were analyzed.

Results: Ambient air $PM_{2.5}$ concentrations ranged from 39.5 to 244.8 $\mu g/m^3$. Most abundant PAH were acenaphthene, dibenzo(a,e)pyrene, naphthalene, and acenaphthylene, among 20 PAH species. AhR mRNA level either decreased or increased after exposure in 75% of the participants, and most of the subjects also had their IL-1, IL-6, IL-8, IL-10 gene levels altered in their post-shift levels compared to pre-shift levels ($P < 0.05$).

Conclusion: PAHs from traffic $PM_{2.5}$ may induce changes in expressions of AhR and related gene levels.

PP-31-011

Correlation Between Environmental Factors and Atopic Dermatitis

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Background/Aims: It is well documented that the environmental factors, such as air pollutions, volatile organic compounds (VOCs), and suspended bacteria and molds, are important for the development of atopic disease and for triggering atopic symptoms. But there are not enough universal results, which verify the relations. The low allergen room is aimed to minimize the environmental factors that could aggravate the atopic dermatitis. It is designed to remove inhalant allergens, dust, and micro-organisms, which could cause allergic symptoms, and minimize exposure to indoor air pollutants such as VOCs and formaldehyde. The purpose of this study was to verify if improvement in indoor environment can relieve the clinical manifestations of atopic dermatitis and to find the relationship between indoor environment and severity of atopic dermatitis.

Methods: A total of 35 children (mean age, 24.3 months) with severe atopic dermatitis (Severity Scoring of Atopic Dermatitis [SCORAD] > 15) and 21 children from a day-care center without atopic dermatitis (mean age, 37.4 months) were recruited. Patients with severe atopic dermatitis were admitted in the low allergen room for 3–4 days (mean, 3.32 days) to see whether clinical symptoms were improved by temporary changing the patient's residential environment while maintaining the regular medical treatment. Severity was assessed using the SCORAD. We compared residential environment in their homes with environment of the low allergen room by measuring indoor air pollutants. Dust, formaldehyde, VOCs (benzene, toluene, ethyl-benzene, xylene, and styrene), carbon monoxide, carbon dioxide, nitrogen dioxide, ozone, suspended fungi, and bacteria were analyzed.

Results: SCORAD score was reduced from 44.3 ± 10.9 to 33.2 ± 8.5 by hospitalization in low allergen room. Wilcoxon Signed-Rank test showed significant improvements of symptom scores in patients with atopic dermatitis ($P < 0.001$) and suspended fungi ($P = 0.010$) was significantly high in residential environment compared to the low allergen room.

Conclusion: The change in residential environment is likely to improve clinical symptoms of atopic dermatitis. It is presumed that particulate matter, formaldehyde, suspended bacteria, and suspended fungi could aggravate atopic dermatitis, but it is too early to conclude that particulate matter, formaldehyde, suspended bacteria, and suspended fungi act as aggravating factors in atopic dermatitis. Further studies are needed for clarifying the relationship between indoor environment and the severity of atopic dermatitis.

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PP-31-012

A Portable Device Capable to Ensure a Good Air Quality Inside a Rain Covered Baby Carriage With a Particle Removal Efficiency of About 90%

Giovanni Invernizzi,[1,2] Annie Sasco,[3] and Ario Alberto Ruprecht[1,2] *[1]SIMG, Milan, Italy; [2]ISDE, Milan, Italy; and [3]Victor Segalen Bordeaux 2 University, Bordeaux, France.*

Background/Aims: Protecting children from exposure to airborne pollutants along busy roads is mandatory. The aim of this study is to check the efficiency of a portable device to deliver filtered air inside a rain covered baby carriage.

Methods: The device is applied externally to the rear of a baby carriage (internal volume, 0.2 m^3), and delivers 60 L/min of ambient filtered air via a short pipe inside. The number of particles/L was measured with a particle profiler (Model 212, Metone) with a sampling time of 10. Particle classes sized 0.3–0.5, 0.5–0.7, 0.7–1.0, 1.0–2.0, 2.0–3.0, 3.0–5.0, and 5.0–10 um were studied.

Results: Mean number of particles 0.3–0.5 um decreased from 63,329/L to 6826/L, for background and filtered air, respectively, in about 12 minutes, with a half-life of 2 minutes. Overall efficiency rate ranged 89.2%–98.1%.

Conclusion: The efficiency of the device in delivering clean air into a baby carriage in our experimental setting is promising for testing both in the real world and in a clinical setting.

PP-31-013

Converting Human Activity Patterns Into Resuspension Schedules in Contam

Lisa Bramwell and Andrea Ferro *Clarkson University, New York, NY.*

Background/Aims: Human activity patterns have been found to significantly influence exposure to resuspended particles. Several indoor human activities can resuspend particles namely, vacuuming, folding clothes, walking, and even grooming (eg, Ferro et al, 2004; Thatcher and Layton, 1995). To estimate the fraction of exposures resulting from these activities, a model employing particle resuspension and transport, human activity patterns, and ventilation schemes can be employed.

Methods: This work contributes to the development and testing of a resuspension module in NIST's multizone ventilation and indoor environment model CONTAM. This research work aims to create an input file of human activity patterns based on those archived in the consolidated human activity database CHAD. This database comprises 22,968 person day diaries of activity patterns (McCurdy et al, 2000).

Results: A program was developed to convert a randomly selected diary into a suitable schedule for CONTAM use.

Conclusion: This will in turn inform resuspension schedules in CONTAM leading to the generation of concentration time profiles.

PP-31-014

The Relationship Between Environmental Pollutants and Skin Prick Test of Child and Adolescent in Gwangyang Port Area

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Background/Aims: Although allergic diseases have been dramatically increased in children and adolescents over recent years, there have been a few sufficient surveys about the relation between living environmental exposure of industrialized area and skin prick test. The comparison of various allergen tests between children and adolescents living around thermal power station and in a rural area may provide a clue to the association of air pollutions to the prevalence of allergy.

Methods: A total of 1062 children and adolescents (aged from 8 to 19 years) living in Gwangyang, Yeo-su, and Ha-dong in South Korea were enrolled in this study. In all, 821 children and adolescents living around thermal power station and 241 children and adolescents living in a rural area. Skin prick test for 12 types of allergens was applied to the subject children and adolescents. Each subject was evaluated by a questionnaire developed by the International Study of Asthma and Allergies in Childhood.

Results: There is a significant correlation between environmental exposure history and positive result of Prick test for cockroach ($P = 0.002$), especially in Gwangyang and Ha-dong ($P = 0.015$, $P = 0.047$). Our results show that, between environmental exposure and positive result of Prick test for *Dermatophagoides farinae* ($P = 0.014$), *Dermatophagoides pteronyssinus* and ($P = 0.013$) in the children of Ha-dong. There is a significant correlation between Cat epithelium and exposed group in Gwangyang ($P = 0.019$).

Conclusion: Our result suggests that air pollutions may be associated with an increased the occurrence of allergic response in children and adolescents. And, there are different results among the 3 districts of Gwangyang area. And, further investigations are needed to understand the pathogenic mechanisms.

PP-31-015

Association Between Ambient PM_{10} and Daily Outpatient Visits for Cardiovascular Diseases in Beijing, China

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Background/Aims: To estimate quantitatively the short-term effect of the ambient particulate matter (PM_{10}) on hospital outpatient visits of local residents for cardiovascular diseases in Beijing, China.

Methods: Daily outpatient visit data were extracted from the database on medical insurance from 2000 to 2002 in Haidian district, Beijing by diagnosis codes classified according to International Classification of Diseases (ICD)-9, for cardiovascular diseases (ICD-9: 390–429, 440–448), as well as hypertension (ICD-9: 401–405), ischemic heart diseases (ICD-9: 410–414), and arrhythmia (ICD-9: 426–427). The daily data of air particulate matter levels and meteorological data for Beijing were obtained from national meteorological center of China Meteorological Administration during the same period. Meteorological data included average air temperature, average atmospheric pressure, relative humidity, and average wind speed. Time-serial analysis using generalized addictive model was applied. Controlling for those confounding factors such as long-term trend, day-of-week effects, and meteorological factors, considering lagged effect and cumulative effect, excess relative risks of daily hospital outpatient visits associated with increased PM_{10} level were estimated by fitting a Poisson regression model.

Results: A 10 $\mu g/m^3$ increase in PM_{10} levels was associated with an excess relative risks of 0.25% (95% confidence interval [CI]: 0.22% to 0.28%), 0.11% (95% CI: 0.08% to 0.15%), 0.41% (95% CI: 0.37% to 0.45%), and 0.02% (95% CI: −0.21% to 0.26%) for cardiovascular diseases, hypertension, ischemic heart diseases, and arrhythmia, respectively. Lagged effect and gender difference were observed.

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Conclusion: The ambient PM_{10} level was associated positively with daily outpatient visits for cardiovascular diseases.

PP-31-016

The Concentration-Response Curve Relation Between Air Pollution and Respiratory Hospital Admissions in Children Under 5 Years Old in Taiyuan, Shanxi, China

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Background/Aims: To explore the shape of concentration-response relation between air pollution and hospital admissions for respiratory diseases among children.

Methods: Electronic medical record abstracts were collected from 22 major hospitals in Taiyuan, and daily air pollution data including particulate matter $(PM)_{10}$, SO_2, NO_2, and CO were obtained from local environmental monitoring stations. We built Poisson regression models that included nonparametric adjustments for longer term trends, weather variables, and day-of-week with the logarithm of the expected value of daily hospital admissions as a function of air pollution using natural cubic splines with 2 knots.

Results: The strongest association of PM_{10} with all respiratory diseases was found during nonheating period, while it was in heating period for 3 gaseous pollutants. For PM_{10} and NO_2, their main effects were cumulative effects, whereas the lag effects of SO_2 and CO were their main effects. All 4 pollutants were curvedly associated with children's respiratory hospital admissions, with a threshold only for CO lag effect (2120 $\mu g/m^3$). The effect of NO_2 was stronger than PM_{10}, SO_2, and CO. For 10 $\mu g/m^3$ increase in the concentration of NO_2 (Avg06, heating period), PM_{10} (Avg06: 2120 $\mu g/m^3$, heating period), the percentage increased was 6.04% (95% CI: 2.09%, 10.13%). Air pollutions were more strongly associated with admissions for chronic lower respiratory diseases and acute lower respiratory infections than for acute upper respiratory infections and pneumonia.

Conclusion: The study confirmed the acute effect of air pollution on children's respiratory hospital admissions, and suggested the larger excess risks in a high level of air pollution setting.

PP-31-017

Daily Visibility and Mortality: Assessment of Health Benefits From Improving Visibility in Hong Kong

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Background/Aims: Visibility in Hong Kong has deteriorated significantly over 40 years with the frequency of visibility below 8 km in the absence of fog, mist, or precipitation, increasing from 6.6 days in 1968 to 54.1 days in 2007.

Methods: During 1996–2006, we obtained mortality data for all natural and cardiorespiratory causes, visibility recorded as visual range in kilometers, temperature and relative humidity from an urban observatory, and concentrations of 4 criteria pollutants. A generalized additive Poisson regression model with penalized cubic regression splines was fitted to control for time–varying covariates.

Results: For all natural causes of mortality an interquartile range of 6.5 km increase in visibility at lag 0–1 days was associated with an excess risk (ER%) (95% Confidence Interval) of −1.13 [−1.76, −0.49] for all ages and −1.37 [−2.09, −0.65] for ages 65+; for cardiovascular mortality of −1.31 [−2.49, −0.13] for all ages, and −1.72 [−3.00, −0.44] for ages 65+; for respiratory mortality of −1.92 [−3.35, −0.49] for all ages and −1.76 [−3.25, −0.28] for ages 65+. The estimated ER% for daily mortality derived from both visibility and air pollutant data were comparable in terms of magnitude, lag pattern, and dose-response relationships especially when using particulate matter with aerodynamic diameter ≤ 10 μm to predict mortality associated with visibility.

Conclusion: Visibility provides a useful proxy for the assessment of environmental health risks from ambient air pollutants and a valid approach for the assessment of the public health impacts of air pollution and the benefits of air quality improvement measures in developing countries where pollutant monitoring data are scarce.

PP-31-018

Southern Taiwan Dust Concentration and Variations in Wind Speed

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Background/Aims: Suspended particulate matter PM_{10} is part of the pollutant standards index. According to the environmental protection agency's air quality standards, standard PM_{10} should fall in around 125 ($\mu g/m^3$), any value past 150–300 will cause a variety of health problems.

Methods: From 2000 to 2009, PM_{10} value has been observed to be on a steady decrease, proving that the environmental protection agency and related department's hard work has been paying off.

Results: Its been discovered that there is a correlation between PM_{10}'s yearly concentration average and yearly average wind speed variation. When wind speeds exceeds 3 m/s, PM_{10}'s concentration rises to 56 $\mu g/m^3$, this result shows that there is a relationship between wind speed and PM_{10}'s concentration, sandy coastal regions of Taiwan could also be a factor to take into account. Wind speed can be used as a pointer as to PM_{10}'s concentration variation, by studying its velocity.

Conclusion: Long-term exposure of dust particles for citizens living in down draft areas along the river bed caused them to wake up in the morning with a runny nose coupled with sneezing and coughing and also skin rashes.

PP-31-019

Effects of Fine Particulate Matter on Rates of Cardiovascular Diseases in a Developing Mega City

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Background/Aims: Adverse health effects of air pollutants, especially of particulate matter, have been demonstrated in recent studies conducted in the large cities. Most of these studies were from developed countries, where the levels of particulate matter are significantly lower than in developing countries. The objective of this study was to investigate the effects of fine particulate matter ($PM_{2.5}$) on hospitalization rates for cardiovascular diseases in Karachi, Pakistan, which is one of the megacities of developing countries.

Methods: Ambient air samples were collected from 2 sites, namely Korangi (industrial/residential) and Tibet Center (commercial/residential). Daily levels of $PM_{2.5}$ were monitored as well as daily metorological variables (temperature and relative humidity). Information on daily hospital admissions (HA) and emergency room (ER) visits for cardiovascular diseases was collected from 3 major hospitals of the city. Multivariate Negative Binomial regression analysis was conducted using daily HA and ER visits as outcomes, daily levels of $PM_{2.5}$ as exposure,

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and temperature, relative humidity, days of the week, gender, and age as covariates.

Results: Simple statistics showed that the mean level of $PM_{2.5}$ in Karachi, 76.3 mg/m^3 (multiple peaks up to 269 mg/m^3) and 99.9 mg/m^3 (multiple peaks up to 279 mg/m^3) in Tibet Center and Korangi, respectively, which is 5–7 times higher than US EPA standards for $PM_{2.5}$. We found significant positive correlation between daily levels of the $PM_{2.5}$ and rates of the HA and ER visits with cardiovascular diseases after adjustment for possible confounders. Incidence rate ratios (IRRs) per unit increase in level of $PM_{2.5}$ were 1.0022 (95% confidence interval [CI]: 1.001–1.003; $P < 0.0001$) and 1.001 (95% CI: 1.00–1.002; $P = 0.004$) for ER visits and hospital admissions, respectively, in Korangi. For the Tibet center, the IRRs were 1.001 (95% CI: 1.00–1.002; $P = 0.16$) for ER visits and 1.001 (95% CI: 1.00–1.002; $P = 0.056$) for hospital admissions. When daily level of $PM_{2.5}$ was treated as a categorical variable relations were less strong at the highest level category. Temperature and relative humidity were both positively correlated with outcome variables. Regarding gender, females were more likely to visit the ER, while males were more likely to be admitted to the hospitals. IRRs were significantly higher for the 40–60 age groups than either younger or older age groups.

Conclusion: Air pollution is an important environmental health issue in developing countries. The $PM_{2.5}$ significantly increases daily rates of ER visits and HA. Other meteorological factors also increase rates, and may become an even bigger concern with global warming.

PP-31-020

Ambient Fine Particulate Matter is Associated With Risk of Hospitalization for Acute Decompensated Heart Failure Among Patients With Depressed Left Ventricular Ejection Fraction

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Background/Aims: Short-term changes in ambient particulate matter (PM) levels may increase the risk of hospitalization for acute decompensated heart failure (ADHF). However, whether this association varies according to heart failure etiology or clinical presentation is unknown. Accordingly, we evaluated whether the effects of ambient PM differ by heart failure type as assessed by the left ventricular ejection fraction (LVEF).

Methods: We abstracted data on patient and clinical characteristics for patients hospitalized with ADHF at 10 clinical centers in Santiago, Chile between 2005 and 2008. Daily data for meteorological and particulate air pollution (PM_{10}, $PM_{2.5}$) were obtained from the MACAM regulatory monitoring network. We evaluated the association between moving averages (1–28 days) of PM_{10} and $PM_{2.5}$ and risk of hospitalization using a time-stratified case-crossover design, controlling for temperature and dew point using natural splines (3 d.o.f. each). Analyses were conducted overall and stratified by LVEF (<50% vs. ≥50%).

Results: Data on LVEF were available from 386 patients (age: 69.3 ± 16.0 years, mean ± Standard Deviations; 55% male) hospitalized for ADHF. Overall, a 10 μg/m^3 increase in mean $PM_{2.5}$ levels over the previous 12 days was associated with a 24.4% (95% confidence interval [CI]: 0.4%, 54.0%) increased risk of hospitalization. Among 261 patients with LVEF <50%, the association with $PM_{2.5}$ was a 25.8% (95% CI: 2.8%, 54.0%) increased risk observed with a 5 day moving average to a peak of 81.3% (95% CI: 13.9%, 188.5%) increased risk observed with a 21-day moving average. No associations were observed between $PM_{2.5}$ and risk of hospitalization among 125 patients with EF ≥ 50%. The results for PM_{10} were qualitatively similar to those for $PM_{2.5}$.

Conclusion: Our results suggest that the effects of ambient PM on heart failure patients differ according to disease etiology and/or clinical presentation, with stronger associations observed for patients with reduced LVEF.

PP-31-021

Evaluation of the Odor Threshold Concentration Levels of the Pollutants Emitted By Stationary Sources of One of the Ukrainian Industrial Facilities

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Background/Aims: The issue of the nature and spatial dispersion of the smells that come from the industrial and social facilities is one of the dominant directions in the ambient air pollution studies. The prolonged population exposure to air pollutants leads to the decrease in quality of life.

The research was aimed at the assessment of human health risks related to the exposure of the population to odors emitted by Ukrainian facility that develops the supple polymer food wrap.

Methods: Mathematical modeling is one of the most effective and rational way to evaluate the odor effect formed by industrial facilities.

The following technical approaches were applied for the purpose of evaluation of the odor threshold concentrations:

- Data preparation algorithm for the calculation of averaged concentrations of pollutants;
- Software package ISC-AERMOD View v.6.4.0 that helps to evaluate averaged (hourly, daily, monthly, and annual) concentrations, to build models of the spatial pollutants dispersion for hourly periods (1 minute–1 hour), and to determine the peaks of the concentration during 1-hour averaging period.

Results: Thirteen odorous substances were prioritized. Odor perception threshold concentration levels were determined for 9 of the studied pollutants, namely, formaldehyde, propyl alcohol, isopropyl alcohol, ethanol, ethyl acetate, cyclohexanol, nitrogen dioxide, ozone, and kerosene. Concentration levels were calculated in 5 receptor points for each of the studied pollutants and compared with the meanings of odor perception thresholds levels. The odor dispersion area over the nearby located to the facility territory was identified.

Conclusion: The research showed that concentrations of the 9 prioritized pollutants over studied area do not exceed the recommended norms of the odor threshold sensitivity. Risk levels formed by these substances do not exceed the levels of acceptable risk and do not pose a substantial hazard for the health of the exposed population.

PP-31-022

Effects of Chronic PM Exposure From Local Heating on Self-reported Respiratory and Cardiovascular Health in the RHINE Tartu Cohort

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Background/Aims: Residential wood combustion is widely used for local heating in Northern Europe, and it has been found to be a significant source of particulate pollutants in Estonia. Because of poor combustion, the emissions, and due to bad dispersion conditions, the concentrations can be relatively high. The relationship between particulate matter (PM) and health effects has been shown in numerous studies; however, it has been difficult to separate the source-specific effects from the effects of all types of PM. This paper aims to study the effects of local heating-induced PM on respiratory and cardiovascular health.

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Methods: The relationship between particles and self-reported symptoms was studied in the Respiratory Health in Northern Europe Tartu cohort. A postal questionnaire with questions regarding respiratory complains, cardiac disease, lifestyle as smoking habits, indoor environment, occupation, early life exposure, and sleep disorders was sent to 2460 adults. The annual concentrations of particles induced by local heating were modeled with an atmospheric dispersion model AirViro and obtained $PM_{2.5}$ concentrations in 200 × 200 m grid cells were linked with home addresses, using geographic information system. The relationship between the level of fine particles outside home and self-reported health problems was analyzed with logistic regression model.

Results: The annual average exposure to PM induced by local heating was 4.1 μg^{-3} (max, 7.4 μg^{-3}). We found a significant relation with wheezing, OR = 1.10 (95% CI: 1.00–1.21); and cough, OR = 1.07 (95% CI: 1.00–1.14) per 1 μg^{-3} increase in $PM_{2.5}$ exposure. The associations were slightly positive but nonsignificant for chronic bronchitis, rhinitis, shortness of breath, hypertension, and cardiac diseases.

Conclusion: The local heating pollution seems to induce slight respiratory symptoms such as wheezing and cough. These particles appear to be different from others, as our previous results with traffic-induced PM had shown relationship only with cardiac diseases.

PP-31-023

Estimating Commute Time and Distance for Human Subjects in Air Pollution Epidemiological Studies

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Background/Aims: In-transit exposures to traffic-related air pollutants are frequently high because of vehicle's proximity to traffic emissions and rapid air exchange rate. However, little is known about the affect of people's in-transit exposure on adverse health outcomes mainly due to methodological difficulties in assessing parameters of vehicle travel. In this study, we developed methods to reliably estimate people's commute time and distance based on addresses or coordinates of key locations (eg home, work, school) using widely available online trip routing services.

Methods: We compared the self-reported and global position systems (GPS)-based commute times based on travel diary and GPS tracking data for about 300 households in the 2000/2001 Southern California Association of Government travel survey. In addition, we derived web-based estimates of commute time and distance based on origin and destination locations. Multivariate regression models were developed to estimate actual commute time and distance by including web-based estimates and other influential factors that can be readily obtained either from questionnaire surveys (eg, season, day of the week, time of day, purpose of commute) or from publicly available data (eg, type and speed limit of roadways).

Results: We identified the potential and limitations of using diary or GPS-based method for examining people's commute patterns in epidemiological studies. GPS-based data frequently identify short trips not reported in diaries (eg, a GPS may reveal a subject's sequential locations as work—daycare drop-off—grocery shopping—home, whereas a diary may indicate location as work—home). We found that web-based estimates correlated better with GPS-based estimates for commute distance than commute time. Our preliminary regression models can explain 85% of the variance in GPS-based commute time.

Conclusion: On the basis of simple questionnaire data and trip routing tools, we can reasonably estimate subjects' commute time and distance for in-transit exposure assessment in air pollution epidemiological studies.

PP-31-024

Air Pollution and Respiratory Diseases Hospital Admissions: Sex-related Patterns in a Population Living Nearby a Steel Producing Plant in Brazil

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Background/Aims: Epidemiologic studies have been supplying evidence on the association between different health problems and the daily increase of air pollution levels. Studies analyzing such association considering gender as a susceptibility factor have been inconclusive. This study aimed to evaluate the air pollution effect on respiratory diseases hospital aiming to evaluate the role of age and gender as susceptibility factors.

Methods: Volta Redonda is a city in Southeast region of Brazil, wherein the country's largest steel producing plant is settled. This ecological time-series study used data on local daily hospital admissions for respiratory diseases (ICD-10, J00–J99) in the whole population and among those aged ≥65 years. Data were stratified by gender; PM_{10}, and SO_2 average concentrations, minimum temperature, and relative humidity along January 2002–December 2006. Furthermore, hospital admissions data were analyzed using generalized additive Poisson regression, with constrained distributed lag models adjusted for long time trend, weekdays, and holidays. The quality of fit for the final model was estimated using residual deviance analysis and the Akaike criteria.

Results: An increase of 10 $\mu g/m^3$ in PM_{10} concentration was associated with a highest risks—-1.06 (95% CI: 1.003–1.111)—-of hospital admissions in elderly women, and according to similar increased levels of SO_2 concentration, a risk of 1.04 (95% CI: 0.924–1.178) was observed. For elderly men, the increased risks of hospital admission were 1.02 (95% CI: 0.961–1.076) and 1.02 (95% CI: 0.897–1.162).

Conclusion: This study showed an association between PM_{10} and SO_2 air concentrations and increased risks of hospital admissions for respiratory diseases, being higher among elderly women. Therefore, age and gender act as factors of susceptibility to hospital admissions for respiratory diseases.

PP-31-025

An Update on the Multiethnic Study of Atherosclerosis and Air Pollution

Joel Kaufman *University of Washington, Seattle, WA.*

Background/Aims: "MESA Air" (Multi-Ethnic Study of Atherosclerosis and Air Pollution) is a multicenter prospective cohort study of air pollution and cardiovascular disease (CVD) launched in 2004, combining state-of-the-art cardiovascular outcome measurements with individual-level exposure assessment. The central hypothesis is that long-term exposure to airborne fine particulate matter is associated with accelerated atherosclerosis and risk of clinical cardiovascular events.

Methods: MESA Air builds on the framework of the National Heart, Lung, and Blood Institute multiethnic study of atherosclerosis (MESA). MESA studies risk factors (and evidence of pre-clinical processes) that predict development of clinical CVD among individuals without known CVD, in a population-based sample from 6 major metropolitan areas. MESA Air adds to MESA individual-level exposure estimates that integrate spatio-temporal modeling of outdoor air concentrations, participant-specific predictions of residential pollutant infiltration efficiency, and time-location patterns. MESA Air supports a follow-up measurement of intima-medial thickness of the carotid artery and coronary artery calcification (CT scan) in 3600 participants in an examination now underway. Annual follow-up of each participant (n > 6000) is followed by medical record review. Individual exposure estimates will be combined with each participant's cardiovascular status to understand the influence of air pollution exposure on progression of CVD.

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Results: MESA Air is halfway through its 10-year project period; analysis of primary study outcomes will not proceed until 2012. However, progress to date is notable: Advances in exposure modeling approaches will be reviewed. Initial epidemiologic analyses demonstrate associations between predicted outdoor air pollutant concentrations at participants' homes and extent of emphysema (CT scan), microvascular phenomena (retinal photography), and left ventricular mass (MRI).

Conclusion: MESA Air is a comprehensive epidemiologic study of long-term air pollution exposures and CVD. This research will provide refined estimates of risks associated with exposure to air pollution and stimulate hypotheses regarding biologic mechanisms. The presentation will provide analysis updates and opportunities for collaboration.

PP-31-026

Increased Mortality in Diabetics Exposed to Ozone

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Background/Aims: Associations between ozone exposure and mortality have been established. However, the relationship between ozone exposure and diabetes mellitus mortality, 1 of the top 10 leading causes of death in the world, remains unclear. In this study, we aim to explore the relationship between ozone exposure and mortality from diabetes.

Methods: Between 2006 and 2008, death of diabetic (ICD-9, 250; N = 5767) patients more than 50 years of age taken from National Mortality Registry in metropolitan Taipei, Taiwan, were included for analysis. Average levels of ozone each day were calculated from 15 monitoring stations of Taiwan Environmental Protection Agency in this area. Case-crossover design was applied to examine the odds ratio between the risk and reference periods, whereas daily moving average from zero day (the day of death) to seventh day was used, and 4 reference days were chosen by every 7 days before the day of death for 1 month. Temperature and relative humidity were included in the 1-pollutant model, and PM_{10} or $PM_{2.5}$ was further adjusted in 2-pollutant model separately after calculating the correlation of air pollutants.

Results: In 2-pollutant model with $PM_{2.5}$ adjusted, the trend of accumulative effect of ozone was observed. Diabetic patients were at risk (OR = 1.09, 1.01–1.17) for deaths in an interquartile increase of ozone (11.6 ppb) within 5 days exposure. In ozone-associated deaths from diabetes, male was at higher risk (OR = 1.14, 1.03–1.26), and younger age group (50–65: OR = 1.19, 1.01–1.40) was at elevated risk than older groups. Similar results were also observed when PM_{10} was controlled in 2-pollutant model.

Conclusion: Mortality from diabetes is associated with increased ozone exposure, and the risk is higher for males and those aged 50–65. The specific causes of diabetes mellitus death need further investigation.

PP-31-028

Time-activity Patterns: A Case of South Durban, South Africa

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Background/Aims: Exposure modeling in the developing world is constrained by a lack of population specific time-activity patterns data. The application of data from the developed world in exposure modeling in the developing world is fraught with uncertainties, concerning among others the exposure setting characteristics, the amount of time spent in various microenvironments, and the drivers for time spent in various microenvironments. The objective of this study was to determine time-activity patterns for an adult population in south Durban, South Africa, to inform air pollution exposure modeling. A questionnaire was administered to a sample of the adult population between January and June 2007.

Methods: The data were analyzed using STATA 10. Descriptive statistics were calculated for the amount of time spent in various microenvironments. Linear regression modeling was used to determine factors that influence the amount of time spent in these locations by the study population.

Results: Results indicated that time spent indoors, outdoor, and on transportation activities by the Durban adults differed to that reported for the developed world adult populations by approximately 12%–16%, 44%–55%, and 50%, respectively. Statistically significant drivers for mean time indoors were age, season, and temperature ($P < 0.05$). Mean indoor time at home was dependant on age ($P < 0.05$), and employment status and weekend versus weekday ($P < 0.001$). Mean time outdoor was dependant on age and temperature ($P < 0.05$). None of the factors evaluated were statistically significant drivers for mean time spent on transportation activities. Overall gender, education, and precipitation were not statistically significant drivers of time spent in different microenvironments ($P > 0.05$).

Conclusion: The results suggested that time-activity patterns for the developed and developing world differ. Therefore, exposure modeling in the developing world needs to be informed by population specific time-activity patterns.

PP-31-029

Exposure to Highway-related Ultrafine Particles and Cardiovascular Markers: The CAFEH Project

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Background/Aims: A significant portion of urban air pollution derives from motor vehicle exhaust on highways and busy streets. Recent studies have shown that the near-highway environment contains elevated concentrations of ultrafine particles (UFP; diameter <0.1 micrometer), which is a concern, because UFP is generally more toxic than larger particles. We are involved in a 5-year, observational, cross-sectional, community-based participatory research study (titled Community Assessment of Freeway Exposure and Health [CAFEH]) of exposure and cardiovascular health outcomes in neighborhoods immediately adjacent to major highways in the Boston, Massachusetts, area.

Methods: We are conducting environmental monitoring of particle number concentration and other air pollutants in Somerville (just north of Boston) near Interstate-93 (>1.5 × 105 vehicles/d), using a mobile monitoring platform and 2 fixed sites. The residents aged ≥40 living <100, 100–400, and 1000 m have been selected for participation. Participants complete a survey of demographics, time-activity, cardiovascular diagnoses, and potential confounders. A subset of these participants agreed to have blood pressure measurements taken and to donate blood samples for C-reactive protein (CRP), lipids, and fibrinogen analysis.

Results: Data collection is ongoing, and we have preliminary results for the first set of participants. The cohort is predominately female and white, with a mean age of 58 years. Prevalence of hypertension and pre-hypertension based on measurement is 36% and 78%, respectively. The mean levels of CRP and fibrinogen are 1.9 and 455 mg/dL, respectively. Mean systolic and diastolic blood pressure in the left arm is 135 and 77 mm Hg, respectively. There are weak correlations between systolic blood pressure and both hypertension and cardiovascular diagnosis. In addition, there is a weak association between distance-to-highway and CRP.

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Conclusion: There are associations of interest in this near-highway cohort; however, definitive conclusions cannot be drawn at this time. Continued recruitment will allow us to more accurately evaluate associations between exposure and outcomes of interest.

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PP-31-031

The Effects of Fine and Coarse Particles on Daily Mortality in Seoul, Korea

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Background/Aims: Many multicity studies have demonstrated an association between acute exposure to ambient particles and both mortality and morbidity. Less is known about the health risks associated with short-term exposure to fine particles (those with an aerodynamic diameter of ≤ 2.5 μm; $PM_{2.5}$).

Methods: We conducted a time-series study to investigate the acute effects of $PM_{2.5}$ and PM_{10} on daily mortality in Seoul, Korea from January 2005 to December 2008. We performed the time-series analysis using the generalized additive model to analyze the mortality, air pollution, and covariate data.

Results: We found that $PM_{2.5}$ and PM_{10} were significantly associated with the mortality from all causes and from specific causes. A 10 $\mu g/m^3$ increase of concentration of $PM_{2.5}$ corresponded to 0.95% (95% confidence interval [CI]: 0.57%–1.34%), 1.64% (95% CI: 0.89%–2.37%), and 2.16% (95% CI: 0.57%–3.77%) increase of all, cardiovascular, and respiratory mortality. A 10 $\mu g/m^3$ increase of concentration of PM_{10} corresponded to 0.44% (95% CI: 0.25%–0.63%), 0.76% (95% CI: 0.40%–1.12%), 1.13% (95% CI: 0.35%–1.90%) increase of all, cardiovascular and respiratory mortality.

Conclusion: Our analyses show an increased risk of mortality for all and specific causes associated with $PM_{2.5}$, and the risks are higher than PM_{10}, and suggest the rationale for the establishment of national ambient air quality standard of $PM_{2.5}$ in Korea.

PP-31-032

Time-series Analysis of Association Between Inhalable Particulate Matter and Daily Mortality in Urban Residents in Tianjin

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Background/Aims: To study the association between particulate matter less than 10 μm in aerodynamic diameter (PM_{10}) and daily mortality in urban population in Tianjin.

Methods: We collected air quality data, daily mean temperature, relative humidity, and daily cause-specific death counts, and used generalized additive models to explore the relationship between ambient particulate matter and daily mortality, after adjusting the effects of long-term and seasonal trend, weather conditions and other gaseous pollutants, such as sulfur dioxide and nitrogen dioxide.

Results: An increase of 10 $\mu g/m^3$ in PM_{10} was associated with 0.45% (95% CI: 0.21%–0.69%) nonaccidental morality, 0.60% (0.29%–0.91%) circulatory morality, and 0.82% (0.04%–1.61%) respiratory morality, respectively.

Conclusion: The findings indicate that exposure to PM_{10} is significantly associated with daily mortality in urban population in Tianjin, especially with the circulatory mortality and respiratory mortality.

PP-31-033

Associations Between Socioeconomic Status and Air Pollution Exposure in Canadian Cities: Implications for Environmental Justice and Epidemiological Research

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Background/Aims: Research examining the association between socioeconomic status (SES) and exposure to air pollution across multiple cities will improve our understanding of the variability in, and potential determinants of, environmental inequities. Here we report a national study that explores the association between SES and proximity to air pollution sources in 144 Canadian metropolitan areas, as well as between SES and concentrations of nitrogen dioxide (NO_2) levels derived from land use regression models developed previously for a subset of 7 cities.

Methods: SES variables were compiled from census data for 41,485 dissemination areas (DAs), representing 400–700 individuals per DA. Air pollution exposures were calculated for block points within each DA, representing approximately 123 individuals per block. SES surrogates included 8 census variables broadly covering social and material deprivation. Air pollution indicators included proximity to major roads, industrial land use, and point source emission sources. Concentrations of NO_2 were extracted from land use regression models available for 7 cities (Victoria, Vancouver, Edmonton, Winnipeg, Toronto, Sarnia, and Montreal). Analyses included Spearman/Pearson correlations, loess plots, and multiple logistic regression with a smoothing function to account for spatial autocorrelation.

Results: Significant associations were found between SES and air pollution indicators across all 144 Canadian metropolitan areas, but large between-city variations exist. Similar results were found using NO_2 estimates for 7 large cities. For example, the likelihood of a DA being in the bottom 10th percentile of median household income in Vancouver and Montreal increased by 1.81 (95% CI: 1.72–1.90) and 2.78 (95% CI: 2.44–3.19) times, respectively, with each 5 ppb increase in NO_2. Current analyses are examining potential city and neighborhood level determinants of these environmental inequities.

Conclusion: SES is associated with higher exposures to air pollution in several Canadian cities; however, the magnitude of these associations vary. Documenting and explaining this variation has important implications from both an environmental injustice and epidemiological perspective.

PP-31-034

The Effects of Short-term Exposure on Hospital Admissions for Acute Lower Respiratory Infections in Young Children of Ho Chi Minh City, Viet Nam

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Background/Aims: Emerging evidence suggests that exposure to outdoor air pollution increases the risk of acute lower respiratory infections in young children, but few studies have been conducted in developing countries of Asia, where populations are exposed to higher levels of pollution and experience the greatest burden of disease. A team of local and international experts conducted an epidemiologic investigation in Ho Chi Minh City, Vietnam (HCMC). The hospital component estimated the effect of short-term exposure to air pollution on hospital admissions for acute lower respiratory infections (ALRI) in young children.

Methods: Over 15,000 daily admissions for pneumonia and bronchiolitis from 2003 to 2005 were collected from 2 pediatric hospitals. Daily, city-level exposure estimates PM_{10}, O3, NO_2, and SO_2 were generated using data from the city's ambient air quality monitoring network. Both individual and district-level indicators of SEP were assessed. Analyses were conducted using case-crossover and time-series approaches.

Results: Increased exposure to air pollution is associated with increased ALRI admissions in HCMC in the dry season. The excess risk per 10 $\mu g/m^3$ is 3.1% for PM_{10}, 15.6% for NO_2, and 7.7% for SO_2. Several data limitations, however, limit our ability to draw conclusions about differential impacts by SEP on ALRI in young children in HCMC.

Conclusion: This study, to the best of our knowledge, is the first to assess the health effects of air pollution in HCMC. It focuses on an understudied health outcome, ALRI, which is responsible for a substantial burden of disease among young children in developing countries.

PP-31-035

A Study on the Health Effect of the Air Particles From Sand Storms on the People Living in the City Far Away From the Area Producing the Sand Storm

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Background/Aims: To assess the acute health effects of the air particles in sand storm (DSS) on the exposed population.

Methods: We selected the general residents living in Baotou city which is located 200–250 km from Tenggeli Desert and Wulanbuhe Desert, in Inner Mongolia, where is often influenced by the dust and sand storm (DSS) as the study subjects. Using both epidemiological follow up study and Panel study, we explored the effects of the air particles in DSS on the respiratory symptoms and functions of the exposed population.

Results: The results of the follow-up study showed that the ambient PM_{10} and $PM_{2.5}$ levels of the study field (Baotou city) increased significantly during the DSS (the largest concentration of PM_{10} increased to 3.713 mg/m^3 and $PM_{2.5}$ to 1.353 mg/m^3), however, the level of the other air pollutants decreased companied with the strong wind at the same time. The incidence of the related respiratory symptoms in the exposed subject were positive and associated significantly with the increase of the concentration of PM_{10} ($P < 0.01$), and these effects could recover generally 1 week after. The results of Panel Study (over 300 schoolchildren) showed that the average daily level of Pulmonary Expiratory Flow Rate (PEFR) of the subject children were negatively correlated with increase of the concentration of $PM_{2.5}$ during 40 days of the DSS ($P < 0.01$).

Conclusion: These results suggest that the increase of ambient particles from the DSS can induce the increase of the respiratory symptoms and the decrease of the PEFR Level of the subject children, they maybe express a short-term effects mainly.

BIOMONITORING, BIOMARKERS, AND EXPOSURE BIOLOGY

PP-29-057

Cytogenotoxic Effect on Workers Exposed to Styrene. Influence of Genetic Polymorphisms

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Background/Aims: Styrene is a commercially important chemical widely used in the manufacture of resins, polyesters, and plastics. The highest levels of human exposure to styrene occur in occupational settings, especially during the production of reinforced plastic products, which involve manual lay-up or spray-up operations. The objective of this work was to study the occupational exposure to styrene in a multistage approach, in order to integrate the following end points studied: styrene in workplace air, mandelic and phenylglyoxylic acids in urine, hemoglobin (Hb) adducts, sister-chromatid exchanges (SCE), micronuclei, DNA damage (comet assay), and genotypes of polymorphic genes of some metabolizing enzymes.

Methods: In all, 75 workers from a fiberglass-reinforced plastics factory and 77 unexposed controls took part in the study.

Results: The mean air concentration of styrene in the breathing zone of workers (30.4 ppm) was higher than the threshold limit value of 20 ppm recommended by the ACGIH, and the biological exposure index adopted by the ACGIH for exposure to styrene prior to the next shift (mandelic and phenylglyoxylic acids = 400 mg/g cr) was exceeded, indicating that styrene exposure for this group of workers was higher than recommended. The level of Hb adducts and SCE in exposed workers was significantly higher as compared with controls. The DNA damage was higher among styrene-exposed workers than in controls. No significant differences were observed in the micronuclei. Concerning the effect of the genetic polymorphisms on the different exposure and effect biomarkers studied, we observed the effect of microsomal epoxide hydrolase activity on Hb adducts of highly exposed individuals and on the levels of SCE of exposed workers.

Conclusion: The present results suggest the importance of individual susceptibility factors in modulating genotoxicity, although cautious interpretations are required since the size of the study population limits the power of many of the analyses. Because the effects of these polymorphisms are relatively subtle, and some important alleles are relatively rare, a much larger study population will be necessary to evaluate their effects on biomarkers, especially when gene-gene interactions are considered.

PP-29-058

Urine Lead in 1430 Pupils in Tangshan

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Background/Aims: To investigate the urine lead levels in adolescent in Tangshan, and to provide baseline data in the assessment of lead pollution in children.

Methods: Multistage stratified sampling methods are used to choose 1430 pupils in Grade 3–Grade 4 from 67 primary school in 14 counties in Tangshan area. Morning urine (10–30 mL) was collected and sent to our laboratory in 2 hours. Atomic absorption spectrophotometry was adopted to measure the lead concentration in urine. The results were expressed as geometric mean.

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Results: The geometric mean of urine lead was 0.87 μg/L, and the P50, P75, P90, P95 were 1.9 μg/L, 4.3 μg/L, 7.9 μg/L, 11.9 μg/L, respectively. Urine lead level is lower in male (0.78 μg/L) than in female (0.996 μg/L) ($t = 2.34$, $P = 0.0194$). Luan Nan County (3.98 μg/L), Zun Hua County (3.58 μg/L), and Luan Xian County (3.15 μg/L) were among the first 3 counties with the highest urine lead.

Conclusion: Higher urine lead levels were found in the urban and downtown area in Tangshan, which should be taken as a in environmental monitoring.

PP-29-059

3-Hydroxypropyl Mercapturic Acid Interlaboratory Method Standardization to Measure Acrolein Exposure in Human Urine

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Background/Aims: An interlaboratory comparison was set up to measure the consistency of analysis of 3-HPMA (3-hydroxypropyl mercapturic acid), a biomarker of acrolein exposure, across 4 participating laboratories using LC-MS/MS. In the first phase, measurement differences between the laboratories were observed, and it was concluded that further method of standardization was required. A number of potential sources of variance, including differences in calibration standards used, were identified.

Methods: Following a review of the 3-HPMA methods used by each laboratory, a second interlaboratory comparison study was initiated incorporating a common internal standard in the operating protocol (3-HPMA-13C3-15N). The objective of the new study was to validate 3-HPMA measurement capability by LC-MS/MS between the same 4 laboratories, using identical sets of samples and the same internal standard.

Results: The results from this second interlaboratory study demonstrate that the use of a common internal standard improved the reproducibility of 3-HPMA quantification by lowering the average interlaboratory coefficient of variation (CoV) from >20% to 13%. This compares favorably with World Health Organization standardized clinical methods, which typically report average interlaboratory CoV above 10% (1–2). As expected, the repeatability of the quantification was not adversely affected by the new internal standard, given that no other changes were made to the overall procedures within the individual laboratories.

Conclusion: In conclusion, the results from this new study demonstrate that the use of a common internal standard improved the interlaboratory reproducibility of 3-HPMA quantification between participating laboratories.

PP-29-060

Postapplication Formation of Pesticide Degradation Products in a Test House

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Background/Aims: Human exposure to preexisting degradation products of pesticides is a concern when conducting dose reconstruction studies where metabolic products are used to estimate exposure. The purpose of this research was to determine whether there was significant formation and translocation of pesticide degradates in an unoccupied test house where pesticides had been recently applied.

Methods: To conduct the study, propoxur, cis/trans permethrin, and cypermethrin were sprayed in a simulated crack and crevice application in 1 room of the test house. Fipronil was applied to the same surfaces via syringe. Floor surface samples (n = 47) were collected at 1, 2, 3, 7, 14, 21, 28, and 35 days postapplication using isopropanol wetted cotton wipes and a stainless steel template with a 929-cm^2 wiping area. No samples were taken from surfaces that had received direct pesticide application. The wipes were analyzed to determine the concentrations of the parent pesticides and the following degradation products: 2-iso-propoxyphenol, cis/trans 3-(2,2-dichlorovinyl)-3-3-dimethyl-(1-cyclopropane) carboxylic acid (cis/trans DCCA), 3-phenoxybenzoic acid (3-PBA), fipronil sulfone, fipronil sulfide, and fipronil desulfinyl.

Results: Excepting a single sample where fipronil was not found, the parent pesticides were present in all samples. In contrast, the propoxur metabolite 2-iso-propoxyphenol was not detected in any sample. Fipronil sulfide was present at low levels (5.5 ± 3.0 pg/cm^2) in 44 samples, whereas fipronil sulfone and desulfinyl were not found. Trans-DCCA, cis-DCCA, and 3-PBA were present in low, but quantifiable amounts, in 42, 16, and 9 wipes, respectively. Although 2 of the degradates were present in most of the samples, their continuous low level occurrence throughout the study period did not indicate an association with the pesticide application performed in the study.

Conclusion: The study results indicate that formation and translocation of these metabolites to other surfaces after a recent indoor pesticide application may not be a significant factor affecting dose reconstruction studies.

PP-29-061

Exploring Exposure in 27 Countries in a European Human Biomonitoring Study—Cophes

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Background/Aims: Human Biomonitoring (HBM) is an effective tool to assess human exposure to environmental pollutants and potential health effects of such pollutants. In support of the European Environment and Health Action Plan, European scientists are developing a functional framework to define, organize, and manage a coherent approach toward HBM in Europe.

Methods: Scientists from 35 institutions in 27 European countries formed COPHES (COnsortium to Perform Human Biomonitoring on a European Scale), which is funded by the European Community's Seventh Framework Program.

Results: COPHES is an essential step to establish harmonized procedures for a HBM in Europe. It furthermore aims to support chemicals policy such as REACh and to improve quantification of exposure of the general population to existing and emerging pollutants. HBM can be used to determine reference values of exposure, to support policy making by evaluation of policy actions aimed at reducing exposure to potentially hazardous environmental stressors and to promote more comprehensive health impact assessments of policy options. Starting from a review of existing and planned HBM studies in different EU Member States, harmonized study protocols are being prepared and will be tested out from 2011 onwards. In a Pilot Study, the focus is given to the mercury, cadmium, phthalates, and ETS in children and their mothers. Depending

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on priorities and funding possibilities of Member States, further substances might later be included. An extensive training and capacity building program will be developed for all European countries who express an interest.

Conclusion: An extended communication strategy will target not only the scientific community and the individual participants in the HBM study, but also policymakers, stakeholders, and the population at large. The project is coordinated by BiPRO GmbH, Germany, in close collaboration with the Katholieke Universiteit Leuven, Belgium. It started on 1 December 2009 and is scheduled to run for 3 years.

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PP-29-062

Modification of the Relationship Between Urinary 8-OHdG and Hippuric Acid Concentration by GSTM1, Gstt1, and Aldh2 Genotypes

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Background/Aims: Urinary hippuric acid (HA) has been widely used as a biological marker of occupational exposure to toluene, although it is no longer valid for low levels of toluene exposure. Toluene exposure is known to induce oxidative deoxyribonucleic acid damage and the metabolism is affected by genetic polymorphisms of some metabolizing enzymes. Therefore, genetic polymorphisms of these metabolizing enzymes must be considered in the evaluation of oxidative stress caused by toluene exposure. We evaluated the relationship between urinary 8-hydroxydeoxyguanosine (8-OHdG), a marker of oxidative deoxyribonucleic acid damage, and urinary HA in individuals without occupational exposure to toluene and characterized the possible roles of GSTM1, GSTT1, and ALDH2 genotypes in the relationships between these markers.

Methods: In this study, we enrolled 92 healthy Koreans. Urinary HA and 8-OHdG levels were measured and the correlations between them were statistically tested according to the GSTM1, GSTT1, and ALDH2 genotypes.

Results: HA did not significantly correlate with urinary 8-OHdG in overall subjects. However, the correlation between them showed a statistical significance in individuals with GSTM1-null, GSTT1-null, and ALDH2*2/*2 genotypes ($R = 0.776$, $P < 0.01$).

Conclusion: This study shows that the relationship between urinary HA and 8-OHdG concentration is modified by genetic polymorphisms of some metabolizing enzymes such as GSTM1, GSTT1, and ALDH2.

PP-29-063

What Do Late-life Polychlorinated Biphenyls (PCB) Levels Tell us on Lifetime Internal Exposure? An Evaluation of Exposure Misclassification in Retrospective Breast Cancer Epidemiologic Studies

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Background/Aims: Despite the experimental evidence of polychlorinated biphenyls (PCB) carcinogenicity, epidemiologic studies on the association between PCB exposure and breast cancer remain mostly inconclusive. These studies may be hampered by the fact that the PCB levels are measured at the time of diagnosis or a few years before and might not represent internal exposure during hypothesized periods of susceptibility like puberty. We conducted this study to evaluate PCB exposure misclassification in a large sample of French women, using a published physiologically based pharmacokinetic model for persistent organic pollutants.

Methods: Lifetime PCB-153 pharmacokinetic profiles were backtracked using a physiologically based pharmacokinetic framework that integrates information on women age, height profile, weight changes across time, pregnancies, and breast-feeding history. Environmental exposure was optimized to match simulated blood concentration with levels measured at the age of diagnosis (28–75 years) while taking temporal trends of contamination into account. We performed analyzes with 2 different half-lives (10 and 30 years) as values reported in the literature vary. The area under the curve of blood concentration for each 10-year interval and maximum blood concentration (Cmax) were then compared to measured levels with following 2 approaches: (i) quartile classification in different age categories and (ii) correlation analyzes.

Results: We found a quartile misclassification varying from 10% to 75%, early decades of life being the ones displaying the highest discrepancy with quartiles based on late-life PCB levels. Measured concentrations and simulated maximum blood concentration were correlated with coefficients of $r = 0.88$ and 0.81 (Spearman rank correlation) for half-lives of 10 and 30 years, respectively.

Conclusion: Assuming that backtracked levels were accurate, these results suggest that classification based on PCB levels measured at the time of diagnosis does not adequately reflect exposure during earlier hypothesized windows of susceptibility. Hence, caution should be exercised when interpreting results from breast cancer epidemiologic studies.

PP-29-064

Assessments of PAHs Exposure and Health Effects for Foundry's Workers

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Background/Aims: Occupational exposure to polycyclic aromatic hydrocarbons (PAHs) and metals has been reported in foundries. We aimed to evaluate the oxidative damage of foundry workers with different job tasks and the association between 1-hydroxypyrene (1-OHP), metal exposure, and oxidative damage in foundry workers exposed to pervasive carcinogens.

Methods: Oxidative damage of the foundry workers and air samples for metals analysis in different manufacturing process were collected at 2 foundry plants.

Results: A higher PAH level was found for big moulding process than for the small one, and the chemical binder in the different size moulds was hypothesized to be the main cause. The higher PAH levels were found in the painting area (95.51 $\mu g/m^3$), pouring area (18.42 $\mu g/m^3$), and inside the office (16.48 $\mu g/m^3$); as well as the higher BaPeq levels were in the painting area (152.3 ng/m^3), and the furnace for melting iron (96.9 ng/m^3). The gas phase (over 90%) was the major contributor of total PAHs in the manufacturing areas. A higher concentration of 1-OHP was found in the exposed group (0.322 ± 0.289 $\mu g/g$ creatinine) relative to the control group (0.178 ± 0.289 $\mu g/g$ creatinine) ($P < 0.05$). Moreover,

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higher levels of 1-OHP were found in workers involved in manufacturing processes (0.346 μg/g creatinine) compared to administrative workers (0.018 μg/g creatinine).

Conclusion: A positive correlation was identified between levels of 1-OHP and 8-hydroxydeoxyguanosine (8-OH-dG), DNA strand breakage, and malondialdehyde in all study subjects. Together with the evidence from environmental and biological sampling, a long working history and work in the melting, grinding, and sand treatment processes should be given seriously consideration in occupational disease prevention. Moreover, health risk assessment of PAHs exposure showed that lung cancer risks were 9.06 32 × 10−4 and 1.09 × 10−3 in foundries A and B, respectively.

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PP-29-065

Cadmium and Tubular Dysfunction Markers in Urine of Smelter Residents in Korea

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Background/Aims: The aim of this study was to assess the possible influence of long-term environmental exposure to cadmium (Cd) on the level of renal dysfunction markers.

Methods: The study subjects included 572 inhabitants near a zinc smelter and 413 control group. Each of the participants provided informed consents, offered spot urine samples, blood samples, and filled questionnaires. Urinary and blood Cd and the markers of renal tubular dysfunction (N-acetyl-β-D-glucosaminidase; NAG and β2-microglobulin; β2-MG) were measured. The urine samples were adjusted with urinary creatinine concentration.

Results: Geometric means for blood and urinary Cd in smelter inhabitants were 2.23 μg/L and 2.23 μg/g creatinine, respectively. Geometric means for NAG and β2-MG were 4.69 U/g creatinine and 88.08 μg/g creatinine. Correlation coefficients of blood Cd with NAG and β2-MG were 0.115 (P = 5 μg/L in blood Cd and >5 μg/g creatinine in urinary Cd), the correlation coefficient between urinary Cd and NAG was higher than in those with low Cd level (0.362 vs. 0.110).

Conclusion: This study suggests that chronic exposure to Cd might produce tubular damage in the kidney and that urinary NAG might be a good tubular dysfunction marker than β2-MG for chronic Cd exposure.

PP-29-066

Urinary 1-Hydroxypyrene Levels in Children Residing Near a Coal-fired Power Plant and a Steel-manufacturing Mill

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Background/Aims: This study aimed to evaluate the impact of industrial emissions from a coal-fired power plant and a steel-manufacturing mill on children's exposure to polycyclic aromatic hydrocarbons (PAHs) by measuring urinary 1-hydroxypyrene (1-OHP), the metabolite of PAHs.

Methods: Dispersion modeling method was used to identify 4 study communities. Two villages located downwind and most likely to be affected by the plants were the high exposure communities, and 2 villages located upwind and 7–15 kilometers from the plants were the low exposure communities. Ambient levels of particulate matter (PM_{10}) and PAHs were measured in each community. In total, 380 children aged 1–13 years and randomly sampled from these 4 communities participated in this study. Personal information was collected by interview, and urinary 1-OHP was measured by the high performance liquid chromatography-fluorescence detection (HPLC-FLD) method.

Results: Children living in the high exposure communities had a significantly higher mean urinary 1-OHP concentration than those in the low exposure communities (0.19–0.20 μmol/mol creatinine vs. 0.12–0.14 μmol/mol-creatinine). PM_{10} concentrations in high exposure communities (34.61–75.74 $\mu g/m^3$) were higher than that in the low exposure communities (28.75–37.64 $\mu g/m^3$). The concentrations of total PAHs were higher in the high exposure communities (7.64–12.18 ng/m^3) than that in low exposure communities (6.69–7.37 ng/m^3). Results of the multiple regression showed a significantly positive association between urinary 1-OHP and ambient levels of PM_{10} and PAHs after adjusting for age, gender, income, environment tobacco smoke, and area of exposure community.

Conclusion: In conclusion, children living downwind and in proximity to the coal-fired power plant and steel-manufacturing mill had increased urinary 1-OHP levels.

PP-29-067

European Hot Spot of Air Pollution by $PM_{2.5}$ and Bap: Ostrava, Czech Republic

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Background/Aims: Ostrava region in the Northern Moravia (Silesia) is the most polluted region in the Czech Republic by particulate matter (PM_{10} and $PM_{2.5}$) and carcinogenic polycyclic aromatic hydrocarbons (c-PAHs) as benzo[a]pyrene (B[a]P). Sources of this pollution are industry, traffic, and local heating. In the most polluted district of Ostrava-Bartovice in the year 2008 was PM_{10} 48.6.

Methods: Personal monitoring of c-PAHs and volatile organic compounds, the impact of these concentration to biomarkers as deoxyribonucleic acid adducts, chromosomal aberrations, 8-oxodG, lipid peroxidation, genetic polymorphisms (metabolic and deoxyribonucleic acid repair genes), and gene expression profiles were followed.

Results: In the Ostrava city were selected 70 volunteers-nonsmokers working in the office and 23 city policemen-nonsmokers from the near by district town Karvina. As controls were city policemen from Prague (N = 65). The personal monitoring to c-PAHs and volatile organic compounds was carried on in March 2009. The determined concentration of B[a]P was in Ostrava versus Karvina versus Prague 2.55.

Conclusion: Results imply the significant genetic and oxidative damage observed in volunteers in polluted region. It corresponds to the shortage of life expectancy in males in the districts of Ostrava and Karvina versus Czech Republic.

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PP-29-068

Urinary Cadmium Concentrations Among Female Teachers From Northern California

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Background/Aims: Cadmium is a toxic metal associated with kidney disease and increased mortality. It has been classified as a probable human carcinogen, demonstrated to have estrogenic properties, and associated with breast cancer in previous case-control studies. Exposure to cadmium occurs from smoking, diet and inhalation of air polluted from combustion, mining, and manufacturing. Excretion of cadmium in urine is widely considered a biomarker of lifetime exposure. Urinary cadmium concentration has been associated with age, smoking status, body surface area, parity, and household income in previous studies. Our objectives were to identify predictors of urinary cadmium concentrations and determine the within-person correlation among repeat samples.

Methods: We collected a 24-hour urine sample from 298 women enrolled in the California Teachers Study in 2000 and a second 24-hour sample from 141 participants approximately 3, 6, or 9 months later. Urinary cadmium concentrations (μg/L) were determined by ICP/MS. Age, body mass index, smoking status, diet, alcohol consumption, parity, and other reproductive factors were obtained by interview. Environmental cadmium exposure from traffic, industrial and commercial emission sources, as well as modeled outdoor air concentrations were estimated using a geographic information system. We used mixed-effects models to estimate the within-person correlation between repeat measurements and identify predictors of urinary cadmium levels.

Results: The arithmetic mean creatinine-adjusted cadmium concentration was 0.43 (standard deviation = 0.24 μg/g) and the range was 0.1–1.5 μg/g. The within-person correlation among repeat samples was 0.49. Urinary cadmium levels increased with age and lifetime pack-years of smoking and decreased with greater alcohol consumption and number of previous pregnancies. These factors explained 38% of the variability in urinary cadmium concentrations.

Conclusion: These preliminary results suggest that a single measurement of urinary cadmium does not accurately assess lifetime exposure. Additional analyses will evaluate the role of dietary, environmental, and other potential predictors.

PP-29-069

Alteration of Mitochondrial DNA Copy Number and Mitochondria-rich Plasma Proteins Are Biomarkers for Benzene Exposure in Blood and Leukemia Cells

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Background/Aims: Exposure to benzene and its metabolites increases risk of various hematological disorders. However, biomarkers of benzene toxicity have not been comprehensively studied in blood and leukemia cells. We previously reported impaired mitochondrial function after benzene exposure (Third World Health Organization Conference on Children's Health and the Environment). The current study was investigated to discover biomarkers for benzene exposure in blood cells and leukemia cell lines.

Methods: Peripheral blood, bone marrow and leukemia cells (THP-1, K562, Molt-4 and HL-60) were cultured in RPMI media with adding 0, 1, and 10 mM of benzene. Viability and apoptosis were assessed by tryptophan blue dye exclusion test and flow cytometry using annexin V. Hydrogen peroxide was measured using enzyme immunoassay. Mitochondrial mass, membrane potential, and mitochondrial deoxyribonucleic acid DNA (mtDNA) copy number were measured using MitoTracker Green, Red probes, and real-time polymerase chain reaction, respectively. 2-DE and MALDI-TOF/TOF technologies were performed to identify mitochondrial proteins.

Results: Cell number was gradually increased regardless of concentration of benzene in day 3, and then steadily maintained during 3 weeks culture. Viability of 4 leukemia cell lines disclosed significant decrease after 2 week treatment of benzene. Apoptosis was increased in time- and dose-dependent manner after 2 weeks treatment of benzene. Mitochondrial contents and membrane potentials were dramatically increased in 3-week culture at dose-dependent manner. Hydrogen peroxide level was significantly elevated after 2-week treatment of benzene (4.4 $\pm$ 1.9 μM/mg protein) compared with nonbenzene treatment group (1.2 $\pm$ 1.0; $P = 0.001$). mtDNA copy number was gradually increased after exposure to benzene. Ten mitochondrial protein markers showed remarkably aberrant expression after benzene exposure. Among them, heterogeneous nuclear ribonucleoprotein A2/B1 isoform B1 (hnRNP B1) was markedly increased after benzene exposure.

Conclusion: Increased mitochondrial mass, mtDNA copy, and hnRNP B1 protein were biomarkers for benzene exposure in blood and leukemia cells.

PP-29-070

Levels and Temporal Trends (2002–2008) of Dioxins in the Blood of Urban Dwellers in Korea

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Background/Aims: In Korea, the number of municipal and hazardous waste incinerators, both of which emit dioxin-like compounds, has increased since 1980. Therefore, the human health risks caused by dioxin have become a matter of increasing public concern. We measured the recent background serum levels of exposure to PCDD/Fs and analyzed trend of dioxin levels in the blood of urban dwellers in Korea between 2002 and 2008.

Methods: Blood samples were obtained between 2002 and 2008 from 278 volunteers. All participants were nonsmokers and were 21 to 75 years of age, who had lived in the urban area for at least 5 years. Quantitative assessment of the levels of dioxin compounds (17 congeners) in the serum was performed using high-resolution gas chromatography/high-resolution mass spectrometry according to the US Environmental Protection Agency 1613 method. Toxic equivalents (TEQ) were calculated using the TEQ factors established by World Health Organization in 2005.

Results: The means and standard deviations of dioxins were 10.66 $\pm$ 7.34 in 2002, 8.20 $\pm$ 6.07 in 2003, 10.01 $\pm$ 7.56 in 2004, 10.12 $\pm$ 5.48 in 2006, 10.66 $\pm$ 5.64 in 2007, and 10.97 $\pm$ 4.71 pg-TEQ05/g lipid in 2008. The percent contribution of lower chlorinated PCDD increased but those of OCDD and PeCDF decreased. In all years, age was positively associated with blood levels of dioxins, whereas the blood levels of dioxins did not significantly change over 6 years. Between 2002 and

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2008, if the subjects' BMI was greater than 25 in the older (40+) age group, the dioxin levels of subjects who had higher BMIs (≥25) declined less than that of the older subjects with lower BMIs (<25).

Conclusion: Although the dioxin levels in blood did not decline over time from 2002 to 2008, the serum levels of dioxins were significantly correlated with age and BMI. The significant time-BMI interaction of serum dioxin levels indicates that body fat affects the reduction rate of the dioxins concentration in blood.

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PP-29-071

Biomonitoring of Perfluorinated Compounds in Anglers

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Background/Aims: In North Rhine-Westphalia, Germany, the contamination of surface waters with perfluorinated compounds became known in 2006. Several contaminated water bodies serve as fishing areas. A cross-sectional study was performed to investigate the perfluorinated compounds (PFC) blood concentrations in anglers.

Methods: Lifestyle factors, fish, and drinking water consumption habits were assessed by questionnaire and interview. Perfluorooctanoate (PFOA), perfluorooctane sulfonate (PFOS), perfluorohexanoate, perfluorohexane sulfonate, perfluoropentanoate, and perfluorobutane sulfonate in blood plasma, and PFOA/PFOS in fish and drinking water samples were measured by solid phase extraction, high performance liquid chromatographs, and tandem mass spectrometry detection.

Results: PFOS-concentrations in fish depend on fish species and area, where the fish was caught. Typically, the highest concentrations were measured in perch and pike. Mean PFOS-concentrations in fish were 60 (maximum: 208) μg/kg. PFOS-concentrations in blood plasma of 120 anglers ranged from 1 to 649 μg/L, PFOA-concentrations were 2–167 (median, 11 μg/L), perfluorohexane sulfonate 0.4–17 (median, 2.7). Fish consumption was significantly associated with PFOS blood concentrations. Eight microgram PFOS/L (median) were observed in anglers without fish consumption compared with 45 μg/L in those eating fish 2–3 times/month and 118 μg/L in those consuming fish weekly.

Conclusion: Distinctly increased PFOS concentrations were observed in anglers consuming fish from PFC-contaminated water bodies. The PFC-blood levels in the mentioned group of anglers will be followed to estimate elimination half-life of PFOS.

PP-30-056

Creatinine in Spot Urine Samples: Sources of Variation and the Adjustment of Urinary Biomarkers Among Roofers Exposed to Asphalt

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Background/Aims: Urinary biomarkers of environmental exposures and early effects are often reported with respect to levels of urinary creatinine. This study investigates sources of variation of urinary creatinine and the effects of adjustment on urinary 1-hydroxypyrene (1-OHPyr) and 8-hydroxy-2′-deoxyguanosine (8-OHdG).

Methods: Urine samples were collected from 19 roofers in South Florida before and after 6 hours of work. 1-OHPyr was analyzed though LC-MS/MS, 8-OHdG was analyzed by enzyme-linked immunosorbent assay, and creatinine was analyzed using a colorimetric kit. Statistical tests were performed after natural logarithmic transformation.

Results: When compared to the Hispanics, African American roofers had higher levels of urinary creatinine before (220.3 vs. 78.7 mg/dL, $P = 0.06$) and after the work (395.0 vs. 123.6 mg/dL, $P = 0.01$). A negative correlation was observed between creatinine in urine and amount of alcoholic drinks consumed within the last 24 hour (Pearson $r = -0.470$ and -0.515 for before and after the work, respectively, $P < 0.05$ for both). In linear regressions models of urinary creatinine, African American race explained 38.2% of the variation before the work, and 44.8% of the variation after the work. Linear regression models of urinary (after work) 8-OHPyr and 1-OHPyr were compared with and without creatinine adjustment. When 8-OHdG levels were adjusted, the model explained 17.2% less of the variation (71.3% vs. 88.5%) and had twice the estimated error variance (0.202 vs. 0.107) than the model without adjustment. When 1-OHPyr levels were adjusted, only levels of 1-OHPyr before work remained in the model explaining 78.4% of the variation. The model without adjustment included other variables (gloves, burn due to work) and explained 82.1% of the variation.

Conclusion: Our results show that urinary creatinine levels may vary greatly because of individual factors, such as race and alcohol consumption. Routine adjustments of urinary biomarkers may introduce additional error into analyses.

PP-30-057

Secondhand Smoke Exposure Among Bar and Nightclub Employees Mongolia

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Background/Aims: Little information is available on levels of exposure to secondhand tobacco smoke in public places in Mongolia.

Objective: To assess secondhand smoke exposure in bars and nightclubs in Ulaanbaatar by measuring air nicotine concentrations in each establishment and hair nicotine concentrations among smoking and nonsmoking employees.

Methods: This study was part of a multi-country study to assess secondhand smoke exposure in bar or nightclub employees. Participation was voluntary and required informed consent. A total of 10 establishments of 14 invited accepted to participate (response rate 71%). A total of 50 employees (32 never smokers, 2 former smokers, and 16 current smokers) were recruited. Establishment owners and employees were interviewed face to face. Two air nicotine monitors were placed in 2 different locations within the establishment for 7 days. Hair samples were collected from the back of the scalp. Air nicotine and hair nicotine concentrations were assessed using gas chromatography.

Results: Smoking was allowed in all establishments. The mean (SD) hours of operation were 10.8 (2.6). Median (range) air nicotine concentrations were 14.8 (4.0, 25.2) $\mu g/m^3$. Concentrations were higher in venues with no outdoor area (median, 20.7 vs. 14.1 $\mu g/m^3$). Of them, 58% of the employees were men and 42% women. Their mean (SD) age was 22.3 (4.5) years, and they worked an average of 12.2 (SD: 4.2) h/d for 5.3 d/wk (SD: 1.4). 69% employees reported that they would prefer to work in a smoke-free environment, 38% of current smokers reported that a smoke-free legislation would help them quit, and both former smokers reported that a smoke-free legislation would help them to remain quit. Median (range) hair nicotine concentrations among nonsmokers were 4.24 (0.17, 32.7) ng/mg. Hair nicotine concentrations were higher among nonsmoking employees reporting more than 13 hours of secondhand smoke exposure per day (median, 5.77 vs. 2.97 ng/mg). Median (range) hair nicotine among smoking employees was 18.1 (0.45, 111.5) ng/mg.

Conclusion: This study found very high levels of exposure to secondhand smoke in bars and nightclubs from Ulaanbaatar, Mongolia. Of high

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concern, time-weighted air nicotine concentrations measured in this study were markedly higher than concentrations measured in bars and nightclubs from several African, American, Asian, and European countries. Implementing a comprehensive smoke-free legislation that protects workers and customers from exposure to secondhand smoke is urgently needed in Mongolia.

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PP-30-059

Biological Monitoring of Aromatic Amines, Benzene, and Benzo[A]Pyrene in Workers of a Modern European Coke Oven Plant

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Background/Aims: Coke oven emissions are complex mixtures of coal and coke particles, vapors, gases, and tars containing metals, polycyclic aromatic hydrocarbons (PAH), and aromatic amino and nitro compounds. Some epidemiologic literature suggests that coke oven workers may bear an elevated bladder cancer risk. Occupational exposure to aromatic amino and nitro compounds, and PAH is discussed being responsible for that observation.

Methods: In this study, we examined 47 workers from a modern coke oven plant regarding their external and internal exposure to 24 aromatic amino and nitro compounds, including the known human bladder carcinogens o-toluidine, 2-naphthylamine, benzidine, and 4-aminobiphenyl. Internal exposure was assessed by arylamines in pre- and postshift urine and the corresponding hemoglobin adducts. In addition, S-phenyl mercapturic acid and 3OH-benzo[a]pyrene were measured in urine to monitor exposure to benzene and benzo[a]pyrene. Individual smoking behavior was assessed by questionnaire and urinary cotinine.

Results: Neither urinary arylamines nor hemoglobin adducts correlated with the individual external exposure, no significant increases during shift could be observed. Oven-charging operations and leakage around poorly sealed coke oven doors are expected the major sources of gaseous emissions from coke ovens. However, workers engaged in working tasks near these sources did not show higher internal exposure to arylamines. Internal exposure to arylamines was within the range of environmental exposures observed in smokers and nonsmokers of the general population. But internal exposure to benzene and benzo[a]pyrene was elevated to some extent.

Conclusion: The results of biological monitoring reveal that internal exposure to arylamines was primarily influenced by individual smoking habits. On the other hand, workers were occupationally exposed to benzene and PAH although its exposure was on a comparatively low level. If coke oven workers in this modern plant bear an elevated bladder cancer risk, it could hardly be explained by occupational exposure to those aromatic amino compounds known to be bladder carcinogens in human beings.

PP-30-060

Inflammation, Oxidative Stress, and PAHs Exposure Biomarkers in Children With Atopic Dermatitis

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Background/Aims: Particulate-bounded polycyclic aromatic hydrocarbons (PAHs) are common air pollutants generated from automobile exhaust in urban area. The traffic-related pollutants can exaggerate existing atopic symptoms such as asthma and atopic dermatitis. This study was to investigate urinary eosinophil cationic protein (ECP) as an inflammation biomarker and 8-hydroxydeoxyguanosine (8-OHdG) as an oxidative stress in children exposed to PAHs.

Methods: We recruited 43 children with physician-diagnosed atopic dermatitis who attended elementary school located in Incheon city, Korea. With subjects' agreements, their urine samples were repeatedly obtained. The levels of urinary ECP, 8-OHdG, 1-OHP, and 2-napthol were determined.

Results: Of 228 urine samples, the level of ECP, 8-OHdG, 2-napthol, and 1-hydroxypyrene were 0.2 ± 0.36, 13.9 ± 6.8, 3.4 ± 4.6, and 0.2 ± 0.12 μg/g creatinine in mean ± standard deviation, respectively. The urinary 1-OHP was positive correlate with 8-OHdG but not significant. The urinary 2-napthol showed positive and significant correlation with ECP and 8-OHdG concentrations. There was also significant correlation between urinary ECP and 8-OHdG in children.

Conclusion: In atopic children, exposure to PAHs may increase urinary inflammation and oxidative stress markers.

PP-30-061

Hemoglobin Adducts of Alkylating Substances—-Long-term Parameters of Smoking During Pregnancy

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Background/Aims: Few data exist on the transplacental passage of carcinogenic and mutagenic compounds of tobacco smoke. In our study, exposure to alkylating substances was studied in maternal venous and umbilical cord blood samples from 47 mother/child pairs including maternal smokers (15) and nonsmokers (32).

Methods: Hemoglobin adducts at the N-terminal valine were analyzed in terms of N-2-carbamoylethylvaline (AAV), N-2-cyanoethylvaline (CEV), and N-2-hydroxyethylvaline (HEV). An N-alkyl-Edman degradation was used for sample preparation. Maternal smoking status was assessed by questionnaire.

Results: Nearly identical median levels of AAV were found in maternal and fetal samples of nonsmoking mothers (41.9 and 41.4 pmol/g globin, maternal/fetal ratio ~1). Concentrations were about 50% higher in mother/child pairs of maternal smokers. Maternal AAV was associated to their corresponding fetal levels ($P = 0.0003$, $r = 0.51$). CEV could be detected in maternal and fetal blood of smoking mothers only. The median levels were about twice as high in maternal compared with the fetal samples (70.9 vs. 39.4 pmol/g, maternal/fetal ratio of ~2). No association for maternal and fetal CEV was found in smoking mothers. Median concentratons of HEV were 19.8 and 3.3 pmol/g in nonsmoking mother/child pairs, whereas 121.8 and 48.7 pmol/g could be determined in smoking mother/child pairs. The maternal/fetal ratio was ~7 in nonsmoking but only 2.5 in smoking mother/child pairs. Maternal HEV was associated with their corresponding fetal levels with borderline significance ($P = 0.0424$, $r = 0.30$).

Conclusion: The results show that alkylating substances are either fully (AAV) or partly transported to the fetus (CEV and HEV), leading to similar or lower concentrations in the fetus. However, no active transport to the fetal unit was observed. Smoking leads to higher adduct levels in the maternal/fetal unit and unequivocally, similar to adults, pose a mutagenic and carcinogenic hazard to the fetus. Overall, our results contribute to the risk assessment of alkylating substances in the most vulnerable population, the fetus.

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PP-30-062

The Pyrethroid Insecticide Exposure in Children

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Background/Aims: The pyrethroid insecticide is originated from pyrethrum, and is widely used for insect control. This study is performed to investigate the exposure of pyrethroid insecticide to children using biological monitoring.

Methods: Seventy children at Gangneung and Kyongki-do were recruited for analysis of the metabolites of pyrethroid insecticide. The samples of urine were collected for analysis. The analytical method for metabolites of pyrethroid insecticide was developed.

Results: For biological monitoring, the analytical method of metabolite of pyrethroid insecticide should be determined. The analytical method of metabolites of pyrethroid was cis/trans-DCCA, DBCA, F-PBA, and 3-PBA using a N-tert-butyldimethylsilyl-N-methyltrifluoroacetamide derivation and gas chromatography-mass spectrometry. Recovery of pyrethroids varied from 82% to 158%. The method detection limit of pyrethroids insecticides was 0.21–0.39 μg/L. The method presented here is precise, accurate, and sensitive. The urinary concentration of pyrethroid insecticide metabolites were cis-DCCA 1.50 μg/g Cr, trans-DCCA 1.49 μg/g Cr, and 3-PBA 2.42 μg/g Cr. These finding were similar to those of other country.

The urinary concentration of the metabolites of pyrethroid insecticide was higher in home pesticide usage group.

Conclusion: These results showed the need of continuous biological monitoring of pyrethroid insecticide exposure.

PP-30-063

Effects of the Crude Oil Exposure by Hebei Spirit Oil Spill on Oxidative Stress in Residents and Clean-up Volunteers of Taean, Korea

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Background/Aims: The purpose of this study was to evaluate health effects of exposure to crude oil by the Hebei Spirit oil spill occurred in the Taean, Korea.

Methods: The study subjects included 429 residents of coastal areas and 275 persons living in inland area. We collected information about demographic characteristics, smoking habit, alcohol consumption, and number of clean-up working days, and so on. To evaluate on the health effects of exposure to crude oil, we measured oxidative stress markers of DNA and lipids, such as 8-hydroxydeoxyguanosine (8-OHdG) and malondialdehyde (MDA) in urine.

Results: The geometric means of urinary 8-OHdG and MDA of residents of coastal area (5.10 μg/g creatinine and 4.46 μmol/g creatinine, respectively) were significantly higher than those of inland areas (3.57 μg/g creatinine and 3.09 μmol/g creatinine, respectively). Urinary 8-OHdG and MDA levels were significantly higher in subjects who had participated in clean-up work than in those who had not. A significant dose-dependent relation was observed between the levels of urinary 8-OHdG and MDA and total number of clean-up working days.

Conclusion: These results suggest that the subjects participated in clean-up work were exposed to high levels of various chemicals including polycyclic aromatic hydrocarbons, which may accumulate in human body and continuously induce oxidative stress in body.

PP-30-064

The Quantitation of HEMA and TZCA in Human Urine Using High Performance Liquid Chromatography Electrospray Ionization Tandem Mass Spectrometric Detection

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Background/Aims: Ethylene oxide (EtO) and formaldehyde (FA) are well-known human carcinogens and used as a sterilizer and a tissue-fixative at health care facilities. Because many health care-workers and patients can be exposed to the toxic chemicals, biological monitoring of internal dose is important in public health perspectives.

Methods: In the present study, we suggest a novel method to measure N-Acetyl-S-(2-hydroxyethyl)-L-cysteine and thiazolidine 4-carboxylic acid simultaneously in samples of small volume of human urine (50–100 uL) as exposure biomarkers for EtO and FA, respectively. The analytes were determined with hydrophilic interaction liquid chromatography ion exchange negative electrospray ionization tandem mass spectrometry after liquid-liquid extraction. Quantification was based on peak areas relative to the internal standards, using deuterium-labeled N-Acetyl-S-(2-hydroxyethyl-d4)-L-cysteine and L-5,5-dimethylthiazolidine-4-carboxylic acid.

Results: This novel method allows for the accurate, sensitive, and reproducible analysis of EtO and FA and was successfully applicable to field study of occupational exposure to EtO and FA. The limit of quantitation (precision and accuracy $<$20%) was 1 ng/mL for each.

Conclusion: The results of this assay indicate that our method can be successfully applicable to the environmental levels and occupational exposure to EtO and FA.

PP-30-065

Simultaneous Determination of Trichloroacetic acid, Dichloroacetic Acid, S-(1,2-dichlorovinyl)Glutathione, S-(1,2-dichlorovinyl)-L-cysteine and N-Acetyl-S-(1,2-dDichlorovinyl)-L-cysteine Using Liquid Chromatography Electrospray Ionization Tandem Mass Spectrometry

Miyeon Shin,[1] Youngah Ahn,[1] Jung Dae Jeon,[2] Young Lim Kho,[2] and Sungkyoon Kim[1] *[1]Seoul National University, Seoul, Republic of Korea; and [2]Eulji University, Sungnam, Kyeonggi, Republic of Korea.*

Background/Aims: Trichloroethylene (TCE), a useful industrial solvent and well-known environmental contaminant, is carcinogenic in animals and classified as "probably carcinogenic" in human beings. Much of toxic mechanism is still elusive, which is in part because of difficulties in valid measurements of the reactive metabolites of TCE. Recently, we reported a novel method to determine trichloroacetic acid (TCA), dichloroacetic acid (DCA), S-(1,2-dichlorovinyl)-L-cysteine (DCVC), and S-(1,2-dichlorovinyl) glutathione. In the present study, we fortified the method to enable us to detect N-Acetyl-S-(1,2-dichlorovinyl)-L-cysteine (NAcDCVC) in multimedia of biological specimens such as animal serum and human urine.

Methods: All analytes were simultaneously analyzed using high performance liquid chromatography coupled with electrospray ionization mass spectrometry in small volume biological samples such as urine and serum. First, DCA, TCA, and NAcDCVC were extracted in ether. Then, DCVC and S-(1,2-dichlorovinyl) glutathione were extracted by solid phase extraction.

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Results: The limits of detection are 0.01 nmol/mL (DCA), 0.4 nmol/mL (TCA), 0.001 nmol/mL (DCVC), 0.001 nmol/mL (DCVC), and 0.0005 nmol/mL (NAcDCVC). Interestingly, the slopes of calibration curves for the analytes were close to each other, regardless of media.
Conclusion: To our knowledge, no studies have detected these 5 metabolites of TCE concurrently in a sample. The present method is expected to elucidate the complex toxicokinetics and risk assessment of TCE.

PP-30-066

Phthalate Metabolites and Self-reported Diet

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Background/Aims: General population is exposed to phthalates like DEHP through nutrition, consumer products, and medical devices. Oral intake is assumed to be the main pathway of this exposure. Aim of the presented analysis was to identify associations of phthalate metabolites and nutrition in a group of volunteers.
Methods: Male patients of an andrological clinic, students, and a music class of an adult education centre were asked to complete a questionnaire concerning type and frequency of food consumption. Spot urine samples were collected to determine phthalate exposure. We analyzed primary and secondary metabolites of DEHP: MEHP, 5OH-MEHP, 5oxo-MEHP, 5cxMEHP in each sample. Crosstabs (χ^2 testing) and regression models adjusted for age and BMI were employed to identify associations between the sum (cΣDEHP4) of the metabolites classified in quartiles and the dichotomized frequency of food consumption.
Results: For cΣDEHP4 median (μg/L) in the study group (n = 399; age: median = 34 years; 5.5% women; BMI = 25.5) was 37.95. Crosstabs showed significant higher rates of frequent consumption (>once a week) of "black tea (day before probe)" (P = 0.047), "meat" (P = 0.024), and "smoked and processed meats" (0.004) related to cΣDEHP4 ≥75th percent (67.51 μg/L), while "salad and vegetables" (P = 0.002) and "fresh fruits" (0.003) to cΣDEHP4 ≤25th percent (18.68 μg/L). None of the other parameters (snacks, milk/milk-products, drinks, etc) were related to high cΣDEHP4. Regression analysis found associations for "meat" and high cΣDEHP4, while high BMI-values were associated inversely.
Conclusion: The association between high cΣDEHP4 and frequent consumption of meat/processed meat could be attributed to production and packaging processes, where DEHP's lipophilic character might be important. This is confirmed by the results for salad/vegetable/fruit. The inverse effect of BMI on MEHP described elsewhere could also be confirmed for the sum (cΣDEHP4). However, due to the structure of study group (94.5% male) the results should be considered as preliminary and further systematic investigation, eg, with nutrition protocols in a survey are needed.

PP-30-067

Blood and Urinary Cadmium Concentration of Residents Around Abandoned Metal Mines in Busan and Gyeongsangnam-do

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Background/Aims: The purpose of this study is to evaluate the blood and urinary cadmium concentration levels between residents around the abandoned metal mines and the control group.
Methods: Blood and urinary cadmium concentration levels were analyzed through investigations of the dietary habits and dietary water of subjects who live near abandoned metal mines (exposure group) (n = 190) as compared to those who live in designated control areas (control group) (n = 256).
Results: The blood cadmium (1.93 μg/L) and urinary cadmium concentrations 2.41 μg/g cr) of exposure group were higher than those levels for members of control group (blood cadmium: 1.19 μg/L, urinary cadmium: 1.94 μg/g cr). The blood and urinary cadmium concentration levels were high in vegetarians of the exposure group and in the control group also these levels differed significantly between the exposure group and the control group.
Conclusion: It was found that the exposure group, those who lived around abandoned metal mines had higher blood and urinary cadmium concentration levels than the control group. It is hoped that the findings of this study will in the future prevent further illness from this type of exposure.

PP-30-068

Blood Total Mercury and Fish Consumption in the Korean General Population in KNHANES III, 2005

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Background/Aims: To assess the association of total blood mercury and fish consumptions in the Korean general adult population using a representative sample.
Methods: We studied the blood mercury concentration in a representative sample of 1749 Koreans who were included in the Third Korean National Health and Nutritional Examination Survey (KNHANES III) performed in 2005, and compared it with the frequency of fish consumption collected during the nutrition survey of KNHANES III.
Results: The geometric means of the blood mercury levels in female subjects (n = 890), male subjects (n = 859), and all participants (n = 1749) representing adult Koreans aged ≥20 years were 3.70 g/L (95% confidence interval [CI]: 3.46–3.94 g/L), 4.70 g/L (95% CI: 4.38–5.02 g/L), and 4.15 g/L (95% CI: 3.93–4.38 g/L), respectively. The geometric mean of the blood mercury level was significantly higher in the high-fish-consumption group (4.38 g/L; more than once a week) than in the low-consumption group (3.71 μg/L: less than once a week), but the intergroup difference of 18% was less than that in Western countries. Among the 9 listed individual types of fish and shellfish, the blood mercury level increased with the frequency of consuming squid, clam, and salted seafood. However, the association of blood mercury level with the frequency of consuming squid disappeared when analyzing male subjects only. The proportion of Korean women aged 20–49 years having blood mercury levels of at least 5.8 g/L was 27.7% (150/542) in our study.
Conclusion: The blood mercury level in a representative sample of the Korean adult population was found to be associated with fish consumption in both men and women. However, a high consumption of fish increased the blood mercury level by only 18%.

PP-30-069

Effect of Sample Collection and Storage Conditions on DNA Damage in Buccal Cells From Agricultural Workers

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Background/Aims: A variety of methods exist for collecting buccal cells from the oral cavity including rinsing with saline, mouthwash, or scraping the oral cavity. Unknown are the impact of these different sampling procedures on the integrity of buccal cells for the Comet assay. Buccal cells are usually cryopreserved with dimethyl sulfoxide (DMSO) then examined later for DNA damage by the Comet assay.
Methods: This study examined oral rinses from farm workers who worked in berry fields in the state of Oregon for the influence of method of sample collection and cryopreservation on buccal cell survival and the integrity of DNA.
Results: In individuals who rinsed with Hank's balanced salt solution (HBSS), the viability of leukocytes (90%) was significantly ($P < 0.01$) with DMSO concentration. Cell survival was greatest at 5% DMSO but it steadily diminished with either increasing or decreasing concentrations of DMSO. Cryopreservation also influenced the integrity of DNA in the comet assay. Although tail length and tail moment were comparable in fresh or cryopreserved samples, the average head intensity for cryopreserved samples was ~6 units lower (95% CI: 0.8–12 units lower) than fresh samples (t25 = −2.36, $P = 0.026$).
Conclusion: These studies suggest that the collection and storage of buccal samples are critically important factors for assessing DNA damage in epidemiological studies. Moreover, leukocytes appear to be a more viable source of human tissue for assessing DNA damage and possibly other biochemical changes.

PP-30-070

Bioconcentration Factor of Perfluorinated Compounds in Blood of Common Carp, *Cyprinus Carpio*

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Background/Aims: The effects of Perfluorinated compounds (PFCs) on common carp (*Cyprinus carpio*) were investigated using blood samples.
Methods: Target chemicals comprise 9 species of PFCs including 3 sulfonates (PFBS(C4), PFHxS(C6), PFOS(C8)) and 6 carboxylates (PFOA(C8), PFNA(C9), PFDA(C10), PFUnA(C11), PFDoA(C12), PFTrA(C13)). Carps were exposed to PFCs at the same concentration ranges (negative control, 5 and 50 ng/mL) and exposure period. Experiments were performed in totally 49 days 21 days of uptake stage followed by 28 days of depuration.
Results: The results showed that PFOS was detected at as high as 5411.1 and 39944.2 ng/mL at low (5 ng/mL) and high (50 ng/mL) concentrations, respectively. At high concentration exposure, the concentration of PFCs was 5–8 times higher than that of low concentration exposure.
Conclusion: Bioconcentration factor (BCF) was calculated in which BCF values can be sorted as PFOS > PFH × S > PFBS. After the depuration process, PFOS in carps exposed to high concentration was detected at highest level which is 5–7 times higher than that of carps exposed to low concentration.

PP-30-071

The Epidemiological Characteristics of Green Tobacco Sickness and Urinary Cotinine Level in Korean Tobacco Harvesters

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Background/Aims: Green tobacco sickness (GTS) is known as an occupational disease among tobacco harvesters, and a form of acute nicotine intoxication by the absorption of nicotine through the skin from the wet green tobacco plant. We carried out the questionnaire survey and the measurement of cotinine level to understand the prevalence, incidence density, and risk factors of GTS in Korean language.
Methods: We conducted a questionnaire and measured the urinary cotinine level among 40 tobacco harvesters. We measured repeatedly nicotine level at 4 times in urine before, during (χ^2), after a regular shift. To ascertain carry-over effects from previous days of work, we collect baseline urine 6 month after the end of the harvesting season. Urinary cotinine was analyzed with a reverse-phase high performance liquid chromatography system and expressed as geometric mean and standard deviation.
Results: The study subjects were 20 males and 20 females. The prevalence of GTS in 2008 was 37.5%, and was significantly higher in females than in males (55.0% vs. 20.0%, $P < 0.01$). The incidence density of GTS according to the number of workdays in 2008 was 3.4 spells/100 person days. The cotinine level of the sample before work was 708.1 μg/g.cr significantly higher than others, and the cotinine level in non-harvesting period was 135.4 μg/g.cr significantly lower than harvesting period. But, the changes of cotinine level among day time were not significant in harvesting period. The cotinine level in smokers and the harvesters without raincoat were significantly higher than the others. But there was no difference by gender and age.
Conclusion: Our study suggests that there may be many tobacco harvesters suffered from GTS in Korea. And these suffering may continue unless cigarette disappears on the planet. Therefore, more epidemiological studies are expected, and the surveillance system of GTS will be needed.

PP-30-208

Adipose Organochlorine Concentrations and Risk of Non-Hodgkin Lymphoma in Denmark

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Background/Aims: Exposure to organochlorines has been examined as a potential risk factor for non-Hodgkin lymphoma with mixed results probably relating to differences in study design and geographic locale. Our purpose was to examine associations between organochlorine concentrations in prediagnostic adipose tissue samples and risk of non-Hodgkin lymphoma.
Methods: We conducted a case-cohort study of 256 persons diagnosed with non-Hodgkin lymphoma and 256 sub-cohort persons selected from the 57,053 persons enrolled in the Danish Diet, Cancer, and Health cohort between 1993 and 1997. We measured concentrations of 8 pesticides and 10 polychlorinated biphenyl congeners in adipose tissue, collected upon enrollment and estimated risk of non-Hodgkin lymphoma using Cox regression.
Results: The results showed that the risk of non-Hodgkin lymphoma increased significantly (P linear-trend: 0.004) with increasing lipid concentrations of dichlorodiphenyltrichloroethane (DDT). For cis-nonachlor, the upper adipose concentration stratum had a hazard ratio of 2.60 (95% CI: 1.08–6.28) when compared to the lowest stratum and for oxychlordane the 2 upper exposure strata were associated with a significant risk of non-Hodgkin lymphoma when compared to the lowest stratum. The associations found for cis-nonachlor and oxychlordane were strongest amongst women. Adjustment for body mass index, education, smoking status and dietary intake of fat and fruit and vegetables only marginally affected the risk associations found for DDT, oxychlordane, and cis-nonachlor.
Conclusion: This study shows a higher risk of non-Hodgkin lymphoma in association with higher exposure to DDT, cis-nonachlor, and oxychlordane. This is the first study of organochlorines and non-Hodgkin

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lymphoma using prediagnostic adipose tissue samples in the exposure assessment.

CHEMICALS AND ENVIRONMENTAL HEALTH ISSUES (EG, ENDOCRINE DISRUPTORS OR ENDOCRINE DISRUPTING CHEMICALS)

PP-29-072

Evaluation of Levels of Nitric Oxide in Saliva of Children in Relation to Caries Experience and Salivary Flow Rate

Dong Hun Han, Jin Bom Kim, Min Ji Kim, and Eun Ju Jeon *Pusan National University, Yangsan, Republic of Korea.*

Background/Aims: Dental caries is a multifactorial local disease, which involves destruction of the hard tissues of the teeth because of metabolites produced by oral microorganisms. Recently, there has been growing interest in the role of nitrate and nitrite in caries incidence. Thus, the objective of the present study was to determine the levels of nitric oxide in saliva of children in relation to caries experience.

Methods: In Busan, a total of 257 children aged from 6 to 15 years were surveyed from April 2009 to August 2009. This study was approved by the Institutional Review Board for Human Subjects at the Pusan National University Hospital at Yangsan Campus (approval number: 2009016). Oral health status was recorded using a World Health Organization format by the same examiner. Caries assessment was done using DMFT index. Oral health status was recorded followed by stimulated salivary flow rate estimation. Estimation of salivary nitric oxide was measured by the concentration of its stable metabolite nitrite using Classical Griess Reaction. Dependent variable was salivary nitric oxide concentration. Independent variables were DMFT index, salivary flow rate, and experience of passive smoking. The results were statistically evaluated using analysis of variance and Pearson coefficient of correlation with SPSS data processing software version 14.0.

Results: The mean nitrite level of high DMFT index group was much higher when compared with the low DMFT index group (0.24 vs. 0.10, $P = 0.005$). There was a negative correlation between the total nitrite level and the mean salivary flow rate, suggesting that as the average flow rate increases, the mean nitrite level decreases, which was statistically highly significant (Pearson coefficient of correlation = -0.129, $P = 0.039$).

Conclusion: The salivary nitrite levels are higher in children with caries as compared to those without caries. There is a negative linear relationship between the salivary nitrite level and the salivary flow rate.

PP-29-073

Acute and Long-term Excess Mortality After Polychlorinated Biphenyls and Polychlorinated Dibenzofurans Mixed Exposure From Contaminated Rice Oil: Yusho

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Background/Aims: In Japan in 1968, rice-oil contaminated by polychlorinated biphenyls and polychlorinated dibenzofurans (PCDFs) caused severe food poisoning, termed "Yusho" (oil disease). Several previous studies of Yusho attempted to evaluate the effects of exposure using standard mortality ratios (SMRs), and showed the relationship with total, liver, and lung cancer mortality in men. The findings, however, may have been compromised by disease misclassification or an inappropriate reference population. Therefore, we conducted an area-based SMR study to overcome several limitations of the previous studies.

Methods: We adopted the population of a severely affected area (Tamanoura area) as the exposed group, with a reference population from Nagasaki prefecture in Kyushu, which included the Tamanoura area. A large number of residents in Tamanoura were exposed to the rice oil. We estimated SMRs of cancer and noncancer diseases and their confidence intervals (CIs) for the years 1968–2002.

Results: In the first 10 years, SMRs of all causes, diabetes mellitus, heart diseases, hypertensive disease, pneumonia/bronchitis, stomach cancer, and bronchus/lung cancer were elevated. SMRs of heart diseases were 2.0 (95% CI: = 1.1–3.6) in 1968, 2.0 (95% CI: = 1.2–3.6) in 1969, and 1.9 (95% CI: = 1.1–3.6) in 1975. SMRs of bronchus/lung cancer were 3.8 (95% CI: = 1.2–11.8) in 1971 and 3.4 (95% CI: = 1.1–11) in 1974. SMRs of several cancers and intentional self-harm were elevated for decades after exposure.

Conclusion: In this study, we present further evidence about health effects due to severe exposure to polychlorinated biphenyls and polychlorinated dibenzofurans in Yusho.

PP-29-074

Prenatal Exposure to Dioxins in Relation to Allergy and Infection in Infancy—Hokkaido Study on Environment and Children's Health

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Background/Aims: Dioxins (PCDDs/PCDFs and dioxin-like PCBs) are endocrine disruptors. Animal studies suggested that dioxin exposure in utero induced immunosuppression in offspring. The effects of prenatal exposure to dioxins at environmental levels on immune function during infancy have not been clarified in human studies. In addition, human studies have yet to assess the effects of sex or congener-specific differences. The aim of this study is to investigate these effects on risk of infection and allergy in infancy.

Methods: We examined 364 mothers who were enrolled between 2002 and 2005 in Sapporo, Japan, and their infants. Relevant information was collected from a baseline questionnaire during pregnancy, medical records at delivery, and a follow-up questionnaire at 18 months of age. Dioxin levels in maternal blood were measured by HRGC/HRMS. We used multiple regression analyses with adjustment for maternal age, pre-pregnancy body mass index, educational levels, blood sampling time, parity, infant sex, parental allergic history, breast-feeding duration, environmental tobacco smoke exposure, and day care attendance.

Results: PCDFs TEQ levels in the highest quartile were associated with significant increased risk of otitis media (OR = 2.5). In analyses stratified by sex, PCDDs/PCDFs TEQ, and total dioxins TEQ levels in the highest quartile were associated with significant increased risk of otitis media among only male infants. With regard to dioxin congeners, 2,3,4,7,8-PeCDF levels in the highest quartile were associated with significant increased risk of otitis media (OR = 5.3). However, we observed no association between dioxin levels and allergic symptoms in infancy.

Conclusion: This is the first study to indicate that maternal dioxins, at relatively low environmental levels compared with Europe and the United States, increased risk of otitis media during the first 18 months of life, especially among male infants. It may suggest that prenatal exposure to dioxins impairs immune function of male fetus, and leads to decreased resistance to infections in infancy. 2,3,4,7,8-PeCDF may be responsible for the effects.

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PP-29-075

The Association Between Perfluoroalkyl Chemical Levels in Umbilical Cord Blood and Birth Outcomes

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Background/Aims: The perfluoroalkyl chemicals (PFCs) are persistent organic pollutants and commonly used worldwide. In animal and human studies, exposure to PFOS and PFOA is associated with adverse health effects. The objective of this study was to explore the association between birth outcomes the concentration of PFCs in umbilical cord blood plasma.

Methods: The study population consisted of 456 postpartum women collected from 4 hospitals and clinics in northern Taiwan. We interviewed them by a structured questionnaire after delivery and collected maternal and cord blood at birth. The concentration of PFCs in umbilical cord blood was analyzed by UPLC-MS/MS. We examined the association between newborn birth outcomes and log10 transformed PFCs levels by linear regression models.

Results: PFOA, PFOS, PFNA, and PFHxA levels in cord blood plasma were on average 1.82, 2.59, 2.33, and 0.06 ng/mL, respectively. The calibration curve range was 0.5–100 ng/mL. LOD for PFOA and PFOS was 0.04, for PFNA was 0.06, and for PFHxA was 0.07 ng/mL. After adjusting for potential confounders, only PFOS was negatively associated with gestational age (per log10 unit: $\beta = -0.87$ weeks, 95% confidence interval [CI]: −1.4 to −0.32 weeks), birth weight (per log10 unit: $\beta = -288.47$ g; 95% CI: −444.95 to −142.99 g), length (per log10 unit: $\beta = -1.15$ cm; 95% CI: −1.85 to −0.45 cm), and head circumference (per log10 unit: $\beta = -0.89$ cm; 95% CI: −1.38 to −0.40 cm).

Conclusion: Our data suggest inverse association between PFOS levels in umbilical cord blood plasma and birth outcomes. Because of widespread exposure to variety perfluoroalkyl chemicals, further studies should explore other PFCs.

PP-29-078

A Comparison of Dental Caries Status in Cities With or Without Fluoridation

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Background/Aims: We compared dental caries status of deciduous and permanent teeth in Ansan, which has an 8-year water fluoridation program, and non-fluoridated Geoje, Korea.

Methods: In 2007, dental surveys were carried out on 5, 6, 8, and 12-year-old children in the water-fluoridated Ansan city (n = 974) and non–water-fluoridated Geoje city (n = 914). Survey data were analyzed using SPSS v12.0 (SPSS Inc., Chicago, IL). Caries prevention effect was estimated by differences in dmft, dmfs, DMFT, and DMFS indices between the program (water-fluoridated Ansan city) and control groups (non–water-fluoridated Geoje city).

Results: The dmf rate of 5-year-olds was 57.1% in the program group and 69.8% in controls. The dmft and dmfs indices of 5-year-old children in program group were 2.64 and 5.56, respectively. Those in control group were 4.19 and 9.21, respectively. The DMF rate of 12-year-old children was 52.1% in the program group and 64.6% in controls. The DMFT and DMFS indices of 12-year-old children in program group were 1.44 and 2.77, respectively. Those in control group were 2.51 and 4.65, respectively. The caries reduction rate of 5-year-old children was 37.0% based on the dmft index difference. The caries reduction rate of 12-year-old children was 42.6% based on the DMFT index difference.

Conclusion: The community water fluoridation program in Ansan has reduced caries incidence in deciduous and permanent teeth sufficiently to merit extension to other communities.

PP-29-079

A Comparison of Dental Caries Status in Cities With or Without Water Fluoridation

Dong Hun Han,[1] Jin Bom Kim,[1] Kwang Hak Bae[2] *[1]Pusan National University, Yangsan, Republic of Korea; [2]Seoul National University, Seoul, Republic of Korea*

Background/Aims: We compared dental caries status of deciduous and permanent teeth in Ansan, which has an 8-year water fluoridation program, and non-water-fluoridated Geoje, Korea to assess the effect of water fluoridation program.

Methods: In 2007, dental surveys were carried out on 5, 6, 8, and 12-year-old children in the water-fluoridated Ansan city (n = 974) and non–water-fluoridated Geoje city (n = 914). Survey data were analyzed using SPSS v12.0 (SPSS Inc., Chicago, IL). Caries prevention effect was estimated by differences in dmft, dmfs, DMFT, and DMFS indices between the program (water-fluoridated Ansan city) and control groups (non–water-fluoridated Geoje city).

Results: The dmf rate of 5-year-olds was 57.1% in the program group and 69.8% in controls. The dmft and dmfs indices of 5-year-old children in program group were 2.64 and 5.56, respectively. Those in control group were 4.19 and 9.21, respectively. The DMF rate of 12-year-old children was 52.1% in the program group and 64.6% in controls. The DMFT and DMFS indices of 12-year-old children in program group were 1.44 and 2.77, respectively. Those in control group were 2.51 and 4.65, respectively. The caries reduction rate of 5-year-old children was 37.0% based on the dmft index difference. The caries reduction rate of 12-year-old children was 42.6% based on the DMFT index difference.

Conclusion: The community water fluoridation program in Ansan has reduced caries incidence in deciduous and permanent teeth sufficiently to merit extension to other communities.

PP-29-080

Association of Fluoride Exposure and Bone Mineral Density: A Comparison of Area With Individual

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Background/Aims: Although the benefit of fluoridation in the prevention of dental caries has been overwhelmingly substantiated, the effect of fluoride on bone mineral density (BMD) is less clear. This cross-sectional study was designed to compare BMD of adults exposed to fluoride from various source in environment by individual level.

Methods: Participants recruited from 2 Korean cities, Siwha with naturally occurring fluoride in its water system and Ansan with fluoridated water system since 2001. They participated voluntarily with a written informed consent. All subjects took part in BMD examination. BMD was measured by means of dual-energy x-ray absorptiometry at left heel of the subject. To obtain individual fluoride exposure, serum (n = 565), 24 hours urine (n = 99), fingernail (n = 70), and toenail (n = 70) were collected. The measurement of fluoride concentration in serum, 24 hours

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urine, fingernail, and toenail were made by fluoride ion electrode (Orion Research EA940). Linear regression analysis was performed. Outcome variable was BMD, and explanatory variables were fluoride concentration in serum, 24 hours urine, fingernail, and toenail. Confounders were age, gender, residential area, and monthly household income.

Results: BMD showed no relationship with fluoride level in serum, 24-hour urine, fingernail, and toenail. BMD has a tendency of decreasing as the toenail fluoride level increased ($P = 0.082$).

Conclusion: Based on the results of this study, exposure to fluoride appears to have no impact on bone mineral density. However, the relationship of fluoride exposure with bone mineral density by individual and area level requires further investigation.

PP-29-081

Relationship Between Diabetes and Reduction Effect of "Colestimide" on PCBs Accumulation in Human Body

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Background/Aims: Dioxins and polychlorinated biphenyls (PCBs) are lipophilic organic pollutants, and their gastrointestinal absorption is quite efficient. They are excreted into intestinal tract and reabsorbed into the body. This enterohepatic circulation causes accumulation of dioxins and PCBs in human body. It has also been reported that high level of their blood concentrations are correlated with incidence of diabetes mellitus (DM). In this study, we examined the effects of colestimide (CLM), an anion exchange resin, on the reduction of blood PCB level in human beings.

Methods: Thirty-seven subjects with dyslipidemia aged between 43 and 88 year were investigated. Their blood PCB levels were measured to be screened. Subjects with the PCB concentration more than 0.7 ppb were divided to 2 groups with or without colestimide, CLM or non-CLM group, respectively. We examined the blood dioxin and PCB levels of 2 groups before and after more than 12 weeks of treatments.

Results: The blood PCB levels of 18 subjects showed more than 0.7 ppb. They were divided to CLM or non-CLM group. The mean blood PCB level of these subjects was 0.97 ppb (0.74–1.70 ppb). In DM group, the rate of subjects with high PCB level was tended to be higher than that in non-DM group. High blood PCB level may be associated to the onset of DM. The effects of CLM were investigated in 6 cases while the remaining other cases were dropped out. The reduction rate of blood PCB levels were 1.22% or 0.98% in CLM or non-CLM group, respectively. The reduction rates were not significantly different between both groups ($P = 0.197$).

Conclusion: In this study, we could not show statistically significant data as a result of small sample size. Further study is required to conclude the usefulness of CLM for decreasing PCBs in the human body.

PP-29-082

Assessment of Di (2-ethylhexyl) Phthalate Exposure by Urinary Metabolites as a Function of Sampling Time

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Background/Aims: Di (2-ethylhexyl) phthalate (DEHP) is one of the most widespread phthalate plasticizers, and is quickly metabolized and excreted through the urine. This study was performed to determine the proper sampling time of workers' urine for assessing the exposure during working time.

Methods: We collected urine and plasma from 25 dental laboratory technicians. The urine sampling times were at the end of the shift (post-shift) and the next morning before the beginning of the shift (pre-shift). Three metabolites of DEHP (mono(2-ethylhexyl) phthalate [MEHP], mono-(2-ethyl-5-hydroxyhexyl)phthalate [MEHHP], and mono(2-ethyl-5-oxohexyl)phthalate [MEOHP]) were quantified in the urine samples. The urine samples were analyzed by high-performance liquid chromatography with tandem mass spectrometry (HPLC/MS/MS), on-line enrichment, and column switching techniques. A log-transformed creatinine-adjusted urinary MEHP, MEHHP, and MEOHP concentration were compared between the post- and preshift.

Results: The geometric means were 3.10 μg/g Cr for MEHP, 3.40 μg/g Cr for MEOHP, and 4.37 μg/g Cr for MEHHP in the postshift urine samples, and 2.23 μg/g Cr for MEHP, 2.65 μg/g Cr for MEOHP, and 3.54 μg/g Cr for MEHHP in the preshift urine samples. The 3 urinary metabolite concentrations at postshift were significantly higher than the concentrations in the preshift ($P < 0.0001$).

Conclusion: For assessment of DEHP exposure, it is necessary to collect urine pre- and postshift.

PP-29-084

A Short-term Repeated Administration to Low-Dose DEHP, BPA, and BADGE Associated With the Development of Type 2 Diabetes Mellitus in Adolescent Male Sprague Dawley Rats

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Background/Aims: Some of endocrine disruptors such as Di (2-ethylhexyl) phthalate (DEHP) and bisphenol A (BPA) may be related to the development of diabetes mellitus at higher doses than environmental or occupational exposure level. We investigated that the short-term administration of DEHP, BPA, and BADGE in human exposure ranges effects in vivo on the development of type 2 diabetes mellitus.

Methods: The study used male Sprague Dawley rats (5 weeks). The experimental group rats were administered DEHP (0.75, 7.5, 15, 150 mg/kg/d), BPA (0.005, 0.05, 0.1 mg/kg/d), and BADGE (0, 0.5, 5, 10 mg/kg/d) during 7 days by a gavage. We measured the body weight, the fasting blood glucose from the tail vein, and insulin, leptin, adiponectin, and T3 in plasma. The Otsuka Long-Evans Tokushima Fatty rats were used as positive control.

Results: Body weights were not significantly different when compared with the control group. The insulin levels were significantly increased in DEHP 0.75 and 7.5 mg/kg/d. Fasting blood glucose levels in BPA 0.05 and 0.1 mg/kg/d were significantly decreased. The insulin levels were tending to increase all BADGE treatment groups. Fasting blood glucose and T3 levels in BADGE 10 mg/kg/d and leptin and adiponectin in BADGE 0.5 mg/kg/d were significantly increased. In the Otsuka Long-Evans Tokushima Fatty rats, the OGTT, adiponectin, T4, TSH, and MDA were changed.

Conclusion: These results suggest that short-term low-dose exposure to DEHP, BPA, and BADGE could be associated with the developing type 2 diabetes mellitus.

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PP-29-085

A Case-control Study: Exposure Assessment of Volatile Organic Compounds and Formaldehyde for Asthma in Children

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Background/Aims: On the basis of results of a questionnaire distributed to the parents of students in an elementary school located in Seongbuk-gu, Seoul, an asthma case group and a control group were selected.

Methods: Through written messages sent to the parents of students, informed consent was obtained; 33 and 40 students were enrolled in the case and control groups, respectively. To determine the volatile organic compounds (VOCs) and formaldehyde levels of exposure, we performed personal, indoor, and outdoor measurements using a passive sampler for 3 days. In addition, the behavior patterns for the 3 days in the case and control groups were determined through daily time-activity pattern-diaries. The VOCs were analyzed by gas chromatography with flame ionization detection, and formaldehyde was analyzed by a UV spectrophotometer.

Results: In comparing the results of the levels of VOCs and formaldehyde exposure between the case and control groups, it was shown that toluene and o-xylene were higher in personal sampling, and the benzene concentration was higher in the case group in indoor measurements. In outdoor measurements, benzene and methylcyclohexane were higher in the patient group ($P < 0.05$), the asthma ORs were 1.1 and 32.9, respectively. Based on the activity content analysis by time, it was shown that the students spent 88.0%, 7.2%, and 4.9% of their time indoors, outdoors, and in traffic, respectively.

Conclusion: In conclusion, it was shown that the childhood asthma case group was exposed to higher VOCs than the control group, and it was found by measurement methods that VOCs in personal sampling were higher than the values obtained in indoor and outdoor measurements, and the formaldehyde value was the highest in indoor measurements. Therefore, management of VOCs and formaldehyde is required for the prevention of childhood asthma, and personal measurement should be considered for proper evaluation.

PP-29-086

Influence of Water Temperature on Perchlorate-induced Toxicity in *Oryzias latipes*

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Background/Aims: Thyroid hormones play an essential role in the metabolism, growth, and development in vertebrate. Some synthetic chemicals such as perchlorate have been reported to disrupt thyroid function. Perchlorate interferes with iodine uptake in the thyroid hormone synthesis process. Water temperature can induce stress hormone cortisol, which may influence thyroid function as well. However, the effect of water temperature on perchlorate-induced thyroid toxicity is not well understood.

Methods: In this study, *Oryzias latipes* were exposed to sublethal concentration (100 mg/L) of sodium perchlorate at 3 different water temperature, that is, low (26°C), medium (29°C), and high temperature (33°C) for 7 days, and the effect of water temperature on perchlorate toxicity was observed.

Results: Perchlorate exposure decreased transcription of both thyroid hormone receptor alpha and beta mRNAs. Perchlorate exposure at high water temperature induced upregulations of mRNA levels of both NaKATPase alpha and beta, presumably because of increased induction of stress hormone cortisol. Moreover, as water temperature increased, fecundity of fish, eg, number of eggs per pair was decreased.

Conclusion: The results of our study suggested that the decrease of reproduction might be partly explained by disruption in thyroid function, which was resulted from inhibition of thyroid hormone synthesis by perchlorate exposure and interference of tissue response to thyroid hormone signal by high water temperature.

PP-29-087

Parental Exposure to Bisphenol A During Pregnancy and the Anogenital Distance of Male Offspring

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Background/Aims: Bisphenol A (BPA), an endocrine disruptor with both estrogenic and antiandrogenic effects, has been found to have widespread human exposure. The effect of prenatal exposure to BPA on offspring in human beings remains largely unknown. We examined the association between parental occupational exposure to BPA during pregnancy and anogenital distance (AGD), an androgen sensitive endpoint, in male offspring.

Methods: Boys from families in which parent(s) did or did not have occupational exposure to BPA were examined. Their AGDs were measured during a physical examination. Parental BPA exposure level during the index pregnancy was measured by TWA8 (8-hour time-weighted average) derived from personal air measurement and employment history.

Results: A total of 153 boys were included in the final analysis. After controlling for boys' ages and weights using linear regression, parental occupational exposure to BPA during pregnancy was associated with decreased AGD in male offspring with a dose-response relationship: compared to boys from unexposed families, coefficient (β) for AGD associated with occupational exposure to BPA were −2.74, −3.27, −5.77, −10.89, and −11.91 for the boys from families with paternal low TWA8, paternal high TWA8, maternal low TWA8, maternal high TWA8, and parental both exposed, respectively (trend test: $P < 0.01$).

Conclusion: Our findings provide the first epidemiologic evidence that prenatal BPA exposure may be associated with shortened AGD in male offspring, indicating a potential disturbing interference of BPA with the development of fetal reproductive systems. This finding has important public health implications because of ubiquitous BPA exposure.

PP-29-088

PCB Congeners in Serum in 8–9-year-old Environmentally Exposed Children and 4 Years Later-estimation of Elimination Half-lives

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Background/Aims: The Chemko chemical factory situated in eastern Slovakia at Strazske town in the Michalovce District produced polychlorinated biphenyls (PCBs) for 25 years (1959–1984). Large amounts of PCBs were released into the environment (mainly into water courses and soil) due to poor technological measures.

Methods: A total of 434 children (age, 8–9 years) born and living in polluted area were recruited for participation. The mothers of children should have permanently lived in the area for at least 5 years before the child's birth. Of them, 304 children were re-examined 4 years later. The serum concentrations of 15 PCB congeners (PCB 28, 52, 101, 123+149, 118, 114, 153, 105, 138+163, 167, 156+171, 157, 180, 170, 189) were

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determined by high-resolution gas chromatography with electron capture detection. First PCB kinetics was estimated for all children. Elimination half-lives, assuming first-order kinetics, were calculated either directly for each paired values (values x) or using regression model with or without adjustment for BMI (values y). From further statistical evaluation, subjects with serum concentrations less than limit of detection and half-life values 30 years separately for each congener were excluded.

Results: The half-lives calculated by the 2 completely independent methods excellently correlated, as $y = 0.981 \times -0.18$, $R^2 = 0.996$. The apparent and regression model estimates of half-lives in years for the 6 major congeners are as follows: PCB-118, 2.93 and 2.61; PCB-138, 6.23 and 5.87; PCB-153, 5.73 and 5.55; PCB-156, 2.95 and 2.82; PCB-170, 5.41 and 5.06; PCB-180, 5.78 and 5.55

Conclusion: Our data are in agreement with majority of the so far published data on PCB congeners elimination kinetics in human beings, but with regard to its robustness and being based on a large cohort, it significantly contributes to PCB exposure assessment in adolescents.

PP-29-089

Mineral Oils and Harmful Effects on Human and Animal Skin

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Background/Aims: Oil products, such as oils and Vaseline, are widely used not only in industries but also in medical practice. They are components of unguent basis that are used for treatment of various skin diseases.

Methods: The dermatotropic effect of oil components was examined by skin test in rabbits. Skin test is an adequate method for the evidence of follicular hyperkeratosis effect of oil products, industrial substances, as well as daily used agents. The examined material was dripped on the upper part of the ear of a rabbit and the amount was 2 drops. After dripping, the ear was caught in a horizontal position until the sample drips evaporated. On the controlled ear, there was control sample applied under the same conditions. Skin test was evaluated by microscopic and macroscopic way.

Results: In the experiment, there was harmfulness of individual sample found as follows:

1. The least dermatogenic effect was shown by the hydrocarbons that contain 30.2% of aromatic carbon.
2. The higher dermatogenic effect was caused by the sample that contains 35.2% of aromatic carbon.
3. The third place was taken by the sample that contains 47.7% of aromatic carbon and caused even bigger dermatogenic effect than the sample N 2.
4. The sample with 52.4% of aromatic carbon provoked distinct dermal effect.
5. The biggest dermatogenic effect was shown by the sample containing 55.2% of aromatic carbon.

Conclusion: Although carrying experiments on laboratory animals, the harmfulness and possible carcinogen effects of aromatic hydrocarbons on living animals were found out. Having in mind many studies it is advised to use oil products with the least possible percentage of aromatic carbon.

It could contribute a lot to diminishing the distribution of dermatitis among people and animals.

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PP-29-090

Biological Surveillance of Exposure to Inorganic Arsenic and Associated Endocrine Disruptions in a Population Drinking Water From Private Wells in the Region of Abitibi-Témiscamingue, in Quebec (Canada)

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Background/Aims: Private well users were recruited to determine the link between low-dose arsenic (As) and endocrine disruptions.

Methods: After exclusion of participants potentially exposed to sources of As other than water and food, 304 participants (aged ≥7 years) using private wells were recruited for this cross-sectional study. Internal dose was estimated by the sum of urinary methylmalonic acid, dimethylarsinate, As(III), and As(V) corrected for creatinine and by total As in toenails. Thyroid hormones (thyroid stimulating hormone [TSH], FT3, and FT4), glycosylated hemoglobin (HbA1c), and anti-thyroid antibodies (anti-TPO, anti-Tg) were analyzed.

Results: The geometric mean of inorganic As in tested wells (n = 153) was 14.2 μg/L. A logistic regression analysis performed after controlling for confounding factors (age, sex, food sources of As, family history of diabetes, and BMI) revealed that diabetes (HbA1c >6.0%, personal history of diabetes or use of oral hypoglycemic agents or insulin) was associated with both As in well water ($P = 0.009$) and nail As ($P = 0.019$) in adults. An adult diabetic patient was 2.84 times more likely to be exposed to more than 33 μg/L of As in well water than a nondiabetic (95% CI: 1.29–6.24; $P = 0.010$) patient. After exclusion of participants treated for diabetes and controlling for the same confounding factors (except for BMI), linear regression analysis revealed that HbA1c was associated with both As in well water ($P = 0.015$) and the estimated amount of As ingested from the well on an annual basis ($P = 0.036$) in children. After excluding participants treated for hypothyroidism and controlling for confounding factors (age, sex, anti-thyroid antibodies, food sources of As, smoking, and family history of thyroid disease), a linear regression analysis indicated that As in well water was positively associated with TSH ($P = 0.001$) and negatively associated with FT3 ($P < 0.001$) and FT4 ($P = 0.003$) in adults, whereas only TSH was associated with this exposure indicator in children ($P = 0.004$).

Conclusion: This study specifies the endocrine disruptor effect of low As exposure.

PP-29-091

Chemical Analysis of Household and Personal Care Products for Endocrine Disrupting Compounds and Other Chemicals of Emerging Concern

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Background/Aims: Concern about exposure to endocrine disrupting compounds from use of commercial household and personal care products is growing, but limited labeling or testing information is available to evaluate products as exposure sources or inform exposure reduction efforts.

Methods: In this study we tested 214 products, including some advertised as "nontoxic" or "natural," for 66 chemicals. Targeted compounds included parabens, phthalates, bisphenol A, triclosan, ethanolamines, alkylphenols, fragrance compounds, glycol ethers, cyclosiloxanes, and ultra-violet filters. We tested soaps, detergents, and other cleaners; makeup; shampoo and other hair products; lotions; diapers; sunscreen; and

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shower curtains. First, we developed criteria to guide selection of "alternative" products—products expected to be without the targeted chemicals. For comparison, we selected products not meeting the criteria, defined as conventional products and selected, in part, based on market share. To minimize analytical costs, 2 of 7 conventional products were composited within a product type (eg, bar soap) and analyzed as one analytical sample. Each alternative product was analyzed independently to identify specific products without target compounds. A total of 86 product samples were tested.

Results: Results indicate widespread exposure to a range of endocrine disrupting compounds and other chemicals of concern from consumer products. All conventional samples had at least one detected compound; 11 alternative products contained no detectable amounts of targeted compounds. The average number of detected compounds in conventional products was up to 8.7 (uncertainty due to composite sampling) and in alternative products was 2.9. The most frequently detected compounds in conventional samples were 8 fragrance compounds followed by bisphenol A. Further analysis was conducted to determine whether products without chemicals of concern could be identified from product labels. As expected, few compounds (eg, parabens and antimicrobials) were consistently and clearly labeled, emphasizing that current regulations provide inadequate information on product composition.

Conclusion: Findings will be used to design evidence-based exposure reduction strategies.

PP-29-092

A Study of Comparative on the Classification Criteria and Results of Several Chemicals of GHS Between Korea and Japan

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Background/Aims: The objectives of this study were to determine the current status of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) in Korea and Japan. We have also emphasized the need for international harmony in standardizing the GHS classification and finding methods to improve the GHS.

Methods: To determine the difference between the GHS of Korea and Japan. We compared the published GHS classification results of 200 chemicals. We reviewed the concordance rate of Korea and Japan's GHS classifications and analyzed the basis of discordance rate.

Results: As a result of the comparison between GHS classification results of Korea and Japan, the overall concordance rate was 70.9%. The target organ toxicity resulted in the least concordance rate showing 27% for the single exposure and 40.0% for the repeated exposure while the respiratory hypersensitivity and the aspiration hazard resulted in the highest concordance rate indicating 95.5% each. The major cause of discordance showed 74.3% for the "difference of reference," 15.6% for the "difference of building block approach," and 10.1% for the "difference of data in the same reference."

Conclusion: As a result, chemical study of Korea and Japan, health and environmental hazard for the 200 chemicals classified discordance rate was 29.1%, all items matching the category, the results were just a matter of 5 chemicals. To minimize the confusion which may occur because of the introduction of GHS, the uniformity of GHS classification criteria, and results between countries os needed, and the effort for achieving the actual harmony of classification results of chemicals through the establishment of basis for the joint research like GHS Expert Committee between countries or multi parties is also demanded.

PP-29-093

Gene Expression and Epigenetic Changes in Prostate Cells Exposed to Environmental Androgen, Vinclozolin

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Background/Aims: Epigenetic changes (promoter level hypermethylation) and silencing of key tumor suppressor genes are believed to be associated with prostate cancer (PCa) development. Commonly hypermethylated genes include GSTP1, a DNA damage repair gene, RASSF1A, a putative tumor suppressor gene, and MGMT, which codes an enzyme that removes cytotoxic alkyl adducts from DNA. Exposure to certain endocrine disrupting compounds is believed to induce epigenetic changes and influence the initiation and progression of PCa. Vinclozolin, an antiandrogenic fungicide used on food crops such as soft fruits and vegetables, has been shown to produce transgenerational epigenetic alterations in rat offsprings and perturbed DNA methyltransferases expression. We examine alteration in gene expression through gene promoter hypermethylation of specific genes in human prostate cells exposed to vinclozolin.

Methods: Promoter methylation and alteration in the expression of genes GSTP1, RASSF1A, and MGMT were examined in androgen-sensitive human prostate carcinoma cells, LNCaP, and normal human prostate cells, RWPE-1 exposed to dihydrotestosterone, testosterone propionate, and vinclozolin in a time-dose dependant manner. Treated and control cells were harvested at 24, 48, 72, 120, and 192 hours after exposure. Changes in gene expression levels were quantified using qRT polymerase chain reaction. Methylation-specific polymerase chain reaction was performed to examine promoter region methylation differences. Alterations at the protein level was examined by sodium dodecyl sulfate-polyacrylamide gel electrophoresis with subsequent Western blotting.

Results: Cell proliferation and cell viability assays were conducted for time- and dose-dependent exposures. Gene expression and DNA methylation changes in cells exposed to vinclozolin will be presented and the implications discussed.

Conclusion: Findings of this study will shed light on the epigenetic interplay between environmental androgens and human prostate cells. This could help further understand the potential mechanistic role of endocrine disrupting compounds in PCa.

PP-29-094

Maternal Bone Lead Levels Are Prospectively Associated With Increased Blood Pressure in Female Offspring

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Background/Aims: Lead exposure during adulthood is now accepted as a risk factor of hypertension (HNT) and cardiovascular diseases (CVD). However, little is known about the impact on cardiovascular outcomes of prenatal lead exposure, even though the embryo and fetus are generally more susceptible to environmental toxicants. We examined 316 mothers and their children at 7–14 years of age from a sub-study of the Early Life Exposures in Mexico to Environmental Toxicants (ELEMENT) project (1995–2004 in Mexico City) to determine if prenatal lead exposures, as

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assessed by maternal bone and cord lead levels, are associated with blood pressure (BP) in children, a predictor of HTN and CVD later in life.

Methods: BP was measured by mercury sphygmomanometer with appropriate-size cuffs, maternal bone lead by in vivo K-x-ray fluorescence, and umbilical cord lead by atomic absorption spectrometry. Multiple linear regression models were used to estimate the association between BP and lead, and effect modification by gender.

Results: After adjusting for maternal and paternal education, smoking during pregnancy, offspring's age, height and body mass index, maternal tibia (but not cord blood) lead levels were significantly associated with increases in systolic BP (SBP) and diastolic BP (DBP) in offspring girls but not boys (P-interaction = 0.002 for SBP and 0.001 for DBP). Among female offspring, interquartile range increases of the maternal tibia lead levels (13 μg/g) were associated with 3.89 mm Hg (95% CI: 1.38–6.4 mm Hg) and 2.77 mm Hg (95% CI: 1.1–4.43 mm Hg) increases in SBP and DBP, respectively. There was also a significant association of patella lead levels with SBP in girls (P-interaction < 0.03). Similar effects were seen with patella bone lead.

Conclusion: Our findings suggest that in utero lead exposure is associated with increased BP in female offspring at age 7–14 years. This apparent prenatal programming mechanism and modification by gender deserves further study.

PP-29-095

Changes in Immune and Endocrine Effect Markers in Adolescents Exposed to Residues of Organochlorine Pesticides in Brazil.

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Background/Aims: To evaluate the concentration of immunological and endocrine markers among adolescents exposed to organochlorine pesticide residues in Rio de Janeiro, Brazil.

Methods: We obtained laboratory results of serum eosinophils, IL6 (interleukin-6), and IgE for the immunological evaluation, and T3, T4, TSH, Cortisol, Prolactin, FSH, LH, and estradiol for endocrine evaluation, from the data collection from medical records at a local health unit from a previous screening.

Results: We observed that concentrations were considered well above the tolerance limits allowed for immunological markers. The distribution shows typical asymmetrical pattern, due to the presence of individuals with concentrations outlier distribution. Special attention was given to eosinophils (mean 5.54, SD: ±5.29), IL6 (mean 4.53, SD: ±6.28), and IgE (mean 719.94, SD: ±1528.05). As for endocrine markers, observed concentrations were slightly altered, sometimes within the normal range. The average values were as follows: free T4 (1:15 mean ± SD: 0.55), TSH (mean 2.61 ± SD 6.94), cortisol (mean 137.78 ± SD: 57.95), T3 (mean 162.94 ± SD 40.40), LH (mean ± SD 10.52 14.08), prolactin (mean 10.96 ± SD 11.12), estradiol (mean 126.99 ± SD: 533.02), and FSH (18.79 mean ± SD 27.80).

Conclusion: Apparently, the immune system has undergone more significant changes than the endocrine system. However, periodic monitoring and evaluation of health of this population is recommended, considering that the blood is altered especially at this critical period of development.

PP-29-096

Correlation Between Serum Concentrations of Organochlorines and Endocrine and Immune Markers in Adolescents Exposed to Residues of Organochlorine Pesticides in Brazil

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Background/Aims: To evaluate the correlation between serum concentrations of organochlorine exposure biomarkers and markers of immune and endocrine effects in adolescents in Rio de Janeiro, Brazil.

Methods: Laboratory results were obtained in serum concentrations of the isomers of HCH and DDT metabolites, and serum eosinophils, interleukin-6, and IgE for the immunological evaluation, and T3, T4, TSH, Cortisol, Prolactin, FSH, LH, and estradiol for endocrine evaluation, all of them from the data collection from medical records at a local health unit from a previous screening.

Results: There is a strong correlation between increased serum markers immunological and serum organochlorines, with special emphasis on the correlation between eosinophilic and dieldrin, HCH IgE and α, γ HCH, p,p′-DDE, p,p′-DDD and p,p′-DDT, and interleukin and β HCH and the dieldrin, all with statistical significance. The same is not observed for the concentrations of endocrine markers.

Conclusion: Apparently, the immune system has undergone more significant changes than the endocrine system. However, it is recommended that periodic monitoring and evaluation of health of this population, considering that the blood is altered especially at this critical period of development.

PP-29-098

Validation and Application of a Method for the Determination of Bisphenol A in Urine By LC-MS/MS: Short-term Temperature Stability Test

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Background/Aims: Endocrine disruption is emerging as an environmental issue based on the hypothesis that exposure to certain environmental chemicals have an effect on hormonal activity and thus alter the endocrine system, increases the incidence of endocrine disease and disorders, and adversely affects development in both humans and wildlife. One of these chemicals is Bisphenol A (BPA). The ability to measure BPA in urine samples after short-term storage could aid in such studies. Because the half-life of BPA is 6 hours, a measurement would be useful only if the environmental exposure is constant over weeks or months relatively. The aim of this study is to evaluate the stability of BPA in urine. As part of the baseline assessment, urine samples are being collected, processed, and frozen at 4°C, −20°C, and −70°C for short-term storage for experiment later.

Methods: The application for testing urine pools for fractionation therefore has to be accompanied by appropriate validation. Three aliquots of the low, medium, and high concentrations should be thawed at room temperature and kept at this temperature from 1 to 7 days and analyzed. The combination of free and conjugated BPA was measured. Deconjugation was performed with β-glucuronidase at 37°C. After, BPA extraction in sample analysis was conducted using Agilent 6460 HPLC coupled with a triple quadrupole mass spectrometer.

Results: For our study, the concentration of BPA in the urine stored at 4°C or 25°C did not change compared with the concentration of BPA in urine frozen at −70°C immediately after the collection. The concentration of BPA also did not change after about 7 days storage at 4°C, −20°C, and −70°C.

Conclusion: To assess pooling urine sample stability, injections were performed on freshly thawed urine samples. Initially, analyte

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concentrations were determined for pooled urine. Analyte CVs for the concentrations ranged from 1.07% to 6.27% for the pooled urines. These results indicate that analytes in urine samples are stable for 7 days in 4°C, −20°C, and −70°C temperatures should give a representative value of the analyte concentration at time zero for that individual. These findings suggest that development effects of BPA exposure could be investigated with measurements from stored urine.

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PP-29-099

Validation and Application of a Method for the Determination of Phthalate in Urine by LC-MS/MS: Short-term Temperature Stability Test

Hosub Lim,[1] Eunha Oh,[1] Hyoyoung Kim,[1] Yoonee Huh,[1] Yoo Sung Hwang,[1] Kyung-Hwa Park,[2] Tack Shin Kang,[2] and Seung Do Yu[2] *[1]Neodin Medical Institute, Center for Life and Environmental Science, Seoul, Republic of Korea; and [2]Division of Environmental Epidemiology, Department of Environmental Health Risk Research, National Institute of Environmental Research, Inchon, Republic of Korea.*

Background/Aims: Phthalates are widely used in a group of industrial chemicals as solvents, additives, and plasticizers. Humans are potentially exposed to many products contained phthalates. Phthalates are rapidly metabolized in humans to their respective monoesters, which depending on the phthalate can be further metabolized to their oxidative products. Monoesters and the oxidative metabolites of phthalates may be glucuronidated, and these conjugates excreted in the urine and feces. We applied our novel method to analyze urine samples using pooled urine several kind of phthalate reported mEHP, mEOHP, and MnBP. Therefore, information on the concentration of these free species in urine could be helpful for risk assessment. Because conjugates could hydrolyze to their corresponding free forms during collection, handling, and storage of biological specimens, information on the temporal stability of the conjugates is of interest. The ability to measure phthalates in urine samples after short-term storage could aid in such studies. As part of the baseline assessment, urine samples are being collected, processed and frozen at 4°C, −20°C, and −70°C for short-term storage for experiment later.

Methods: The application for testing urine pools for fractionation. Therefore, has to be accompanied by appropriate validation. Three aliquots of the low, medium, and high concentrations should be thawed at room temperature and kept at this temperature from 4 to 24 hours and analyzed.

Results: In our study, the concentration of phthalate in the urine stored at 4°C or 25°C did not change to compare with the concentration of phthalate in urine frozen at −70°C immediately after the collection. The concentration of phthalate also showed same result after about 7 days storage at 4°C, −20°C, and −70°C.

Conclusion: The proper storage conditions depend on a variety of factors used for need to experiment result about sample stored for longer periods.

PP-29-100

Differential Gene Expression Analysis in Human Leukemia Cell Line K562 Treated With Benzene

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Background/Aims: Even though the exposure to benzene has been linked to variety of cancers including leukemia, the detailed molecular mechanism of carcinogenesis by benzene remains unidentified. We investigated the effects of benzene on differential gene expression in leukemia.

Methods: After leukemia cell (K562) were cultured in RPMI media with 10 mM benzene, RNA extraction, and nucleosome extraction. To analyze the gene expression profiles, using 41,000 human whole genome cDNA microarray, western blot analysis.

Results: We initially identified 154 gene altered by benzene treatment. Of these, 88 genes were upregulated and 66 genes were down regulated more than 6 fold, respectively. Functional classification revealed that identified genes were involved in transcription, cell proliferation, cell cycle, and apoptosis. Additionally, we have identified that benzene treatment modified histone modifications including histone H3 and H4 acetylation status in K562 cells.

Conclusion: These gene expression profiles should provide further understanding of the molecular mechanism of benzene-induced leukemogenesis.

PP-29-101

Relationship Between AhR Gene Polymorphisms and Dioxin Concentrations in Maternal Blood—Hokkaido Study on Environment and Children's Health

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Background/Aims: Dioxins (PCDDs, PCDFs, Dioxin-like PCBs) are endocrine disruptors, which when exposed to at low levels during pregnancy, are thought to have negative effects on fetal growth. Maternal dioxin concentrations vary greatly among individuals due to factors such as smoking, parity, and age. However, dioxin concentrations in maternal blood may also be affected by individual dioxin metabolizing ability. Dioxins are metabolized by the CYP1 enzyme family, which is produced by the binding of dioxins with the aromatic hydrocarbon receptor (AhR). Thus far, although 1 study has analyzed dioxin concentrations in relation to CYP1A1 genotype, no such studies have considered AhR. The aim of this study is to determine whether AhR polymorphisms affect dioxin concentrations in maternal blood.

Methods: We examined 421 mothers who enrolled in our study between 2002 and 2005 in Sapporo, Japan. Relevant information was collected from a baseline questionnaire during pregnancy and from medical records at delivery. Dioxin concentrations in maternal blood were measured by high-resolution gas chromatography/high-resolution mass spectrometry. We used multiple linear regression analyses after adjustment for maternal age, height, pre-pregnancy weight, caffeine and alcohol intake during pregnancy, parity, smoking status during pregnancy, education level, annual household income, inshore and deep-sea fish intake during pregnancy, and blood sampling period.

Results: When the difference in beta dioxin congener concentrations (log10 [pg/g lipid] scale) between the AhR (G>A, Arg554Lys) GA/AA referent genotype and GG genotype were measured, total non-ortho PCBs (beta = −0.044), and total mono-ortho PCBs (beta = −0.054) levels were significantly decreased. Specifically, 3,3′,4,4′-TeCB (#77), 3,3′,4,4′,5-PeCB (#126), 2′,3,4,4′,5-PeCB (#123), 2,3′,4,4′,5-PeCB (#118), 2,3,3′,4,4′-PeCB (#105), and 2,3′,4,4′,5,5′-HxCB (#167) levels were significantly decreased.

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Conclusion: This is the first report to analyze the relationship between xenobiotic metabolizing-enzymes and dioxins-congener concentrations in maternal blood. AhR polymorphisms may affect dioxin concentrations in maternal blood.

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PP-29-102

National Estimates of Blood Lead, Cadmium, and Mercury Levels in the Korean General Adult Population

Nam-Soo Kim and Byung-Kook Lee *Soonchunhyang University, Choongnam, Republic of Korea.*

Background/Aims: To assess the extent of exposure to lead, cadmium, and mercury in the Korean general adult population using a representative sample.

Methods: We studied blood concentrations of 3 heavy metals in a representative sample of 1997 Koreans as part of the Third Korean National Health and Nutrition Examination Survey (KNHANES III) performed in 2005.

Results: The geometric means of the blood lead, cadmium, and mercury concentrations were 1.61, 1.53, and 4.15 μg/L, respectively (95% confidence intervals [CIs]: 2.50–2.71, 1.48–1.58, and 3.94–4.36, respectively). Women had significantly lower blood lead and blood mercury concentrations in adjusted and unadjusted analyses but no difference between genders was observed in blood cadmium analysis. The geometric mean blood lead and mercury levels were higher in subjects older than 40 years than in those younger than 40 years. Smoking status only affected the blood lead concentration, with this being higher in smokers than in nonsmokers. Blood cadmium levels did not differ with demographic and lifestyle variables after covariate adjustment. Blood mercury concentrations were higher in those who consumed alcohol, and also increased with the frequency of fish consumption.

Conclusion: This biomonitoring study of blood heavy metals in the Korean general population as part of KNHANES III provides important reference data stratified by demographic and lifestyle factors that will be useful for the ongoing surveillance of environmental exposure of the Korean general population to heavy metals.

PP-29-103

Environmental Risk Factors of Breast Cancer in Korea

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Background/Aims: Incidence of breast cancer in Korea has rapidly increased since 1990. Furthermore, the increasing rate in Korea is about 20 times in comparison with that of Europe or United States. It is supposed that some associations between unknown environmental contaminants and breast cancer may exist. The purpose of this study is to list up the potential environmental risk factors of breast cancer and to find out some possible relationships.

Methods: We reviewed literature on the potential risk factors including genetic, behavioral, and environmental factors including contaminants including endocrine disrupting substances and other carcinogens. We collected the data related to breast cancer in South Korea. These data include breast cancer mortality data from Korea National Statistical Office and cancer incidence data from the Korea Central Cancer Registry, and nutritional information, dietary habit, and smoking rate from Korean National Health and Nutrition Examination Survey (KNHANES). We analyzed the correlation of breast cancer mortality and breast cancer incidence with monitored hazard pollutants from National Institute of Environmental Research (NIER).

Results: Many studies reported some environmental pollutants might act as a human carcinogen or endocrine disruptor. They suggested dioxins, bisphenol-A, PAHs, and benzene as noticeable risk factors. The consumption of these chemicals in Korea has quickly increased as the result of rapid industrialization after 1960s. It is known that the lag time of breast cancer is between 10 and 40 years (mean, 20 years). Considering them, it is reasonable that environment pollutant could contribute the breast cancer increase.

Conclusion: The shortage of this study is that it stays only a descriptive analysis on account of limited information and environmental data. Nevertheless the causal relationship is not clear as yet, potential environmental hazards should be avoided by the precautionary principles.

PP-29-104

Environmental Exposure Level of PBDEs in Some Industrial Area in Korea

Junheon Yoon, Ig-Chun Eom, Sue Jin Kim, Jaecheon Cho, Chonrae Cho, Doo-Hee Lee, and Kyunghee Choi *National Institute of Environmental Research, Incheon, Republic of Korea.*

Background/Aims: The goal of this study is to measure the contamination levels of PBDEs in a variety of environmental media, such as water, sediment, and soil. In this study, we focused on the monitoring at 3 industrial areas in Shiwa Ansan, Ulsan Onsan, and Yeosoo-Kwangyang regions.

Methods: The number of sites investigated were 18 sites for water, 13 sites for sediment, and 16 sites for soil. The target PBDEs examined were 27 congeners from Mono-BDE to Deca-BDE and analyzed using HRGC/HRMS.

Results: The results showed that Deca-BDE is a major congeners in all media. Concentration levels of total PBDEs in water, sediment, and soil were 0.35–11.28 ng/L, 1.4–204.9 μg/kg, 0.6–185.7 μg/kg, respectively. The patterns of PBDEs profile is little different among 3 industrial regions. Low brominated BDEs were dominant chemicals in Shiwa Ansan region but Yeosoo-Kwangyang regions shown that high brominated BDEs like heptadeca were major compounds.

Conclusion: High brominated BDEs like Deca, Nona, Octa, Hexa were detected the most of sites. However, concentration variation of each media were too high to estimate consistency of PBDEs exposure among 3 regions. It means that these industrial regions have some different point sources of PBDEs.

PP-29-105

mRNA Expressional Changes in Rat Livers Exposed to Silver Nanomaterial

Sang Hee Lee, Gyoun Baek Seo, Ki Eun Joung, Byungcheun Lee, Junheon Yoon, and Kyunghee Choi *National Institute of environmental Research, Incheon, Republic of Korea.*

Background/Aims: Toxicogenomics tools combined with bioinfomatics are recognized as powerful and efficient high-through techniques to prioritize the chemicals. The aim of the study is to explore the applicability of this technique in investigating the bioreactivity of nanomaterials via profiling the mRNA expression induced by exposure to nanomaterials.

Methods: The citrate capped silver nanomaterial (<20 nm, colloid in the water) was chosen since this material is known to be well dispersed in

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water. Furthermore, the side effects due to dispersants or capping materials would be minimized since only citrate, the capping material which can be found in the organisms, is used to assist homogenous dispersion. Sprague Dawley rats were exposed to the silver nanomaterial (Ag NM) via oral route using a gavage at the doses of 0, 5, 10, and 20 mg/kg bw for 14 days. The mRNA expressional changes in the rat livers were studied using Rat whole genome 4 × 44 K oligo chips.

Results: The functional analyses suggested that Ag NM would induce the changes mRNA expression in the rat liver related to transcription, transport, signal transduction, cell differentiation, immune response. Furthermore, RT-PCR data showed Ag NM would induce up-regulation in CytP450 subfamilies, the oxidative stress related genes and down-regulation in xenobiotics clearance related genes CAR (Constitutive Androstane Receptor) and CCL2 (Chemokine [C-C motif] Ligand 2, MCP-1; Monocyte chemotactic protein) and PPAR-α (Peroxisome Proliferator-Activated Receptor-α).

Conclusion: From the results, the genomic technique combined with bioinfomatics could be applicable to investigate the effects of nanomaterials. However, further studies would help to interpret the mRNA expressional changes in predicting any phenotypical changes.

Emerging Environmental Problems - Ionizing Radiation, Electromagnetic Field, Stress, Hazardous Wastes

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PP-29-106

Assessment of Stress and Its Risk Factors Among Primary School Teachers in the Klang Valley, Malaysia

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Background/Aims: This cross-sectional study determined the workplace stressors, stress levels, mental health status, and their influencing factors, among primary school teachers in the Klang Valley, Malaysia.

Methods: In all, 9 primary schools in Klang Valley, which fulfill the inclusive criteria, were randomly selected from a list obtained from the Ministry of Education website. A total of 272 teachers from the selected school volunteered to participate in the study. A questionnaire was used to determine sociodemographic background, working information, and medical history. Teacher stress inventory was used to measure the stressor and stress levels, whereas General Health Questionnaire was used to measure the mental health status.

Results: Results showed that most of the teachers experience moderate stress level (71.7%) and only 12.1% had low mental health status. Student misbehavior was the main stressor in the school environment (mean = 2.62). Gender (P = 0.001) and workload (P = 0.002) showed a significant contributing factors toward mental health status.

Conclusion: These primary school teachers experience stress mainly due to the student misbehavior and the mental well-being was influenced by the workload and gender. Women teachers with heavy workload had relationship with lower mental health status.

PP-29-107

The Health Effects of the Electromagnetic Field Associated With Mobile Phone Base Station: A Provocation Study

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Background/Aims: To examine the acute effect after short-term exposure to mobile phone base station, we conducted a double-blind provocation study.

Methods: We recruited subjects with and without electromagnetic hypersensitivity syndrome through a homepage and excluded pregnancy women; people wearing artificial hearing aid or pace maker; and those who had brain injury, seizure, cardiovascular diseases, psychological disorders, or other health problems that might interfere with the assessment of health effects. The participants received electromagnetic field (EMF) exposure in a laboratory room that can block all nonionizing radiations. Each participant went through two 30-minute experiment sessions, including one with real EMF exposure and the other under sham condition. The 2 sessions were separated by a washout period of 30 minutes, and so the whole experiment ran for 90 minutes. The EMF emitted from mobile phone base station was simulated using a machine, with the power density 1/10 of the ICNIRP recommended exposure limit. Physiological changes including the heart rate and its rate variability, blood pressure, skin temperature, and O_2 saturation were monitored from before the experiment to after the experiment ended. The perception of EMF and subjective symptoms was also monitored.

Results: A total of 102 volunteers participated in this study by the end of March 2010. There were 72 males and 30 females. There were 71 volunteers aged below 30 years. There were 21 volunteers aged between 30 and 40 years. There were 9 volunteers aged between 40 and 50 years. There was 1 volunteer with age above 50 years.

Conclusion: This study is unique in that the provocation was performed in a laboratory that can block all the nonionizing radiations from the environment. Therefore, the interference of background EMF, which is inevitable in other settings, can be minimized, leading to more reliable study results.

PP-29-108

Effects of Radiofrequency Electromagnetic Field Exposure on Sleep Disturbances

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Background/Aims: Possible effects of radiofrequency electromagnetic field (RF-EMF) exposure on sleep impairments are of public concern. The aim of this study was to investigate the association between RF-EMF exposure and sleep disturbances.

Methods: A total of 1375 randomly selected participants from Basel, Switzerland, were enrolled in a questionnaire survey: 82% participated in a follow-up 1 year later. Standardized questions on daytime sleepiness (Epworth sleepiness scale; ranging from 0 [no daytime sleepiness] to 21 [excessive daytime sleepiness]) and subjective sleep disturbances (Swiss

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health survey; ranging from 0 [no sleep disturbances] to 12 [sleep disturbances]) were assessed. One hundred twenty participants were asked to wear an actigraphic device for 2 weeks to objectively measure sleep efficiency and sleep duration (nested sleep study). Exposure to RF-EMF was either predicted with a validated exposure prediction model (cohort study) or measured in the sleeping room (nested sleep study). For the cohort analysis, multivariate linear regression models for exposure at baseline and change in sleep disturbances over 1 year were calculated. In the nested sleep study, mixed linear multilevel models for 1484 nights were performed. Statistical models were adjusted for relevant confounders.
Results: In the cohort analysis, neither excessive daytime sleepiness nor sleep disturbances were related to RF-EMF exposure. The corresponding regression coefficients for the top exposure decile as compared with the low exposure group (<median) were −0.24 (95% CI: −0.81 to 0.33) for daytime sleepiness and −0.31 (95% CI: −0.78 to 0.17) for sleep disturbances. In the nested sleep study, sleep efficiency (coefficient: −1.20; 95% CI: −3.34 to 0.95) and sleep duration (coefficient: 0.11; 95% CI: −0.31 to 0.53) in the highest exposed group (top decile) were not associated with exposure.
Conclusion: Our analyses do not suggest an effect of RF-EMF exposure on the development of sleep disturbances after 1 year of exposure. These findings are confirmed with objective actigraphic measurements.

PP-29-109

Association of Changes of Thyroid Hormone Levels With Brominated Flame Retarded Exposure Around E-waste Dismantling Site

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Background/Aims: Brominated flame retarded (BFR) released from e-waste activity might affect the health of local people. Assessing the effect of e-waste exposure via recycling, and dismantling and changes of thyroid hormone levels is an area of ongoing research.
Methods: The processing of e-waste recycling was investigated. A total of 236 occupational exposure people and 89 nonoccupational exposure people from e-waste recycling sites were surveyed, and their thyroid hormone levels (T3 and T4), free thyroid hormones (fT3 and fT4), and thyroid stimulating hormone were assayed. The level of polybrominated diphenyl ethers congeners and Polybrominated biphenyl congeners in serum was determined here. Linear regression model was taken to analyze the relations between thyroid hormone levels and BFRs concentrations.
Results: Lower level of T3 in exposure groups were observed ($P < 0.01$). BDE205 with T4 positively varied were confirmed by linear regression model (unstandardized regression coefficient, beta = 0.25, $\rho = 0.001$) and a weaker positively trend in BDE126 and T4 was found.
Conclusion: BFRs exposure may contribute to the changes of thyroid hormone levels.

PP-29-110

Electromagnetic Radiations From Cell Phone Inhibit Plant Root Growth Through Induction of Oxidative Damage

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Background/Aims: Enhanced and indiscriminate use of wireless technologies in the past few years has raised the levels of electromagnetic field radiations (EMFr). Among these, the number of mobile phones has tremendously increased in recent years and hence the hazardous effects of EMFr on living systems including plants. Though the biological effects of EMFr have drawn the attention of many scientists as well as environmentalists, yet there is lack of evidences of effects of mobile phone radiations on plants and their mechanism of action. Therefore, a study was planned to investigate the effects of mobile phone radiations on early growth of *Brassica campestris* and evaluate the associated biochemical changes.
Methods: We studied the effect of actual cell phone EMFr (at power density: 8.55 μW cm−2; 900 MHz; for 1/2, 1, 2, and 4 hours) in terms of early root growth, generation of reactive oxygen species (ROS) in terms of malondialdehyde and hydrogen peroxide content, effect on membrane integrity and root oxidizability and changes in levels of superoxide dismutases, catalases, guaiacol peroxidase, and ascorbate peroxidases.
Results: It was observed that cell phone EMFr inhibited the germination, early growth of Brassica. Further, EMFr enhanced lipid peroxidation and increased H2O2 accumulation and electrolyte leakage from Brassica roots thereby indicating ROS-mediated oxidative stress. It was accompanied by a significant increase in the activities of scavenging enzymes. However, the enhanced activities of scavenging enzymes could not prevent the damage induced by cell phone EMFr.
Conclusion: The study concluded that cell phone EMFr inhibits Brassica root growth by inducing ROS-generated oxidative stress despite increased activities of antioxidant enzymes. The obtained results point to the possible effect of cell phone EMFr on natural ecosystem process and therefore a need for risk assessment due to cell phone EMFr and development of proper management strategies to check EMFr pollution in the natural environment.

ENVIRONMENTAL TOXICOLOGY

PP-29-115

Surface Photochemistry: on the Search of Efficient Photodegradation Methods for Indigo Dyes Through Advanced Oxidative Processes

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Background/Aims: Immobilization of TiO_2 layers on glass and Modified Fenton test of the effect of advance oxidative processes on photocatalytic degradation of indigo blue. Particularly TiO_2 photocatalysis and Fenton are known for being nonselective processes able to mineralize recalcitrant chemicals.
Methods: A TiO_2 emulsion was prepared, mixing 12 g TiO_2, 4 mL H_2O and 0.4 mL acethylketone for 10 minutes. Then, 25 mL H_2O and 0.2 mL Triton X-100 were added. After proving that TiO_2 deposited on glass effectively enhances the photodegradation of adsorbed indigo, we test various continuous flow and batch reactors, with and without TiO_2 adsorbed on internal reactor wall, using different irradiation sources. Modified Fenton approaches are also being tested.
Results: TiO_2-coated glass enhances photodegradation of adsorbed indigo and dye absorption totally disappears after 6 hours irradiation with 125 watts Hg lamp; approximately 40% of color disappears in the first 1 hour. We tested continuous flow and batch reactors also on treatment of dye liquid streams (with or without TiO_2 on internal reactor wall) using lamps. In TiO_2 absence, there is no indigo degradation. Irrespective reactor or irradiation source used, very low % of degradations (<10%) with TiO_2 introduction in the system. Fenton-based processes gave more promising results, with more than 50% color removed in about 0.5 hour. The problem of iron residue removal remains to be solved.
Conclusion: To date, only Fenton-based methodologies seem to be able to remove the indigo blue color from those model waters.

PP-29-117

Using a Chemical Mixture of Pyrethroid Pesticides to Determine Rodent Tissue Clearance Rates

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Marcelo Wolansky,[2,5] Michael J. DeVito,[2,6] and Rogelio Tornero-Velez[1]
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Background/Aims: Surveys in the United States have repeatedly demonstrated the presence and co-occurrence of various pyrethroid pesticides in residences and daycare facilities. Since pyrethroids co-occur and have similar modes of action, pharmacokinetic models will be better informed if data are derived from studies using chemical mixtures. The objective of this research was to develop and apply methods with sufficient sensitivity to determine tissue clearance profiles for a mixture of pyrethroids.

Methods: The pyrethroids selected for the mixture (cis- and trans-permethrin, cyfluthrin, cypermethrin, deltamethrin, and esfenvalerate) and their relative proportions in the dosing solution were based on the distribution of pyrethroid residues measured in a nationally representative probability study of 168 child care centers. The pyrethroids were administered orally in a corn oil vehicle to adult male Long-Evans rats. Animals received either a high or low concentration dose and were sacrificed at 1, 2, 4, 8, or 24 hours after dosing. Tissue concentrations in brain, subcutaneous fat, liver, and whole blood were determined. Two replicates of each sample were analyzed to evaluate method reproducibility.

Results: There was little variability associated with the replicate tissue results compared with results from different animals at the same dose and time point. The limit of quantitation for all pesticides in all tissues was less than 3 ηg/g and this sensitivity allowed the determination of elimination rate constants for all pyrethroids in blood and brain except the low dose esfenvalerate. Elimination rate constants were also calculated for cis-permethrin, cypermethrin, deltamethrin, and esfenvalerate in liver. The half-life of all pyrethroids in blood, liver, and brain was less than 6 hours while the fat functioned effectively as a storage compartment.

Conclusion: The use of empirically based chemical mixtures to determine clearance estimates is feasible and may provide an effective way to relate laboratory kinetic data to human exposure.

PP-29-118

Ostensibly Ineffectual Doses of Cadmium and Lipopolysaccharide Causes Liver Damage in Rats

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Background/Aims: Various hepatotoxicants cotreated with lipopolysaccharide (LPS) have the potential to cause severe hepatic damage. Whether cotreatment with ostensibly ineffectual (without effect on customary clinical liver function tests, such as aspartate aminotransferase and alanine aminotransferase) doses of cadmium (Cd) and LPS cause liver damage is still unknown.

Methods: We examined the effects of treating ostensibly ineffectual doses of Cd and LPS on liver dysfunction as well as on liver histopathology. We injected rats with saline only, Cd only, LPS only, or a single ostensibly ineffectual dose of Cd (100 μg/kg body weight) plus LPS (0.1 mg/kg body weight). After 6 hours, the rats were killed, and their liver damage was assessed.

Results: Cotreated with ostensibly ineffectual doses of Cd and LPS had higher levels of aspartate aminotransferase and alanine aminotransferase, hepatic lipid peroxidation, peroxynitrite, nitrite, and interleukin-1β (IL-1β), but lower levels of hepatic metallothionein (MT) than did that treated with saline only, Cd only, and LPS only. Histopathological analysis of Cd only and LPS only showed apparent liver damage, but Cd plus LPS showed marked hepatic damage.

Conclusion: We conclude that cotreating the rats with ostensibly ineffectual doses of Cd and LPS is hepatotoxic. Cd promotes LPS-initiated oxidative-stress-associated liver damage by increasing IL-1β and decreasing MT levels in rats.

PP-29-120

Comparison of PAH Levels Between Wild Fish and Farmed Fish

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Background/Aims: Several studies have reported elevated levels of environmental pollutants in farmed fish. These include chemicals that are potentially hazardous to the consumer such as polycyclic aromatic hydrocarbons (PAHs).

Methods: *Mullus barbatus* were captured off the Sicilian Channel in an uncontaminated area. The fishes *Dicentrarchus labrax* and *Sparus aurata* were reared on a farm off the Sicily coast.

PAHs were analyzed in 5 g of fish sample, extracted by sonication with organic solution 50:50 of dichloromethane and acetone, purified by C18 SPE and analyzed by HPLC UV-FL. We compared the levels of PAHs in wild fish and in farmed fish.

Results: The average of 16 PAHs is as follows: 26.47 ppb in *M. barbatus* (minimum 4.03–maximum 137.91), 23.59 ppb in *S. aurata* (minimum 10.08–maximum 49.85), and 37.61 ppb in *D. labrax* (minimum 5.07–maximum 81.61).

Conclusion: PAHs concentration in *M. barbatus* and *S. aurata* is similar, whereas the levels found in *D. labrax* are significantly greater. The contamination of farmed fish also certainly depends on quality of feed, because the main ingredients, such as fish oil and fish meal, are considered the main source of persistent organic pollutants. However, there are no sufficient data in literature to compare the contamination of PAHs for 16 analytes in *M. barbatus*. There are no regulatory reference limits for fishing food.

Although these pollutants are dangerous to human health, we must not forget that aquaculture is a vital opportunity to provide food supplies to the world's population, especially for a greater diversification of the diet, not only for the benefit of the poorest countries, but also to support the consumption of industrialized countries, given the steady depauperation of natural fish stocks.

PP-29-121

Reduction of Effluent Toxicity During Municipal Sewage Treatment Processes

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Background/Aims: In 2007, the Korean Ministry of Environment issued a legislation stating that by 2011 wastewater effluents should be regulated by employing 24 hours acute toxicity tests and setting a standard of less than 1 toxic unit (TU). The main objective of this study is to perform WET tests on raw wastewater, treatment process effluents, and discharges of sewage treatment plants in Seungki and Jungnang sewage treatment processes (STPs).

Methods: Acute toxicity tests were conducted using the grab samples with concentration range of 6.25, 12.5, 25, 50, and 100 vol% with additional control and 5 replicates. Chronic toxicity tests were conducted using the same concentrations as mentioned above for all effluents, testing 1 neonate and 10 replicates per concentration. All experiments were carried out in growth chamber at 21°C ± 1°C and 16-hour light: 8-hour dark photoperiod.

Results: It was also observed that toxicity is reduced as the sewage water passes through the physicochemical and biological treatment processes. The effective concentrations (EC50s) for Seungki and Jungnang STPs are 54.13% ± 32.64% and 30.38% ± 24.96%, respectively. Both Seungki and Jungnang STPs employ pre-precipitation and sedimentation by gravity as preliminary treatment process. The EC50s of the effluents after preliminary treatment are 62.5% ± 34.23% and 37.92% ± 0.94%. For Seungki, STPs where activated sludge process was used as biological treatment process, the EC50 of the final effluent was at 96.49% ± 7.84%. On the other hand, A2O process employed in Jungnang STP attributed to 100% EC50s. Chronic toxicity tests revealed that higher fecundities were observed for effluent samples from Jungnang STP compared to Seungki STP.

Conclusion: Acute and chronic toxicity tests revealed that an increasing reduction in the toxic unit of the effluents was achieved and that the final effluents discharged to the receiving bodies of water comply with the regulated set by the Korean Ministry of Environment.

PP-29-123

Effects of Blood Lead Concentration on Intelligence and Personality in School Children

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Background/Aims: This study was conducted to evaluate the effects of lead concentration in the blood on intelligence and personality in school children in Korea.

Methods: This study was designed as a cross-sectional study. The Korean Intelligence Test-Primary was administered to the 302 school age children (154 third-grade and 155 sixth-grade) of 3 areas: urban, fishery, and agricultural areas of Korea. Blood lead (Pb-B) was measured by means of atomic absorption spectroscopy equipped with graphite furnace atomizer.

Results: Geometric means of Pb-B for boys and girls were 2.79 ± 1.58 μg/dL and 2.54 ± 1.51 μg/dL, respectively. No children exceeded Pb-B of 10 μg/dL that is the recommended level of Pb-B in children by CDC, US. When the subjects were classified by median into 2 groups, upper and lower Pb-B groups, the IQ of upper and lower groups were 106.4 ± 13.7 and 110.0 ± 14.9, respectively. IQ score of upper group was lowered about 4 points than that of lower group. We founded that hyperactivity and autism score of Pb-B groups was higher than that of lower group. These results are coincident with the large-scale study results developed countries that chronic exposure to lead may reduce the intelligence of child.

Conclusion: This study may provide the first suggestive evidence that Pb-B has an impact on childhood intelligence and personality in Korean children. It is necessary to consider the effects of other important factors, such as parental intelligence in the next study.

PP-29-124

Methane and Natural Gas Exposure Limits

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Background/Aims: A threshold limit value (TLV) of 1000 ppm for both hydrocarbons (C1–C4) and natural gas has been proposed by the American Conference of Governmental Industrial Hygienists (ACGIH), but the rationale and the science behind this has not been sufficiently explored. Methane and ethane (the major components of natural gas) are simple asphyxiants and the most toxic components (propane and butane) in the mixture are present in small amounts. Therefore, the rationale for the TLV for light hydrocarbons and natural gas needs to be explored on a scientific basis.

Methods: A systematic search of literature was conducted using the following databases: PubMed, Scopus, Toxicology Abstracts, Health and Safety Science Abstracts, Compendex, OSHLINE, and TOXLINE. Search terms such as methane, natural gas, toxicity, aliphatic hydrocarbons, human health effects, source, exposure, TLV, occupational, environmental, hazard, and toxicology were included in the search string.

Results: Having examined all the relevant databases and literature on the toxicity, epidemiology, exposure, and explosive limits of light hydrocarbons and natural gas, we confirm that methane behaves more as a simple asphyxiant than as a systemic or target organ toxin. Fatalities in workers exposed to methane in confined spaces are believed to be caused by a lack of oxygen or explosions having crossed the lower explosive limit, rather than the toxicity of methane.

Conclusion: Methane appears to be a simple asphyxiant with no systemic toxicity and we propose that it should be assigned no occupational exposure limit; the same reasoning would apply to natural gas which contains 92% methane. However, considering the explosive characteristics, the other option would be to assign the occupational exposure limits for methane (5300 ppm), ethane (3000 ppm), and natural gas (5300 ppm) at 10% of their lower explosive limits. The current exposure guidelines for propane and butane would remain unchanged in consideration of their chemical and biological properties.

PP-29-125

Acute Sensitivity of *Neocaridina denticulata* to Pentachlorophenol Sodium Salt Following Hardness or pH

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Background/Aims: As an indigenous species has long-adapted to particular water environments, the species can be a suitable indicator to assess environmental risks caused by hazard chemicals in the particular site. Thus, *Neocaridina denticulata*, a small freshwater shrimp indigenous to Korea, is worth considering for a test species for such purpose. This study was performed to deduce the optimal experimental conditions (hardness and pH) for acute toxicity test using *N. denticulata*.

Methods: They were exposed to a certain concentration of pentachlorophenol sodium salt (PCP Na) for 96 hours under the various conditions of hardness and pH, respectively.

Results: The results suggested that the optimal condition of each test environmental factor could be soft water to moderate hard water for water hardness and 7 to 8 for pH.

Conclusion: We expect this study to provide basic information for a future study on toxicity test using *N. denticulata*.

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ETHICS AND JUSTICE IN ENVIRONMENTAL HEALTH POLICY

PP-29-126

Criticism to the Limulus Amebocyte Lysate Test as a Replacement Method to the Rabbit Pyrogen Test and Environmental Health Implications

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Background/Aims: This work intends to debate the acceptance of the limulus amebocyte lysate test as a complete alternative method to rabbit pyrogen test in detecting endotoxins.
Methods: The work is based on literature review and analysis about ethic, methodological, and environmental questions.
Results: There is evidence that the extraction of hemolymph from *Limulus polyphemus* (horseshoe crabs) causes the death of about 30,000 crabs per year in the United States. That places the biomedical industry as one of the main causes of death of that arthropod. Added to that is our ignorance of the degree to which the phylogenetic scale of consciousness ceases. Therefore, we do not know about sentience of arthropod and other invertebrates. There are some evidences in the literature that horse shoe crabs eggs serve as intertidal migratory birds' food and a growing in *Limulus* death because of limulus amebocyte lysate kit production may be a factor of disturbance of theses birds' behavior. Five tests are already validated for the detection of pyrogen, possibly as replacement of the rabbit pyrogen test, which are based on the measurement of pro-inflammatory cytokines (interleukin-1β, interleukin-6). Four of these 5 tests use human blood and the other test uses human cell line (Mono Mac 6).
Conclusion: There are several ethical advantages in using human blood, as human donors must be able to understand the research and give their consent to harmless donation. Because in vitro tests with human blood are potential complete replacement methods with no ethical consequences and without environmental disturbances, more studies for catch-up validation of those tests in different products from used in the validation study should be conducted and encouraged to be later incorporated to pharmacopoeias.

PP-29-127

Disparities in Traffic Exposure in the United States

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Background/Aims: Disadvantaged populations in the United States are considerably more likely to experience poor health status and poor health outcomes. Although many disparities are attributable to socioeconomic conditions, including income and access to health care, environmental exposures are known to be higher among those with lower socioeconomic status and many nonwhite race/ethnicity groups. The purpose of this study was to examine disparity in traffic exposure using a nationally representative sample of the US population.
Methods: We combined data from the 1999–2008 National Health and Nutrition Examination Survey with traffic data from the National Highway Planning Network using geographical information system.
Results: Using distance-based measure of exposure, we observed that the median distance to busy roadways was shorter for non-Hispanic Black and Mexican American participants compared with non-Hispanic white participants, who lived farther away (median distance (interquartile range [IQR]) non-Hispanic black: 483 (215, 941) m; Mexican American: 426 (194, 833) m; non-Hispanic white: 577 (259, 1224) m). Furthermore, among those living within 100 m of a major road, traffic density, as measured by the Average Annual Daily Traffic was higher for non-Hispanic Black and Mexican American as compared with non-Hispanic white participants. Distance and traffic density measures were more similar by smoking status (eg, median distance: 481 (IQR 217, 973) m for never smokers compared to 433 (IQR 195, 938) m for current smokers).
Conclusion: These differences in traffic exposure may explain some of the observed health disparities in the United States.

PP-29-128

Environmental Justice in Regulatory Analysis: Potential Types of Policy and Analytical Questions and Applications of Resulting Information

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Background/Aims: To achieve environmental justice (EJ) as part of its mission, the United States Environmental Protection Agency is required by Executive Order (E.O.) 12898 to identify and address disproportionately high and adverse health and environmental impacts of its programs, policies, and activities on minority and low income populations. One such activity is regulatory development. Regulatory development is the process through which regulations such as acceptable ambient levels of contaminants or source specific emission standards are generated, and therefore represents the first line of public health action to prevent harmful exposures.
Methods: Until recently, "achieving environmental justice" as required in the E.O. was not an explicit goal of this process. For this reason, there is a general lack of institutional decision frameworks for achieving this overarching goal and analytical approaches to support the decision-making process. Given the language of the E.O., the obvious policy question is whether or not EPA's regulations have disproportionate impacts on minority and low income populations. However, to achieve EJ, which EPA suggests represents a state where everyone enjoys the same degree of protection from environmental hazards for the purpose of having a healthy environment, the policy questions, and therefore analytical questions can be broader, and more directly allow for the incorporation of issues of equity or inequality in overall and factor-specific risks into the regulatory development process. This interpretation imposes some difficulty on the process of identifying the appropriate policy questions within the traditional context of decisions made in the regulatory development process.
Results: This presentation describes key characteristics of a logic model for explicitly considering the attainment of EJ in the context of regulatory development decisions with emphasis on framing the policy questions to produce the appropriate answers.
Conclusion: This model can help assure that EJ analysis is purposeful and that the resulting data informs the regulatory decision.

PP-29-129

Why Have a Great Number of Residents in the Methylmercury-polluted Area Not Been Examined for Minamata Disease?

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Background/Aims: In Minamata, the mercury-contained water was drained for 36 years from 1932 to 1968. The population of the polluted area is about 500,000, but officially certified Minamata disease (MD) is

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only about 2265. In 1996, about 17,000 people were partially compensated but not certified as MD. After the Supreme Court judgment in 2004, 7500 residents have been applying for MD, and 25,000 residents have received partial compensation. In every opportunity of so-called "resolution policy," a great number of unexamined patients have been proved to present. We studied the cause of such silent people.

Methods: Subjects were 513 residents who received Minamata disease examination at our hospital or adjacent clinic from March to April 2005 and who permitted using their information. The average age was 60.3 ± 11.2 (36–90), with Male/female being 243/270. Histories of exposure, complaints were recorded and physical examination and tests were performed. Among them, 493 subjects (96%) had peripheral or systemic sensory disturbance. We performed the following 2 questionnaires with free entry method: Q1. Why have you never received MD examination? Q2. Why did you decide to receive Minamata disease examination this time? Authors classified answers into several categories and added up numbers of each category.

Results: Frequent answers for Q1 were discrimination (222, 43.3%), lack or deficiency of information (102, 19.9%), and changes by aging (53, 10.3%). Frequent answers for Q2 were health problem (253, 49.3%), consultation and information from others (124, 24.2%), and economical problems (119, 23.2%).

Conclusion: These results show that although most of the subjects had evident health problems, they could not even receive medical examination because of discrimination and lack of MD information. This data indicates the presence of (1) mental (psychological) suppression, (2) social suppression, and (3) medical (physical) suppression and interaction of these 3 factors. Methylmercury poisoning is easily suppressed by these complex factors.

MICROBIAL EXPOSURE AND HEALTH RISK

PP-29-161

Health Risk Assessment of Airborne Microbes in the Public Facilities

Yong-Jin Lee,[1] Soo-Hwaun Kim,[1] Hee-Jung Kim,[1] Seong-Hwan Kim,[2] Geum-Ran Ahn,[2] Seong-Ki Jang,[3] Myung-Hee Kwon,[3] and Young-Wook Lim[1] *[1]The Institute for Environmental Research, Yonsei University, Seoul, Republic of Korea; [2]Department of Microbiology and Institute of Basic Sciences, Dankook University, Cheonan, Republic of Korea; and [3]Air Quality Control Research Division, Climate and Air Quality Research Department, National Institute of Environmental Research, Incheon, Republic of Korea.*

Background/Aims: Exposures to airborne microbes in the public environment are associated with a range of health effects with major public health impact, including infectious diseases, acute toxic effects, allergies, and cancer.

Methods: To assess a health risk of exposure to microbes present indoor air of public facilities, we performed a questionnaire survey and measured the level of airborne microbes. Questionnaire was requested to a total of 319 users and staffs in 17 different types of public facility in Korea (library, museum, airport, child care center, hospital, bus terminal, the underground store, etc). The questionnaire included information on environment, demographics, and health status of the users and staffs plus conditions of the public facility. Measurement of airborne microbe concentration was done using Andersen samplers.

Results: Average concentration of airborne fungi was 347 CFU/ while that of airborne bacteria was 784 CFU/. Poisson regression model was used to evaluate relationships between exposure to airborne microbes and risk factors for rhinitis, asthma, and atopy dermatitis. The health risk of similar disease (rhinitis, asthma, atopy dermatitis) in concentration of up to 500 CFU/ for airborne fungi have been observed as risk 1.38 and concentration of 800 CFU/ for airborne bacteria have been observed as risk 0.89.

Conclusion: The complexity of carrying out similar studies highlights the need for establishing valid approaches that would contribute and add to our aerobiological, epidemiological, and clinical knowledge.

PP-29-162

Prevalence of *Legionella* Cooling Tower Water Contamination and *Legionella pneumophila* Antibodies Among Hotel Workers of Jiangsu, China

Hong Sun and Xiaodong Chen *Jiangsu Provincial CDC, Nanjing, People's Republic of China.*

Background/Aims: To determine the prevalence of *Legionella* spp. in the cooling tower (CT) water in Chinese Jiangsu hotels and evaluated their potential effects on the exposed population.

Methods: A total of 148 CTs were investigated and cultured for *Legionella* spp. Water samples (500 mL) from each CT was collected and measured the prevalence of *Legionella*. A total of 304 staffs worked in 2 hotels with only *Legionella pneumophila* serogroup 1 (*L. pneumophila* serogroup 1) contaminated CT and 270 staffs without exposure to CT were recruited, and their serum anti-*L. pneumophila* antibodies were examined, and a total of 200 urinal samples were collected for *L. pneumophila* serogroup 1 antigen.

Results: The prevalence of *Legionella* in the CT water was 75%, and *L. pneumophila* group 1 counts for 85.6%. The serum prevalence of anti-*L. pneumophila* group 1 antibodies in the exposed population was not significantly higher than unexposed subjects (OR = 1.05, $P = 0.865$). No *Legionella* urinary antigen was detected.

Conclusion: Working in *L. pneumophila* group 1 contaminated CT did not increased exposed risk to *L. pneumophila*. We should not pay too much attention to the role of the *Legionella* spp. polluted CT in the infection pathway of Legionnaires disease.

PP-29-163

Needlesticks and Nonreporting: A Review of Bloodborne Pathogen Exposure Among Healthcare Workers

Lara Kostun and David Goldsmith *The George Washington University School of Public Health and Health Services, Washington, DC.*

Background/Aims: This study reviewed current (1992–2008) literature on the occurrence of needlesticks and other sharps injuries among healthcare workers. Understanding the prevalence of bloodborne pathogen (BBP) exposure, incident reporting, and methods for reducing incidents will improve the health and safety of healthcare workers across the globe.

Methods: The authors reviewed articles relevant to sharps injuries and nonreporting of BBP exposures among healthcare workers. We compiled information on rates of needlesticks, other BBP exposures, nonreporting of incidents, and use of safety devices.

Results: Approximately 3 million healthcare workers worldwide sustain percutaneous injuries annually. Roughly 90,000 become infected with hepatitis B virus, hepatitis C virus, or HIV as a result. BBP exposure rates vary according to occupation with nurses sustaining the majority of sharps injuries. Injuries were most commonly caused by needlesticks, with hollow-bore needles causing the majority of such injuries. Two-thirds of injuries occurred after a device was used as intended. Several articles noted that safety devices, even when available, were not used or were used improperly. The use of safety devices could prevent at least 65% of percutaneous injuries. Estimates of incident reporting vary widely. A hospital study in Sweden found an overall reporting rate of 9%. In the United States, the CDC estimates only 43% of injuries are reported.

Conclusion: Despite legal safety requirements and widely available safety devices, needlesticks, and other percutaneous injuries remain highly prevalent among healthcare workers. Due to a low rate of exposure reporting, actual rates of sharps injuries are likely higher than estimated.

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Such low rates of reporting likely contribute to the decreased awareness of and attention to safety practices by both healthcare workers and healthcare facility administrators. Additional research is necessary to determine more accurate exposure estimates. In addition to increasing rates of exposure reporting, safety practices must be improved and widely implemented to reduce future BBP exposures.

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PP-29-209

Investigation of *Legionella pneumophila* Contamination in Cooling Water of Public Buildings in 4 Cities in China

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Abstract:

Background/Aims: *Legionella pneumophila*, the causative agent of Legionnaires' disease, is known to frequently grow in cooling water. Aims of this cross-sectional study were as follows:

Methods: Between the summer months of 2008 and 2009, the total bacterial counts and physical, chemical parameters of *L. pneumophila* in cooling water in 250 public buildings (office buildings, shopping malls, and hotels) of 4 cities were measured. Two hundred fifty water samples were taken from basin of towers. Temperature, pH, residual chlorine in water, and illuminance, ultraviolet intensity around towers were measured in the field. *L. pneumophila*, water turbidity, electric conductivity, total dissolved solid, and total bacterial counts were measured in the laboratory. Cooling tower treatments of 250 public buildings were also investigated by face-to-face interviews.

Results: The samples of 186 (74.4%) cooling water of public buildings were *L. pneumophila*-positive, and LP1 was the commonest. Of the towers, 177 (70.8%) towers were on treatment with biocide, and 154 (61.8%) with water quality testing. Treatment with biocide and basin of towers exposed to sunlight showed correlation with *L. pneumophila* colonization.

Conclusion: In conclusion, public buildings in 4 cities in China represent a source of risk for Legionnaires' disease due to the high frequency of *L. pneumophila* contamination. Effective measures should be developed to manage and inspect the cooling towers in China.

1. To understand the current contaminated situation of *L. pneumophila* in cooling water of public buildings and compare our results with other studies.
2. To describe the status of towers treatment.
3. To understand the risk factors for *L. pneumophila* colonization.

NANOTECHNOLOGY AND HEALTH

PP-29-164

Is Health Risk Due to Nanoparticles Unusually Great and Are They Really Ignored by Physiological Defense Mechanisms?

Sergey Kuzmin,[1] Boris Katsnelson,[1] Larisa Privalova,[1] Marina Sutunkova,[1] Olga Yeremenko,[1] Mark Khodos,[2] and Vladimir Shur[3] *[1]Medical Research Center for Prophylaxis and Health Protection in Industrial Workers, Ekaterinburg, Russian Federation; [2]Ural State Economic University, Ekaterinburg, Russian Federation; and [3]Ural State University, Ekaterinburg, Russian Federation.*

Background/Aims: Ultrafine particles in the ambient air and their counterpart—engineered nanoparticles (NP) constitute one of the "hot spots" of the modern environmental research due to their presumably very high toxicity. It is true however that "this common perception of greater NP toxicity is based on a limited number of studies" (Warheit et al, 2009). Even less unequivocally proved is the widespread concept of quasi-defenselessness of mammals against NPs due to alleged inability of physiological defenses to recognize and deal with NP.

Methods: We used 3 batches of Fe_3O_4 particles of sizes 10 nm, 50 nm, and 1 μm, respectively. Aqueous suspensions were prepared with the help of ultrasonication and instilled intratracheally into the lungs of rats in a 2-mg dose in 1 mL sterile distilled water. After 24 hours, lungs were lavaged, the cells in the obtained fluid were counted, centrifuged, and studied by optical and semicontact atomic force microscopy.

Results: The phagocytic activity of alveolar macrophages and neutrophil leucocytes was demonstrated with a high count of particles within cells and of micropits on the cell surface visualized by semicontact atomic force microscopy. Both methods proved phagocytes to be much more (particle-loaded) in the lungs instilled with 10 nm particles as compared with those instilled with 50 nm particles, NPs of both sizes being engulfed more avidly than microparticles. Judging by neutrophil leucocytes/alveolar macrophages ratio, NPs (and especially 10 nm ones) are much more toxic as compared with 1 μm particles. However, 10 nm NPs are eliminated from lungs most rapidly due to both more active phagocytosis and faster solubilization.

Conclusion: Although the intrinsic bio-aggressiveness of NPs can be much higher than that of the same substance in micrometric particles, the scale of comparative pulmonotoxicity of different NPs depends on complex interaction between their primary impact and activity of pulmonary clearance mechanisms, this activity being far from negligible.

PP-29-165

The Pilot Study of Specific Biomarkers in Health Effects Among Engineered Nanoparticles Manufacturing Workers

Saou-Hsing Liou,[1] Ming-Hsiu Lin,[2] Ching-Hui Hsu,[2] Cuei-Jyun Tsou,[1] Hui-Ling Li,[1] Wan-Fen Li,[1] Pin-Pin Lin,[1] and Li-An Li[1] *[1]National Health Research Institutes, Miaoli county, Taiwan; and [2]Institute of Occupational Safety and Health, Taipei county, Taiwan.*

Background/Aims: Nanotechnology is being promoted rapidly. Although the industrial applications of nanomaterials are increasing daily, in vitro and animal in vivo studies have suggested nanoparticles may cause damage to cellular organelles, lung fibrosis, and granuloma through their ability to trigger the production of reactive oxygen species. However, limited epidemiologic study has been conducted to investigate the potential health effects in the industrial workers. The aim of this pilot study is to develop and identify sensitive and specific markers instead of investigation of health effects of nanoparticles exposure in manufacturing workers from cross-sectional and longitudinal design.

Methods: This study conducted by using cross-sectional designs. We recruited 135 nanoparticle-exposed workers and 56 nonexposed workers from 13 plants in Taiwan. The biomarkers investigated include the following: (1) pulmonary inflammation markers, (2) cardiovascular disease markers, (3) genotoxicity comet assay, (4) oxidative stress markers, and (5) activity and polymorphism of antioxidant enzymes.

Results: Most of exposed workers were male (84.2%) with the average of 35 years old. Of total, 79% of study subjects were graduated from university and only few had smoking (15.8%) or drinking habits (7.9%). The Clara cell protein (CC16 and NF-kB level (inflammation markers); the activity of MPO and aryl esterase (antioxidant markers); vascular cell adhesion molecule (VCAM) and Low frequency (LF); HF and LF/HF in frequency domain of heart rate variability (HRV) (cardiovascular markers) and FEV1, MMF, FEF50%, and FEF75% in pulmonary function test, and cortisol, aldosterone, and testosterone hormone levels showed higher values in the exposed workers than the nonexposed controls, either in cross-sectional study or in longitudinal repeated measurements study. No significant difference in oxidative damage, comet assay, and cardiovascular markers was found after adjusting for potential

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confounders. Control Banding from Nanotool Risk Level Matrix was adopted to categorize the exposure risk levels. CC16 and high-sensitive c-reactive protein (CRP) (hsCRP) were significantly increased in risk level (RL) 2 and RL3 and doses dependent. LF in HRV and VCAM were also marginally significantly increased in RL3, but not doses dependent.

Conclusion: Biomarkers of small airway damage (CC16) and inflammation (hsCRP) as well as biomarkers of injuries to endothelium (VCAM) and sympathetic nerve activation (LF in HRV) may also be served as health effect markers of nanoparticles exposure. These cardiopulmonary injuries markers may be used for surveillance of health effects of nanoparticles exposure.

PP-29-166

Rapid Nanotoxicity Screening Approach of AgNPs Using Negative-charged Vesicle

Sun Hee Jee, So Hyang Shin, and Younghun Kim *Department of Chemical Engineering, Kwangwoon University, Seoul, Republic of Korea.*

Background/Aims: Silver nanoparticle (AgNP), one of commercialized nanomaterials, has received considerable attention in recent years, due to the potential toxicity to the environment and human. To investigate their potential nanotoxicity, OECD members are co-worked in fields of study; material characterization, environmental fate, risk assessment, environmental and mammalian toxicology, and material safety. Especially, in vivo and in vitro cytotoxicity results are increasingly being published.

Methods: However, cytotoxicity studies of nanoparticles included different testing conditions, such as particle concentration, exposure times, and cell-lines. Therefore, it is difficult to determine rapidly whether the cytotoxicity reported is physiologically relevant. Herein, we proposed alternative rapid screening methodology of AgNPs' nanotoxicity, using biomimetic cell-membrane (negative phospholipid vesicle).

Results: When the naked and coated (citrate) AgNP are inserted into the vesicle immobilized gold-chip of SPR instrument, we can in situ detect the cell-membrane penetration of AgNPs, which was confirmed by SPR's angle shift and TEM analysis.

Conclusion: This different feature was due to the surface charge interaction between negative charge of vesicle and positive charge of naked AgNP, while citrate-coated AgNP has negative charge (COO−).

PP-29-167

Exposure Assessment of Silver Nanomaterials in Workplaces

Jinkyu Roh,[1] Sun Hee Jee,[1] Bum Jin Park,[1] Cheon Seok Oh,[1] Younghun Kim,[1] Junsu Park,[2] Jongheop Yi,[2] Byung-Cheon Lee,[3] and Kyunghee Choi[3] *[1]Department of Chemical Engineering, Kwangwoon University, Seoul, Republic of Korea; [2]School of Chemical and Biological Engineering, Seoul National University, Seoul, Republic of Korea; and [3]National Institute of Environmental Research, Incheon, Republic of Korea.*

Background/Aims: Recently, numerous processes for the production of nanomaterials have been developed. With the increasing use of engineered nanomaterials, it is expected to increase the occupational exposures to nanomaterials in the workplace. The exposed nanomaterials may enter and accumulate in our body, potentially causing injury or death to humans. Especially, workers can be directly exposed to nanomaterials for a long time.

Methods: However, the researches on the exposure assessment of nanomaterials to human and environment are just beginning step. Therefore, exposure assessment based on the real-time monitoring of exposed nanoparticle is one of the critical issues for EHS (environment, health, and safety).

Results: In this study, exposure assessment of silver nanoparticles (AgNPs) in the workplaces was performed. AgNPs was generally synthesized by sol-gel chemistry (colloid AgNPs) or plasma explosion method (powder AgNPs). Sampling of exposed nanomaterials was conducted with SMPS (Scanning Mobility Particle Sizer) and auto-sampler, ESP (Electrostatic Precipitator). The collected samples were analyzed by TEM (Transmission Electron Microscope) for size, morphology, and agglomeration conditions.

Conclusion: In the results, the nanoparticle concentrations in the air during the processing step were higher than those of normal conditions.

PP-29-168

Development of Guidance for Safe Management of Nanomaterials in Workplaces

Jinkyu Roh,[1] Sun Hee Jee,[1] Bum Jin Park,[1] Cheon Seok Oh,[1] Younghun Kim,[1] Junsu Park,[2] Jongheop Yi,[2] Byung-Cheon Lee,[3] and Kyunghee Choi[3] *[1]Department of Chemical Engineering, Kwangwoon University, Seoul, Republic of Korea; [2]School of Chemical and Biological Engineering, Seoul National University, Seoul, Republic of Korea; and [3]National Institute of Environmental Research, Incheon, Republic of Korea.*

Background/Aims: With the rapid growth of nanotechnology, various nanomaterials are being produced and many researches are focused on novel synthesis methods and shape control of nanoparticles. However, EHS (environmental, health, and safety) risks of nanoparticles have recently emerged, and thus, it is expected that nanoparticles are released into environment, where their fate and behavior are largely unknown. To investigate their potential nanotoxicity, OECD members are co-worked in fields of study; material characterization, environmental fate, risk assessment, environmental and mammalian toxicology, and material safety. However, the researches on the development of guidance for safe management of nanomaterials in workplaces are just a beginning step, and many OECD member are trying to develop the standard occupational protocol (SOP) for the protection of workers who handle nanomaterials.

Methods: Therefore, herein, we try to establish the occupational safety guidelines in the workplace, especially producing and handling nanomaterials, based on the monitoring and survey data for 4 different industrial facilities which produced nanomaterials, such as silver, titania, and so on.

Results: Based on the measured exposure data with SMPS (scanning mobility particle sizer), we investigated the possibility of potential exposure of nanomaterials at workplace.

Conclusion: In this guidance, we represented on the expose level, toxicity level, and health risk level as guideline.

PP-29-169

Rapid and Reversible Preparation of Citrated-stabilized Silver Nanoplates and Its Nanotoxicity

Jinkyu Roh and Younghun Kim *Department of Chemical Engineering, Kwangwoon University, Seoul, Republic of Korea.*

Background/Aims: The use of engineered nanoparticles poses a risk to both human health and the environment. Engineered nanoparticles are readily released into the atmosphere similar to other pollutants, and then, these nanoparticles induce hazardous effects on bio-organisms by penetration into the cell membrane.

Methods: We tested nanotoxicity of as-made silver nanoplates with rat. First, citrate-stabilized silver nanoplates (AgNPs) were prepared via a seed-mediated method without surfactants, such as cetyltrimethylammonium bromide (CTAB), in a short amount of time (15 minutes).

Results: Silver seeds with 3–4 nm in diameter were added to a growth solution containing AgNO3, trisodium citrate (TSC), and L-ascorbic acid (AA). The size of the AgNPs depended on the concentration of the silver

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seed and TSC. The physical properties of the AgNPs were analyzed by transmission electron microscopy (TEM) and by an ultraviolet-visible (UV-vis) spectrophotometer.

Conclusion: In addition, the spleens of the AgNP-treated rats after 24 hours showed splenomegaly and cellular tissue damage, which meant that the function of the spleen was compromised when compared with the control group. AgNPs induced inflammation and white spots on the surface of the spleen.

PP-29-170

A New Test Method Development for Number Concentration Measurement of Particles Generated by Laser Printer.

Kyung-Hwan Lee, Sun-Man Kim, Ha-Kyu Jung, and Kang-Ho Ahn *Hanyang University, Ansan, Republic of Korea.*

Background/Aims: As the indoor activity increases, the indoor air quality gains more attention. It has been well known that the office printers and/or copiers generate nanoparticles. The adverse effect of nanoparticles to human body is being studied by many researchers. To evaluate the emission rate of nanoparticles from laser printers, the mass concentration measurement method has been used (BAM, 2004). However, the mass concentration measurement method for nanoparticles generated by office machine is tedious and time consuming. Therefore, we developed a number concentration measurement method to evaluate the nanoparticle emission rate from laser printers and copiers.

Methods: The experiments were performed in a chamber with an interior volume of 1 m^3 which meets the requirements of DINEN ISO 16000–9 (2006). A test aerosol is injected in the test chamber and mixed with mixers. At the outlet of the chamber, the particles are sampled by a sampling probe and measured with condensation particle counter to verify the mixing performance of the mixer.

Results: At the exit of the test chamber, several different types of mixers are located for good mixing. We compared the theoretical particle concentration and the sampled particle concentration. At the high air exchange rate, the mixing of particles was not satisfactory. However, at a certain condition the theoretical particle concentration and that of experimental value was in good agreement.

Conclusion: The sampling efficiency of particles between theoretical value and experimental value was changed as the air exchanges of a chamber changes. There was an optimum sampling conditions as the test chamber volume and the air exchange rate changes for particle number concentration measurement.

NOISE AND HEALTH

PP-29-173

The Associations Between Urban Traffic Emissions on Myocardial Infarction Risk

Vilija Malinauskiene and Ada Azaraviciene *Institute of Cardiology, Kaunas University of Medicine, Kaunas, Lithuania.*

Background/Aims: Traffic-related environmental exposures are described as noise and nitrogen dioxide air pollution. Recent studies related to the impact on myocardial infarction show a slight increased risk. The aim of our study was to assess the association between urban traffic noise at the residential area and myocardial infarction risk, controlling traffic-related air pollutant—nitrogen dioxide.

Methods: We conducted a population-based case-control study among men aged 25–64 years in a general population of Kaunas city. The study comprised 1042 cases—patients survived after first myocardial infarction. Control group included 2341 patients without ischemic heart disease signs. We measured traffic-related noise levels at the 117 electoral districts and linked these levels with residential addresses using Geographical Information System techniques. In daytime period (10–12 hours, 10 min), traffic-related noise emission fluctuated between 58 dB(A) and 82 dB(A), and about 18% of citizens were exposed to noise level exceeding 65 dB(A) in their residential district. We used SPSS version 13.0 for data analysis.

Results: The study results showed that after adjustment for age, smoking, blood pressure, body mass index, stress status, and subjective noise annoyance, the risk of myocardial infarction was higher for the men exposed to 70–75 dBA (odds ratio [OR] = 1.17, 95% confidence interval [CI]: 0.99–1.39) and to >75 dBA (OR = 1.30, 95% CI: 0.88–1.92) noise levels in the residential areas. OR for continuous exposure parameter was 1.16, 95% CI: 1.00–1.39. Among subgroup aged 55–64 years, the excess risk to myocardial infarction was found to be higher (OR = 1.28, 95% CI: 0.98–1.65) and 1.70, 95% CI: 1.01–2.93 in moderate and high noise exposure area, respectively. After additional adjustment to nitrogen dioxide, OR for men aged 25–64 years was 1.05 and 1.16, and for men aged 55–64 years it was 1.05 and 1.39, correspondingly.

Conclusion: Our results indicate a relationship between traffic noise exposure and risk of myocardial infarction. Exposure to nitrogen dioxide shows mediating effect.

PP-29-174

The Research of Hearing Loss in Polyester Fiber Workers

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Background/Aims: Noise problems received respect gradually in working places and one of high prevalent occupational diseases was noise hearing loss. If it proceeded precautions beforehand and carried out Hearing Conservation Program certainly, noise-induced hearing loss could be prevented. The cross-sectional study measured the noise in working places and compared by questionnaires.

Methods: The study measured a polyester fiber factory and workers who were 89 exposed subjects and administrators were 38 nonexposed subjects. The working places were estimated using the environmental noise spectrum analysis (LD-824). The personal noise exposure level was estimated using noise-dosimeter and the pure tone audiometry by OSCILLA SM910. According to the gauge sequence surveyed it.

Results: The result was that Leq = 89.4 ± 2.6 dB(A) was higher in working places by exposed group. It was more evident high than administrators nonexposed group, which Leq = 60.8 ± 5.6 dB(A). Bilateral hearing thresholds compared that result found left ears (37.0 ± 16.5 dB(A)) vs. right ears (36.8 ± 15.4 dB(A)) with a dip at 4 kHz. In a multivariate logistic model, the high frequency trisection odds ratio was 3.2 (95% confidence interval [CI]: = 1.3–7.8), 6–10 years Odds Ratio = 3.4 (95% CI: = 1.1–10.5), and over 11 years Odds Ratio = 3.9 (95% CI: = 1.4–10.6) by exposed group. To accompany increasing seniority, hearing loss was more serious.

Conclusion: Personal noise levels were over occupational noise exposure standard 85 dB(A) by workers. In all, 77.5% workers used ear plugs but 22.5% did not use. The factory should notice workers who used ear plugs truly or not. The employer should avoid hearing loss to ensure health for workers.

PP-29-175

Assessment of Combined Effects From Exposure to Cold Stress, Hand-arm Vibration and Noise

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Health, Chung Hwa University of Medical Technology, Tainan, Taiwan; [4]Institute of Occupational Safety and Health, Council of Labor Affairs, Taipei, Taiwan; and [5]Department of Occupational Safety and Health, Chang Jung Christian University, Tainan, Taiwan.

Background/Aims: The aim of this study conducted in a climatic chamber was to evaluate the combined effects of exposure to cold stress, noise, and hand-arm vibration on noise-induced temporary threshold shift, manual dexterity, and blood pressure by adopting Taguchi method.

Methods: A total of 23 healthy volunteers without previous significant noise exposure and smoking history were recruited to participate in this study. All hearing threshold levels at 8 different frequencies (250–8000 Hz) of better ear were measured in an audiometric booth by using the ascending method in 5 dB steps. Dexterity, blood pressure, and heart rate were also measured by Purdue Pegboard test and Crown PM-9000, respectively.

Results: The result shows that hearing loss is mainly induced by noise exposure, and was also enhanced by low temperature exposure and hand-arm vibration. The hand-skin temperature, manual dexterity, and mean arterial pressure were affected by exposure to cold environment, and related health effect was increasing with exposure period. No significant difference was observed both on blood pressure and heart rate in this study.

Conclusion: In conclusion, further investigation of the combined effects on workers by co-exposure to various hazards is needed. The implement of occupational hazard exposure administration is important for prevention of occupation diseases and health promotion of workers.

PP-29-176

Effects of Noise Exposure at Different Frequencies on Hearing Loss in Workers

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Background/Aims: Previous studies have demonstrated that exposure to occupational noise is associated with the hearing loss at high frequencies, but the relationship at different frequencies of noise levels is still unclear. The present study aimed to investigate effects of occupational noise exposure at different frequencies on hearing loss.

Methods: We recruited 199 volunteers working in a screw manufacturing company during 2009. The octave frequency analyzer was used to measure noise levels at different frequencies. A pure tone audiometer was applied to test 147 subjects in the product line. The control group comprised 52 office workers. Multivariate logistic regressions were conducted to estimate the risk of hearing loss by noise exposure at different frequencies.

Results: We found that 98 high-noise-exposure workers (83.8 ± 2.3 dBA; 25.5%) and 49 low-noise-exposure workers (75.0 ± 1.9 dBA; 20.4%) had significantly the higher prevalence rates of hearing loss than the office workers (64.5 ± 6.4 dBA; 3.9%). Only the high-noise-exposure group had the significantly higher risk of hearing loss (OR = 5.05, 95% CI = 1.01–25.31) compared with the control group. The increased risk of hearing loss were significantly associated with noise exposure ≥70 dBA at frequencies of 2 k (OR = 6.60, 95% CI = 1.28–34.18), 4 k (OR = 5.35, 95% CI = 1.07–26.85), and 8 k (OR = 5.83, 95% CI = 1.18–28.89), but were not significant at 125, 250, 500, and 1 kHz.

Conclusion: Exposure to noise levels >80 dBA associated with the hearing loss and noise exposure at 2 kHz may have the greatest effect on the hearing impairment.

PP-29-177

Effects of Noise Exposure at Different Frequencies on Hypertension in Workers

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Background/Aims: Exposure to noise has been demonstrated to associate with hypertension, but the relationship at different frequencies of noise levels is still unclear. The present study aimed to investigate effects of occupational noise exposure at different frequencies on hypertension in 199 screw-manufacturing workers.

Methods: Participants were divided into a high-noise-exposure group (n = 98; 83.8 ± 2.3 dBA), a median-noise-exposure group (n = 27; 76.7 ± 0.9 dBA) and a low-noise-exposure group (n = 22; 73.1 ± 0.0 dBA) based on the measurements by using an octave-band analyzer. The control group comprised 52 office workers. Multivariate logistic regressions were conducted to estimate the risk of hypertension by noise exposure at different frequencies.

Results: There were no significant differences in the risk of hypertension between the 3 exposure groups and the control group. Workers exposed to noise levels >80 dBA during 2–4 years (OR = 7.0; 95% CI = 1.77–27.4), 4–6 years (OR = 3.8; 95% CI = 0.84–17.2), and over 6 years (OR = 2.0; 95% CI = 0.42–9.62) had the higher risk of hypertension compared with the reference group. Such inverse V-shaped associations were significantly observed in workers exposed to noise levels >60 dBA at frequencies of 0.25 kHz and 0.50 kHz as well as those exposed to >70 dBA at frequencies of 1, 2, 4, and 8 kHz, respectively.

Conclusion: Exposure to noise levels >80 dBA during 2–4 years may be associated with the hypertension and noise exposure at 4 kHz may have the greatest effect on hypertension.

PP-29-179

Does Traffic Noise Explain the Association of Residential Proximity to Traffic With Coronary Artery Calcification?

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Background/Aims: Residential proximity to high traffic, a major source of noise and fine particle exposure, has been linked to atherosclerosis. We investigate whether the association of traffic proximity and coronary atherosclerosis can be explained by chronic traffic noise exposure.

Methods: We used baseline data (2000–2003) from the Heinz Nixdorf Recall-Study, a population-based cohort of 4814 participants living in 3 cities in Germany. We calculated the distances between participants′ home address and federal and state highways. For long-term traffic noise exposure, we used categorical noise map values (according to the EU-directive; 2002/49/EC) and assigned these to the participants′ home addresses. Main outcome was coronary artery calcification (CAC) measured by electron-beam computed tomography. We used multiple linear regression to investigate the association of exposure to traffic noise with CAC, controlling for gender, age, education, occupation, smoking, waist-hip ratio, physical activity, LDL, statins, urban background $PM_{2.5}$, and city.

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Results: Distance to federal and state highways and exposure to traffic noise were only weakly correlated in this urban setting ($r = 0.3$).

No consistent association was observed for weighted daily mean or night-time traffic noise exposure with CAC (N = 4249). We estimated CAC to be 3.2% higher (95% CI: 26.0–43.9) for the highest traffic noise category (weighted daily mean > 70 dB; n = 192) compared with the reference group. When noise was included in the model for distance to major roads, the estimate for distance and CAC did not change substantially (without noise: 12.3% increase [95% CI: 2–21.5] in CAC for a reduction of the distance by half; including noise in the model: 14.5% [95% CI: 3.7–24.1]).

Conclusion: With our current traffic noise exposure data, we were unable to show the effect of traffic noise on the biological variability of CAC. Further analyses including residential characteristics and investigation of more refined noise exposure data are necessary.

PP-29-180

Subjective Annoyance From Exposure to Low Frequency Noise of Semiconductor Manufacturing in the Packaging and Testing Processes

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Background/Aims: Subjective annoyance from exposure to low frequency noise is more prevalent because of bulk machine or facility installation in indoor acoustic quality assessment. The purpose of this study is to propose criteria for the judgment of low frequency noise annoyance in the integrated circuit industry on the basis of RC Mark II noise rating by octave-band frequency analysis.

Methods: On-site survey of octave-band frequency in the range of 1–16,000 Hz was measured by sound analyzer according to the locations of workers' complaint. All these data were used to figure out A-weighted; C-weighted sound pressure levels (20–20,000 Hz); room criteria; and sound pressure of LF (16–63 Hz), MF (125–500 Hz), and HF (1000–4000 Hz).

Results: The difference between C-weighted and A-weighted sound pressure levels greater than 8 dB and low frequency noise (its spectrum in 16–63 Hz) above 65 dB indicated significantly subjective annoyance of exposed worker.

Conclusion: In this study, the following criteria were proposed to find the source of workers' annoyance caused by exposure to low-frequency noise.

1. C-weighted sound pressure level is 10 dB greater than A-weighted sound pressure level.
2. Noise in the low frequency range (16–63 Hz) is greater than 65 dB.
3. LF ≥ MF ≥ HF.

PP-29-181

Relationship Between Aircraft Noise Exposure and Depression, Anxiety, Stress in Korea

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Background/Aims: Although there have been many studies on health effects of nocturnal traffic noise, studies on the relationship between aircraft noise and mental health are limited. This study was aimed to evaluate the dose-response relationship between degree of Gunsan airfield noise and mental health.

Methods: Drawing up a noise map was done by following integrated noise model, considering daylight and night flying, and takeoff and turnaround, and also revision and verification were conducted. On the basis of noise map, the neighboring regions of Gunsan airfield were divided into the following 3 groups: the high exposed group with 80 weighted equivalent continuous perceived noise level (WECPNL) or more, low exposed group below 80 WECPNL and above 60 WECPNL, and control group below 60 WECPNL. A total of 1082 individuals aged 30–79 years participated in a comprehensive self-administrated questionnaire, requesting information on demographics, medical history, lifestyle, and depression anxiety stress scale. Of them, 1027 subjects were analyzed, excluding 55 inappropriate targets.

Results: The prevalence of depression, anxiety, and stress was increased by degree of noise exposure (P for trend <0.05). After adjusting for sex, the high-exposed group was found to have an elevated risk of depression (OR, 1.96), anxiety (OR, 4.18), and stress (OR, 3.85).

Conclusion: The aircraft noise seems to be related to mental illness such as depression, anxiety, and stress. Further evaluations are needed to verify the relationship between aircraft noise and mental health through a large-scale follow-up study.

PP-29-182

A Study on the Noise Exposure and Hearing Loss of the Workers in Cable Manufacture

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Background/Aims: The purpose of this study is to explore the current situation of noise exposure, and the noise effect to the hearing of the cable manufacture workers.

Methods: This investigation includes the measurement of sound level in the workplace, personal noise dose, and hearing threshold of the workers, and questionnaire. The study included 241 workers of 2 cable factories. The exposure group includes 27 workers in packing section, 33 workers in copper wire drawing section, 43 workers in copper plating section, and 56 workers in tin-plating section, and 82 administrative staffs for the control group. Noise exposure group has 150 males and 9 females, and control group has 27 males and 55 females.

Results: The measurement of environmental sound levels shows the average equivalent energy sound level (Leq) is respectively 92.3 dB-A of packing section, 87.0 dB-A of copper wire drawing section, 85.3 dB-A of copper plating section, 81.3 dB-A of tin plating section, and 59.4 dB-A of office. The personal noise dose (8-hour) averages of workers in the packing and copper wire drawing section are respectively 86.7% and 53.1%, they are the 2 most exposed sections and both go past the standard in Taiwan which the personal protective equipment and engineering improvement need to be provided. However, almost workers do not wear any hearing protectors in the sampling periods. To compare with the hearing threshold measured and the corresponding values of Taiwan's healthy people, it represents obviously raising hearing threshold in low frequency range. In particular, the workers in the copper wire drawing and copper plating sections are more significant. Moreover, in high frequency range, the workers in the packing and copper wire drawing sections show the more threshold shift.

Conclusion: The sound level of exposure group is much higher than that of control group. Overall, the exposure group shows more abnormal hearing than that of control group. Besides the packing section workers in exposure group have higher abnormal hearing rate, and the workers in the copper wire drawing sections are the next.

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PP-29-183

Relationship Between Aircraft Noise Exposure and Sleep Quality in Korea

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Background/Aims: There have been several studies on the relationship between noise and sleep disorder, but the results vary. This study was aimed to calculate the prevalence of poor sleep and evaluate the relationship between degree of Gunsan airfield noise and sleep quality.

Methods: Drawing up a noise map was done by following integrated noise model, considering daylight and night flying, and takeoff and turnaround, and also revision and verification were conducted. On the basis of noise map, the neighboring regions of Gunsan airfield were divided into 3 groups: the high exposed group with 80 weighted equivalent continuous perceived noise level (WECPNL) or more, low exposed group below 80 WECPNL and above 60 WECPNL, and control group below 60 WECPNL. A total of 1082 individuals aged 30 to 79 years participated in a comprehensive self-administrated questionnaire, requesting information on demographics, medical history, lifestyle, Pittsburgh Sleep Quality Index. Among 1082 individuals, 1005 subjects were analyzed excluding 77 inappropriate targets. According to the Pittsburgh Sleep Quality Index score, subjects were divided into 2 groups of good sleep and poor sleep.

Results: The prevalence of poor sleep was 45.5% in the control group, 71.8% in low exposed group, and 77.1% in high exposed group, illustrating the increases by the noise exposure levels (P for trend <0.001). After adjusting for potential confounding factors, multiple logistic regression analysis was conducted. The prevalence of poor sleep was 2.96 and 4.0 times higher in low- and high-exposed group, respectively, than the control group.

Conclusion: We observed dose-response relationship between degree of the aircraft noise and sleep quality. Further evaluations are needed to verify the relationship between aircraft noise and health through a large-scale follow-up study.

PP-29-184

Influence of Nutrition on the Association Between Occupational Noise Exposures and Hearing Impairment in the US General Population

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Background/Aims: Recently, we have shown a dose-dependent elevation of hearing thresholds across the occupational noise levels in the US general population. Numerous animal studies suggest that dietary antioxidants (vitamins C and E) and other micronutrients (folate and vitamin B12) may play an important role in the pathogenesis of auditory disorders. We investigated potential modifying effects of dietary antioxidants and B-vitamins in the association with occupational noise and hearing loss.

Methods: We examined 3922 adults from the National Health and Nutrition Examination Survey (NHANES) 1999–2004, a representative sample of the US general population. Occupational noise score was assessed by utilizing the O*NET (Occupational Information Network) exposure database (scored as 1–5) across numerous occupations. Air-conduction hearing threshold was computed as a pure-tone average (PTA) of 0.5, 1, 2, and 4 kHz and log-transformed. Quantitative dietary intake data were obtained by means of a 24-hour dietary recall interview. Linear regression models accounting for the complex sampling design were fit with interaction terms between occupational noise and quintiles of each dietary variable, adjusting for potential confounding factors including sociodemographic/clinical risk factors and nonoccupational noise exposures.

Results: The mean of occupational noise score was 3.08 (SD: 0.02). An interquartile range increase in occupational noise score (0.91) was associated with a 10.12% (95% CI: 6.52–13.83) elevation of PTA. We found a statistically significant interaction between occupational noise score and intake of vitamin C on PTA (P for trend = 0.02). The lowest quintile of vitamin C group had a statistically significant elevation of PTA in relation to occupational noise (percent change = 15.92% [95% CI: 6.15–26.58]), whereas the highest quintile group had no association between occupational noise and PTA. No effect modification by other dietary factors was observed.

Conclusion: This study suggests that higher intake of vitamin C may mitigate a harmful effect of occupational noise on hearing loss.

PP-29-185

Aircraft Noise Exposure and Its Effects on Quality of Life and Cognitive Function Among Thai Residents

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Background/Aims: Noise exposure is considered an essential part of daily living for human. However, excessive and prolonged exposure to noise could lead to several adverse health effects. To assess the association between aircraft noise exposure and health effects, we conducted a follow-up study around 2 international airports in Bangkok.

Methods: Data were collected 2 times to compare noise exposure and health effects before and after Don Muang International Airport closure and the opening of Suvarnabhumi International Airport. Study subjects consisted of 332 residents and 284 fourth grade primary school students from the Suvarnabhumi and Don Muang areas. Noise was recorded by an integrating sound level meter which was calibrated and set to record noise every 2 seconds for a period of 24 hours. World Health Organization's quality of life (QOL) and General Health (GHQ-28 Thai version) questionnaires were used to evaluate QOL and subjective health while short- and long-term memories of the children were assessed.

Results: Results showed that Leq,day ranged from 41.0–51.0 and 53–74.1 dB(A) prior to and after Suvarnabhumi Airport opening. Meanwhile, Leq,day ranged from 63.9–74.7 and 54.2–66.4 dB(A) prior to and after Don Muang Airport closure. Residents living around Don Muang Airport had lower QOL scores than those around Suvarnabhumi Airport without statistical significance. At 1-year follow-up, the prevalence of GHQ caseness around Suvarnabhumi Airport was 39.42% (95% CI: 33.21–45.63) which was statistically higher than that of Don Muang area; 17.61% (95% CI: 11.93–23.30). Short-term memory scores of students studying around Suvarnabhumi Airport increased significantly but long-term memory scores remained unchanged. However, long-term memory scores of children in Don Muang area increased significantly after airport closure.

Conclusion: This study suggested that aircraft noise could affect well-being of residents and cognitive function of children living around airport and long-term health surveillance should be initiated.

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PP-29-186

The Effect of Vibration Reduction on the Anti-vibration Gloves Made of Different Materials

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Background/Aims: Hand-transmitted vibration contributes to injury of the vascular, neurological, and musculoskeletal systems and is harmful for job performance of workers.

In a survey of impact wrench users working in a Korean automobile assembly line, all workers did not use anti-vibration gloves at work. Of them, 70% had not experienced anti-vibration gloves; and 83.3% of the workers usually used a cotton glove, a rubber-coated cotton glove, and combination of cotton and rubber coating gloves instead of anti-vibration glove.

The aim of this paper is to evaluate the suitability of anti-vibration gloves, cotton glove, and rubber-coated glove by using, on the basis of vibration transmissibility in accordance with International Organization for Standardization (ISO) 10819, and to examine the effect of vibration reduction on the anti-vibration gloves made of different materials.

Methods: This study targeted 24 anti-vibration gloves, 4 types of a cotton glove, a rubber-coated glove, and combination of cotton and rubber coating gloves.

This paper uses 2 ISO standards for the measurement and evaluation of hand-arm vibration. Some anti-vibration gloves can attenuate vibration, but all the anti-vibration gloves in this study do not satisfy the ISO 10819 requirements. In case of equal vibration types, the outside materials are effective in order of leather, fabrics, and rubber-coating, according to the ISO 5349 standard.

Results: As a result of frequency analysis, the most effective material for vibration attenuation are sponge at 10 Hz or below. Rubber material is effective at 100 Hz or upper. The most effective material for vibration attenuation is gel, sponge, and rubber at whole frequency range.

Conclusion: In case of wearing the gloves, the vibration peak fell down from twice to 8 times, so workers can use vibration tools for more than 8 hours.

TEACHING AND TRAINING ENVIRONMENTAL/OCCUPATIONAL EPIDEMIOLOGY AND EXPOSURE SCIENCE

PP-29-187

Long-term Effect of Multifactor Transfer, Lifting, and Repositioning Intervention Program Among Health Care Workers

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Background/Aims: Various injury prevention programs have shown effectiveness in reducing back pain and musculoskeletal injuries among health care workers. However, little is known about the long-term effect of those intervention programs. The objective of this study was to evaluate the long-term effect of a multifactor Transfer, Lifting, and Repositioning (TLR) intervention program on musculoskeletal injuries among health care workers.

Methods: This was a retrospective, TLR intervention study with a nonrandomized control group. Data were collected from 6 hospitals in 2 Health Regions in Saskatchewan, Canada from 1 September 2001 to 1 December 2006. Logistic regression analyses were performed to estimate the odds ratio and 95% confidence interval.

Results: A total of 1953 injury cases from 1471 individuals (n = 983 for the intervention and n = 970 for the control) occurred during the study period. Most of them were females and 75% were nurses. A number of subsequent, repeated injuries were 149 (15.3%) and 114 (11.5%) individuals for the control and the intervention groups, respectively. The medium- and small-sized hospitals of the intervention group had significantly less repeated injuries than the control group ($P = 0.001$ and 0.002, respectively). RN/GDN nurses had significantly less repeated injuries in the intervention group than in the control group ($P = 0.016$). By body part, the intervention group had significantly less than the control group in all-back injuries ($P = 0.001$). Multivariate analysis showed that the odds of repeated injury for health care workers was significantly reduced in the intervention group comparing to the control group after controlling for hospital size (odds ratio = 0.618, 95% confidence interval = 0.27–0.81; $P = 0.0005$). An interaction of hospital size and group was not observed in the multivariate analysis.

Conclusion: The long-term effect of the multifactor TLR intervention program seemed to be more sustained in the medium- or small-sized hospitals than the large hospitals. The applicability of injury prevention programs to different healthcare settings, such as home care and critical care, and the synergistic relationships between components of multifactor intervention programs need to be further explored.

PP-29-188

Transdisciplinary Academic Education and Professional Training Model in Global Health

Tomas Tamulis *Global Health and Population Studies Program, John A Burns School of Medicine, University of Hawaii, Honolulu, Hawaii.*

Background/Aims: Today human society contends with enormously complex natural and anthropogenic systems that are influences by myriad interdisciplinary factors. It is not possible to study the process and impact of global climate change without considering the oceans, sea-ice, atmospheric constituents and processes, ecosystems and changes in land-use, and other anthropogenic alterations.

Methods: The transdisciplinary approach allows to: (1) grasp the complexity of problems; (2) take into account the diversity of life-world and scientific perceptions of problems; (3) link systematic and case-specific knowledge; and (4) develop transdisciplinary knowledge and practices. The Global Health and Population Studies Program is offered jointly with the East-West Center and University of Hawaii. The program attracted faculty from sociology, anthropology, urban planning and development, economics, political sciences, tropical medicine, and public health to share transdisciplinary research and scholarly expertise, and to create a unique transdisciplinary academic and continuous education environment. The program curriculum covers such topics as global climate change and human health, changes in coupled natural and anthropogenic ecosystems and emerging infectious diseases, disaster management and humanitarian assistance, health, humanitarian assistance, and human rights of special population groups at risk, which are not covered in a normal discipline-specific course or specialization-focus educational program. Students have opportunity to be involved in the transdisciplinary research through practical internships and gain practical experience and skills in epidemiology methods, and to strengthen their professional credentials and future career in global health.

Results: The presentation will discuss the main principals and advantages of transdisciplinary education as compare with traditional discipline-specific, multi-disciplinary or interdisciplinary approach, and opportunities to provide distance-based education for professionally and culturally diverse audiences.

Conclusion: The novel academic and continuous transdisciplinary education is an excellent opportunity for new and current environmental epidemiology and public health professionals to gain necessary knowledge and practical skills in order to confront more effectively contemporary global health problems and issues.

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URBAN PLANNING, GREEN AND SUSTAINABLE DEVELOPMENT

PP-29-189

Understanding How the Retail Food Environment Supports Dietary Goals Among Hispanics in New York City

Yoosun Park,[1] James Quinn,[2] Karen Florez,[2] Kathryn Neckerman,[3] Judith Jacobson,[2] and Andrew Rundle[2] *[1]Smith School of Social Work, Northampton, MA; [2]Columbia University, New York, NY; and [3]University of Chicago, Chicago, IL.*

Background/Aims: Obesity is common among Hispanics in New York City. Yet little is known about how immigration affects dietary practices of Hispanics or whether the retail food environment supports their dietary goals. We conducted a mixed-method study of these issues.

Methods: Food frequency questionnaire data were collected from 451 parents/guardians of New York City Head Start children enrolled in an asthma study. Thirty-two foreign-born, Hispanic female guardians of the children also took part in 60–90 minutes, semi-structured interviews regarding their dietary and nutritional beliefs. Food frequency questionnaire data were available from 345 Hispanic, female guardians of children in the asthma study. The retail food environment within 0.5 km of participant homes was characterized using data from Dun and Bradstreet and the NY State Department of Agriculture and Markets. Generalized estimating equations were used to determine whether neighborhood food environment variables predicted diet adjusting for individual and neighborhood sociodemographic characteristics.

Results: A major theme from the interviews was the identification of healthy foods as freshly harvested vegetables and newly butchered/killed meats. Refrigerated/frozen foods were consistently identified as unhealthy. Healthy food was rarely discussed in terms of nutritional content. Consistent with the qualitative interviews, the statistical analyses found that (1) the presence of a farmers market within the home neighborhood was associated with higher servings per day of fruit, vegetables, and juice (an additional 0.26 servings, $P < 0.001$) and (2) the presence of a farmers market and/or a small animal slaughterhouse was associated with higher servings per day of meat (an additional 0.15 servings, $P = 0.03$). Proximity to supermarkets or produce markets was not associated with consumption of fruit, vegetables, and juice and proximity to supermarkets and meat shops did not predict meat consumption.

Conclusion: The results suggest that programs bringing fresh produce and meat from local farms to city neighborhoods will influence diet among Hispanic women.

PP-29-190

A Study on the Thermal Performance of the Living Wall System

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Background/Aims: This study aimed at framing alternative urban planning scenarios reflecting urban planning factors, performing urban climate simulation, and evaluating low energy characteristics from the viewpoint of urban temperature and energy savings.

Methods: Monitoring thermometer of artificial ground greening to confirm its mitigation effect of plant evapotranspiration was carried out.

Results: According to result of monitoring that, in case of green roof, surface of Grass was lower 2.37°C than surface of concrete and surface of Sedum was lower 3.57°C than surface of concrete in September. In case of green wall, surface of grass was lower 4.78°C than surface of concrete wall, surface of ivy was lower 2.55°C than surface of concrete wall in September. Therefore, it was found that green roof and green wall could have effect on mitigation of microclimate.

Conclusion: The best results were recorded from the grass and Sedum surface presenting highest mitigation effect and lowest daily temperature deviation. From this monitoring, it was confirmed that artificial ground green can do its role of temperature mitigation as green does.

Environmental Exposure and Health

PP-29-198

Metabolic Syndrome and Its Related Factors in an Endemic Area of Dioxin Exposure in Southern Taiwan

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Background/Aims: In previous studies, type 2 diabetes and insulin resistance were found to be related to dioxin levels in an area in the northwestern section of Tainan, Taiwan where residents were exposed to dioxin released from a factory from 1965 to 1979. As insulin resistance is a key factor of metabolic syndrome (MS), we conducted a study to assess the association between MS and the dioxin level in the blood and its related factors.

Methods: We recruited residents with high levels of dioxin, defined as >64 pg WHO98-TEQDF/g lipid and performed health examination between 1 October 2008 and 31 December 2009. MS was defined as meeting 3 of the following criteria: fasting glucose >126 mg/dL, waist circumference >90 cm in men and > 80 cm in women, triglycerides >150 mg/dL, HDL <40 mg/dL in men and <50 mg/dL in women, and blood pressures 130/85 mmHg. The results were compared with a group of residents whose blood dioxin levels were below 64 pg WHO98-TEQDF per gram lipid.

Results: Of the 2933 participants in this study, 319 had high exposure levels. We observed positive associations between MS and dioxin exposure, gender, age, uric acid, liver function, and renal function (all with $P < 0.05$). After adjusting for other factors, we found high dioxin exposure (adjusted odds ratio [AOR] = 1.45, 95% confidence interval [CI]: 1.01–2.07), female gender (AOR = 1.28, 95% CI: 1.01–1.61), high insulin (AOR = 2.61, 95% CI: 1.81–3.75), high uric acid (AOR = 1.48, 95% CI: 1.14–1.92), high GPT (AOR = 2.39, 95% CI: 1.76–3.25), and high MDRD grading of renal function (AOR = 4.96, 95% CI: 1.83–13.45) were independent predictors of MS.

Conclusion: MS is related to high dioxin levels in southern Taiwan. It is also related to the gender, insulin, uric acid, GPT, and MDRD.

PP-29-199

The Strength of the Healthy Worker Effect Varies According to the Type of Cancer Being Studied

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Background/Aims: One type of healthy worker effect is introduced when estimating health risks in a working population by comparing it with the general population. To study how this bias varies according to specific cancer types, we compared mortality and incidence rates in a large cohort

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of workers being employed in the whole range of occupations and the general population.

Methods: The cohort was established using the Norwegian Registry of Employers and Employees, and comprised 366,114 subjects from the general working population in Norway randomly drawn as referents in a cohort study of petroleum workers. The cohort was linked to the Norwegian Cause of Death Registry and Cancer Registry of Norway including all deaths (n = 10,002) and cases of cancer (n = 11,271) reported up to 2003.

Results: There was a marked healthy worker effect in the working population for both overall mortality (standardized mortality ratio: 0.73, 95% confidence interval [CI]: 0.72–0.75) and overall cancer (standardized incidence ratios [SIR]: 0.91, 95% CI: 0.89–0.93). The male working population had markedly lower incidence of cancer of lip (SIR: 0.67, 95% CI: 0.47–0.91), pharynx (SIR: 0.80, 95% CI: 0.64–0.99), esophagus (SIR: 0.60, 95% CI: 0.46–0.78), pancreas (SIR: 0.85, 95% CI: 0.73–0.98), larynx (SIR: 0.74, 95% CI: 0.59–0.92), lung and bronchus (SIR: 0.81, 95% CI: 0.76–0.87), prostate (SIR: 0.93, 95% CI: 0.88–0.98), kidney (SIR: 0.83, 95% CI 0.73–0.94), bladder (SIR: 0.77, 95% CI: 0.70–0.85), and leukemia (SIR: 0.80, 95% CI: 0.68–0.92). In contrast, there was an elevated and significant risk of malignant melanoma both for men (SIR: 1.09, 95% CI: 1.02–1.17) and women (SIR: 1.29, 95% CI: 1.14–1.45), in addition to an increased risk of ovary cancer (SIR: 1.32, 95% CI: 1.1–1.5).

Conclusion: Depending on the type of cancer and population being studied, there is a marked potential for both under- and overestimation of risk of cancers when using the general population as the reference for studies of specific working populations.

PP-29-200

Psychological Symptoms in Residents 7 Months After the Hebei Spirit Oil Spill: Re-analysis Focused on Influencing Factors.

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Background/Aims: We reanalyzed data to investigate the factors including level of exposure to the oil spill and sociodemographic characteristics associated with the psychological symptoms 7 months after the Hebei spirit oil spill.

Methods: The study included 1197 people aged ≥15 years living in the oil spilled area between 7 July 2008 and 1 August 2008 and selected with stratification by 4 exposure level. We visited the subjects' home and interviewed them using the Posttraumatic Diagnostic Scale, Center for Epidemiologic Studies Depression Scale, Scale for Suicidal Ideation, and Symptom Checklist-90-Revision. We calculated age and gender standardized prevalence of posttraumatic stress disorder (PTSD) and depression. We estimated prevalence odds ratios of PTSD, depression, suicidal ideation, and anxiety for oil exposure and sociodemographic factors adjusted for confounding factors.

Results: The age- and gender-standardized prevalences of PTSD and depression were 8.0%, 17.3%, 22.7%, and 37.8% for PTSD and 14.2%, 19.4%, 27.8%, and 34.1% for depression in low, lower middle, upper middle, and high exposure area, respectively.

People having sea-related work reported significantly higher PTSD and depression after adjustment for several confounding factors compared with people who have non-sea-related occupation in all 4 exposure areas. After adjusting for several confounding factors, people who lived in the high exposure area showed higher prevalence of psychological symptoms than those who lived in the low exposure area: prevalence odds ratios [POR] of 3.63 (95% CI: 1.91–6.89) for PTSD, 1.93 (95% CI: 1.14–3.26) for depression, 1.97 (95% CI: 0.48–8.16) for suicidal ideation, and 2.11 (95% CI: 0.79–5.63) for anxiety. The POR of PTSD was highest in people living in high exposure area and having sea-related job than those living in low exposure area and having non-sea-related jobs (POR = 16.7, 95% CI: 8.1–34.6).

Conclusion: Having sea-related jobs and being exposed highly to crude oil increased significantly psychological symptoms such as PTSD and depression.

PP-29-201

Environmental Exposure to Hydrogen Sulphide and Odor From Fish Meal Plants in St. Helena Bay, Western Cape Province, South Africa

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Background/Aims: The study was carried out in response to complaints from the residents of St. Helena Bay regarding odor and hydrogen sulfide (H_2S) emissions from the fish processing factories. The aim of the study was to determine whether the community of St. Helena Bay is exposed to H_2S and odor.

Methods: Dräger-Tubes were used to measure the ambient air concentration of H_2S. A Dräger gas detector pump was used to draw in air through the Dräger-Tubes containing a reagent system. Odor was assessed using the German Standard VDI 3940 and the New Zealand's Good Practice Guide for Assessing and Managing Odor.

Results: Ten H_2S samples were taken in residential areas in close proximity to fish meal plants. The H_2S results were all below the detection limit, that is, below 0.2 ppm. Odor results revealed that odor intensities ranged from "not perceives" to "strong."

Conclusion: The results of the study revealed that the St. Helena Bay community was not exposed to H_2S at the concentration of 0.2 ppm as all the 10 samples were below the detection limit. The perception of odor, however, can be a very sensitive indication for the presence of H_2S at odor threshold levels, which ranges from 0.0005 to 0.3 ppm. Oxidation may be responsible for its inability to be detected. The odor threshold levels are far lower than the lowest-observed-adverse-effect level of 2.8 mg/m^3. Odor exposure during the survey was reduced because of meteorological conditions. The predominant wind direction for the past 30 years suggest that exposure to H_2S and odor could be low as it indicate that wind was blowing from the south for the past 30, 10, and 5 years. This indicates that wind was blowing away from the residential areas.

Odor should be controlled by bioscrubbers with the efficiency of 99%. Biofilters may be used to remove H_2S.

PP-29-202

Improvement of Standard Examination Methods (GB5750-2006) for Chlorine Dioxide and Estimation of Application on Field in Drinking Water

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Background/Aims: To improve the 3 measurement methods of chlorine dioxide, which were specified in Standard Examination Methods for Drinking Water implemented in 1 July 2007. And the field application was examined and estimated.

Methods: The precision, accuracy, and lowest detectable limit were compared between the 3 improved methods and original methods. The improved methods were applied to test the drinking water samples.

Results: The improved methods were much better than the original methods in precision and accuracy of all methods. The lowest detectable limit of DPD and iodimetry were reduced. The recovery of standard

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addition of the improved methods was between 80.00% and ~104.80%. The analysis result showed that the 3 improved methods were essentially identical in detecting chlorine dioxide of water samples.

Conclusion: The improvement of the methods was meaningful and could meet the requirement for determination chlorine dioxide in drinking water.

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PP-29-203

Biomass Smoke and Cooking: Can Carbon Monoxide Be Used as a Proxy Measure of Respirable Particulate Matter?

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Background/Aims: The accurate and cost-effective measurement of parameters such as air pollution in studies are of great importance, particularly in developing country settings where constraints may be magnified. Prior studies have suggested the use of carbon monoxide (CO) as a more economical and simpler proxy measure of fine particulate matter ($PM_{2.5}$), particularly when assessing children's exposures. However, no studies have evaluated the relationship between CO and larger particles (PM_{10}) concentrations, which also have an important effect on respiratory health.

Methods: Concentrations of PM_{10} (area) and CO (area and personal) from the kitchens and sleeping rooms of case and control households in Nouna, Burkina Faso, were measured. These assessments were part of a larger study examining the relationship between biomass smoke and the risk of malaria among women and children. Passive, real-time samplers were used to measure area PM_{10}. Area and personal CO concentrations were measured with dosimeter tubes. Pearson correlation coefficients were calculated to evaluate these relationships.

Results: On comparing overall PM_{10} and CO area concentrations, the 2 measures were found to be significantly correlated ($r = 0.79$, $P < 0.0001$, $n = 224$), although not as strongly. A significant but weaker correlation was also present between area CO and personal CO concentrations ($r = 0.21$, $P = 0.0047$, $n = 183$).

Conclusion: These results suggest that area CO could be a simple proxy measure of area PM_{10} concentrations, although this relationship may not be consistent across all settings. Variations may occur with different stove and fuel types. On the other hand, personal CO measures may not be a reliable indicator of area PM_{10} concentrations, especially since personal exposures are not likely to occur continuously over the entire burn cycle but instead experienced intermittently. Therefore, area CO measures may provide more consistent results of stationary air pollution monitoring.

PP-29-204

Satellite-derived NO_2 and HCHO: Comparison to In Situ Measurement and Application to Air Quality Management

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Background/Aims: Remote sensing technologies are useful tools for informing policy decisions regarding ozone control strategies. Tropospheric NO_2 and HCHO vertical column measurements from satellites can provide constraints on the sources and photochemical processing of NOx and volatile organic compounds (VOC). We then combine satellite measurements of HCHO and NO_2 with GEOS-Chem to estimate ozone production efficiency (OPE). OPE is a measure of ozone production rates relative to NOx cycling and may provide insight into how urban areas can best control ozone concentrations, that is, through NOx or VOC controls. Between 2005 and 2007, monthly variability in HCHO, NO_2, and OPE during April–October in the United States was investigated.

Methods: We evaluate measurements of HCHO from the ozone monitoring instrument against an extensive suite of aircraft measurements and concurrent simulated columns from the GEOS-CHEM global chemical transport model.

Results: Results show that, over regions with typical HCHO columns (0.5–1.4E16 mol/cm^2), ozone monitoring instrument introduces minimal bias (mean = 1.2%). Organic peroxy radical production rates, NOx loss rates, and OPE are all strongly correlated with population density. Both P (RO2) and L (NOx) increase with population density, resulting in lowest OPE values in urban centers (lower ozone production per NOx). On average, OPE >4 for >60% of US land area (representing 1% of US population) whereas the most densely settled 10% of US land area (representing 90% of US population), OPE 2 on average.

Conclusion: Our results show that satellite observations of HCHO abundance are an imperfect proxy for VOC reactivity (since local/regional differences in VOC mix induce variability in radical cycling relative to HCHO yield), yet satellite retrievals provide reliable measures of ozone chemistry and precursor cycling.

PP-29-205

A Change of Atopy Prevalence Among the Industrialized Area Residents in Gyeonggi-do, Korea for 3 Years (2005, 2006, 2007)

MoonHee Kwon *Seoul National University, Seoul, Republic of Korea.*

Background/Aims: The prevalence of allergic disease such as asthma, atopic rhinitis, and atopic dermatitis is significantly increasing around the world, but the cause of it has not been known well to these days. And, it is rare about allergy studies especially on industrialized area residents. This study was designed to evaluate changes of atopy prevalence, the causative allergens, and the affecting factors on sensitization among industrialized area residents in Gyeonggi-do, Korea.

Methods: A total of 2867 (male 1321, female 1546) industrialized area residents for 3 years (2005, 2006, 2007) were participated. Skin prick test with 12 common inhalant allergens was carried out and interpreted as positive when the mean wheal size formed by allergen was larger than 3 mm and larger than histamine size. Atopy was defined when skin reaction to 1 or more allergens was positive.

Results: The prevalence of atopy among industrialized area residents was 27.58%, 37.95%, and 41.18%. When the data was analyzed according to age, the prevalence of atopy was decreasing in the older age, except the 1 of 2007. When the data was analyzed according to sex, the prevalence of atopy was higher in male (37.77%) than in female (33.05%). The positive rate of D. farinae, D. pteronyssinus, Mold 1, Mold 2, Cockroach, Tree 1, Tree 2, Ragweed, Grass, Dog hair, and Cat fur were higher in 2006 than those of 2005 generally. The positive rates of Mold 2, Grass, and Mugwort were higher in 2007 than those of 2006, especially.

Conclusion: The prevalence of atopy among industrialized area residents was remarkably increasing for 3 years (2005, 2006, 2007). But the prevalence of atopy was decreasing as in the older age except for that of 2007, which it was not decreasing in the older age. The changes of skin response to D. farinae, D. pteronyssinus, Mold 1, Mold 2, Cockroach(as contributing factor of asthma), Tree 1, Tree 2, Ragweed, Grass, Dog hair, and Car fur were considered to be contributing of atopy in 2006.

PP-29-206

Military Working Dogs and Pets as Sentinels of Environmental Diseases

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Background/Aims: Because military working dogs and pets share the living environments of their handlers or owners, they offer research opportunities for epidemiologists and veterinarians. This is particularly important for predicting the needs for veterans serving in the armed forces to suggest areas of future health concern, with focus on infectious and chronic illnesses. Our aims are to examine the world's epidemiology literature to assess the strength of these relationships.
Methods: We examined all the published literature on sentinels of infectious and pathology endpoints in animals and subsequent diseases in humans. We used PUBMED for our review, and supplemented this endeavor by seeking unpublished reports of relevance.
Results: Dogs and humans appear to share some respiratory tract cancer risks in common, and there are some infections such as Lyme disease and leishmaniasis that military working dogs share with soldiers and veterans. Pets and their owners appear to share some cancer risks such as bladder tumors.
Conclusion: This appears to be a novel area for sentinel health research, especially because military working dogs have extensive clinical exams that enable an early diagnosis of canine illnesses. More research is justified to better predict the subsequent risks for military veterans and pet owners.

PP-29-207

Salivary Bisphenol-A Level Detected by Elisa After Restoration With Sealant Resin

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Background/Aims: Bisphenol-A diglycidyl ether methacrylate (Bis-GMA), which is synthesized from bisphenol-A (BPA), a compound with exogenous endocrine disrupter action, is widely used as a dental material. In this study, using a ELISA system, we investigated the changes in the BPA concentration in saliva before and after restoration with sealant resin.
Methods: The subjects were 35 healthy adults (18 male, 17 female, mean age ± standard deviation = 26.09 ± 3.10). Saliva samples of 35 subjects were collected in conical tubes before and after filling sealant resin (EMBRACE F-realising Light cure, PULPDENT, USA). One dental practitioner provided the dental sealant treatment to the subjects. BPA was measured using the Ecologiena supersensitive BPA ELISA KIT. Using a paired *t*-test procedure, we evaluated differences in pretreatment and post-treatment samples for the same subjects. We considered differences statistically significant when the 2-sided *P* value was less than 0.05.
Results: We detected BPA in most of the samples tested. Salivary BPA concentrations ranged from 0.00 to 8.15 ng/mL. Salivary BPA concentrations in pretreatment or baseline samples ranged from 0.000 to 3.300 ng/mL and salivary BPA concentrations in immediately post-treatment samples ranged from 0.002 to 8.147 ng/mL. There was non-significant difference between pretreatment and post-treatment in BPA concentration of saliva.
Conclusion: We detected BPA in all baseline (pretreatment) saliva samples tested except 2. Although saliva BPA concentration was not changed after placement of dental sealant in this study, the present study emphasizes the need for additional clinically relevant research to further identify sealants that may lead to BPA exposure.

PP-29-208

Study on the Effect of SPi (Samsung Super Plasma Ion) on Airborne Pollutants in Pig Building

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Background/Aims: This field study was performed to evaluate temporal reduction efficiency of SPi (Samsung Super Plasma ion) on airborne pollutants emitted from pig building.
Methods: Experimental period is 1 May, 2008 65374 30 August 2008. Airborne pollutants investigated in this study gases (NH_3, H_2S, SO_2, and NO_2), particulates (TSP, PM_{10}, $PM_{2.5}$, and PM_1), and biological agents (airborne bacteria and fungi)
Results: In gaseous pollutants, it was found that there is no reduction effect of SPi on ammonia, hydrogen sulfide, nitrogen dioxide, and sulfur dioxide ($P > 0.05$). In particulate pollutants, the SPi showed mean 79% (± 6.1) and 78% (± 3.0) of reduction efficiency for $PM_{2.5}$ and PM_1, respectively, compared to the control without SPi (p0.05).
Conclusion: In biological pollutants, the mean reduction efficiencies for airborne bacteria and fungi by SPi's application were 22% (±6.6) and 25% (±8.7), respectively.

FOOD SAFETY, IMPACT OF NUTRITION ON HEALTH

PP-30-125

Food Environment Quality and Food Choice in Clusters of Colonias Along the South Texas/Mexico Border

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Background/Aims: Residents of South Texas colonias face the greatest structural and neighborhood disadvantage. The goals of this study were to assess the food environment; and to examine the association between neighborhood deprivation and locational disadvantage to food resources.
Methods: The study area included 197 census block groups (772 miles 2). All traditional, convenience, and nontraditional food stores (FS) and food service places (FSP) were identified and gecoded at the level of individual address using ground-truthing. Neighborhood deprivation was determined using socioeconomic variables from the 2000 US census and categorized low to very high deprivation. Locational disadvantage was determined through network distance from the population-weighted CBG centroid to the nearest FS and FSP. Stability and difference in locational disadvantage between types of FS and FSP were examined.
Results: This study included 971 different FS and FSP. In areas of high/very high deprivation, at least 15% of households did not have access to a vehicle. The average network distance to the nearest supermarket/grocery store was 2.7 miles; 3.0 miles to the nearest large supermarket; and 1.1 miles to the nearest convenience store. Almost 32% (n = 63) of all 197 CBG experienced very high locational disadvantage for access to a large supermarket. Among CBG with very high locational disadvantage, distance to the nearest supermarket/grocery store increased significantly with greater deprivation.
Conclusion: This study is the first step in understanding the influence of the food environment on food choice and diet quality in Mexican American families who live in the growing number of colonias where there is limited or nonexistent public transportation. Knowing more about the food environment is essential for combining environmental approaches with traditional health interventions and food assistance programs to make it easier for individuals to make healthier food choices.

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PP-30-126

Investigation of Food Safety and Handling Practices of Households in Jimma Town, Ethiopia

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Background/Aims: In Ethiopia, available studies on food safety indicate that the domestic kitchen is an important place of origin for foodborne diseases. This study was undertaken to assess the knowledge, attitudes, and behaviors about food safety and handling practices of households in Jimma Town, South West of Ethiopia, and generate a baseline for future research and policy recommendation.

Methods: Between 25 April and 25 June, 2009, a community-based cross-sectional study with selected variables was designed and conducted during the investigation period. The study population was a sample of households (n = 840) preparing meals at home for individual or family consumption. Multistage sampling procedure was used to get the sampled population. Data were collected through a house-to-house survey using a face-to-face and observational structured questionnaire and check list.

Results: The investigation revealed a general trend of good knowledge regarding food contamination sources and causes. About 99.4% and 98.5% of respondents knew contaminated water and microorganisms as the source and cause of food contamination and illness, respectively. On the other hand, a high proportion of the respondents 89% to 75% were not knowledgeable about the specific micro organisms that cause foodborne disease and food poisoning such as *Salmonella* and *Clostridium botulism*. The great majority of the respondents showed positive attitude toward adoption of adequate personal hygiene, sanitization of utensils, use of protective clothing and gloves, proper food storage, separating raw food from cooked food, and careful study of food ingredients and labeling.

Conclusion: Improvement in food handling practices in the domestic environment is likely to reduce the risk and incidence of house derived food borne illness. It is hoped that the government and industry would use the outcome of this investigation to target food safety education to the general public by creating public awareness and promoting health education.

PP-30-127

Artificial Sweetener Intake of Korean Children is Insignificant

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Background/Aims: With a recent increase in intake of sweetened beverage among going school children, we attempted to assess dietary intake of artificial sweeteners (AS: aspartame, acesulfame-K, saccharin sodium). Because the previously estimated intake of AS among children was minimal, we focused on intake in consumer (C) group.

Methods: A food frequency questionnaire was developed to estimate the intake of artificially sweetened beverages and snacks on the basis of the result of AS monitoring by Korea Food and Drug Administration (KFDA). In all, 28 schools each were selected for elementary, junior high, and high schools in Seoul, Korea, using a stratified multistage sampling method. Students in a class from second and fifth grades at elementary school, and second grade at junior high school and high school were surveyed for the frequency and amount of artificially sweetened beverages and snacks during 1 week before the survey. The survey was repeated for 3 seasons, from June through December 2009, to compensate for any possible seasonal effect. Sweetener intake was estimated by using AS database of KFDA and compared with the acceptable daily intake (ADI).

Results: A total of 10,099 children responded to the survey. The mean AS intake of group C children was 0.25 ± 0.48 mg/kg bw/d, 0.18 ± 0.44 mg/kg bw/d, and 0.22 ± 0.25 mg/kg bw/d for aspartame, acesulfame-K, and saccharin sodium, respectively. Although these values were 1.5–5.5 times higher than those of all children, the corresponding values of ADI were only 0.63%, 1.23%, and 4.42% of respective ADI values set by JECFA. Even the 95th percentile values of ADI were far lower than the safety limit: 2.48%, 4.86%, and 15.59% for aspartame, acesulfame-K, and saccharin sodium, respectively.

Conclusion: This study revealed that the AS intake through beverages and snacks among children in Korea is insignificant and very safe.

This study was supported by R&D fund of KFDA (0808KFDA999-101).

PP-30-128

Length-normalized Mercury Concentrations in the Tissue of Freshwater Fishes at Korea

Chan-Kook Kim,[1,2] Ji-Hyeon Lee,[3] Mi-Ra Youn,[3] Kun-Ho Park,[1] Tae-Seob Choi,[1] Jung-Suk Lee,[1] Kyu-Tae Lee,[1] Tae-Woo Lee,[1] and Jong-Hyeon Lee[1] *[1]NeoEnBiz, Bucheon, Republic of Korea; [2]Seoul National University, Seoul, Republic of Korea; and [3]Ministry of Environment, Gwacheon, Republic of Korea.*

Background/Aims: This study was implemented to evaluate spatial distribution of mercury (Hg) concentrations in the tissue of freshwater fish in Korea.

Methods: A significant relationship was found between Hg concentration in fish samples and the length of the fish in each fish species. Thus, length-normalized Hg concentrations were compared among different sites for 4 common fish species (crucian carp, Korean bullhead, bass, and mandarin fish).

Results: The length-normalized Hg concentrations for the crucian carp (normalization for length of 15.7 cm) ranged from 11.0 to 193.0 μg/kg, for the korean bullhead (15.4 cm) from 24.5 to 396.6 μg/kg, for bass (16.6 cm) 15.1 to 657.8 μg/kg, and for mandarin fish (18.7 cm) 48.4 to 357.0 μg/kg.

Conclusion: The length-normalized Hg concentrations showed lower level in samples from the down reaches in the river basins than those from an isolated small reservoir and large artificial lake, which are located on the upper reaches of the river basins and far from industrialized areas. These phenomena are similar to "biological hot spot" for Hg driven by landscape characteristics. No significant relationships were found between the length-normalized concentration of Hg in fish-tissue for the 4 species and the concentrations of total Hg and methylmercury in environmental samples (water and sediment).

PP-30-129

Mercury Concentrations in Korean Freshwater Fishes

Chan-Kook Kim,[1,2] Ji-Hyun Lee,[3] Mi-Ra Youn,[3] Tae-Seob Choi,[1] Kun-Ho Park,[1] Jung-Suk Lee,[1] Kyu-Tae Lee,[1] Tae-Woo Lee,[1] and Jong-Hyeon Lee[1] *[1]NeoEnBiz Co., Bucheon, Republic of Korea; [2]Seoul National University, Seoul, Republic of Korea; and [3]Ministry of Environment, Gwacheon, Republic of Korea.*

Background/Aims: This study was implemented with the objective of building a nation-wide monitoring system of the mercury level in freshwater fishes in Korea.

Methods: Fish samples were captured by fishing gear during 2006 to 2007. A total of 53 species from 102 sites were identified, and 3366 fish samples were analyzed. Total mercury concentrations in the edible part of the fish samples were measured by cold vapor atomic fluorescence spectrometer and calculated on wet weight base. Methylmercury (MeHg)

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concentration in the samples was analyzed by gas chromatography-cold vapor atomic fluorescence spectrometer.

Results: Mean concentration of mercury in each species ranged from 9.3 μg/kg (leather carp) to 195.8 μg/kg (mandarin fish). In descending order by mean concentration of mercury, skygager (*Erythroculter erythropterus*) showed 159.8 ± 113.3 μg/kg (n = 108); short barbell gudgeon (*Squalidus japonicus*), 157.5 ± 46.2 μg/kg (n = 4); bass (*Micropterus salmoides*), 152.3 ± 180.8 μg/kg (n = 133); Korean piscivorous chub (*Opsariichthys bidens*), 149.9 ± 127.1 μg/kg (n = 99); and catfish (*Silurus asotus*) 145.6 ± 168.7 μg/kg (n = 201).

Conclusion: Most of species listed above are piscivorous fishes. Fish-tissue mercury concentrations tend to increased with on creasing tropical level, and were higher in piscivore rather than omnivore and benthivore. The ratio of MeHg to total Hg in 176 fish samples of 17 species ranged from 74.4% to 96.6% and reached an average value of 83.0%.

PP-30-131

Human Health Risk Assessment From Exposure to Polycyclic Aromatic Hydrocarbons and Alkylated PAHs in the Hebei-Spirit Oil Spill Area

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Abstract:

Background/Aims: During the past year when the Hebei-Spirit oil spill occurred, human health risk for polycyclic aromatic hydrocarbons (PAHs) and alkylated PAHs by oil-contaminated oyster consumption was estimated as 2 approaches.

Methods: (1)Individual PAH method that estimates the potency of benzo[a]pyrene (B[a]P) and then expresses the oyster levels of 15 PAHs and some alkylated PAHs as "B[a]P equivalents" (In the absence of reported data, the potency of the alkylated PAHs was considered the same as their parents' toxicity), and (2) Margin of exposure (MOE) approach based on dietary exposure for consumers to B[a]P, PAH2, PAH4, and PAH8, and their corresponding benchmark dose lower confidence limit values. It was assumed that toxicity of alkylated PAHs was similar to those of PAHs with the same back-born structure.

Results: Cancer risk was estimated 6.7×10^{-6} for 16 PAHs, and 6.7×10^{-5} for alkylated PAHs. The resulting MOEs for average consumers were 177,197 for B[a]P; 20,971 for PAH2; 30,412 for PAH4; and 40,991 for PAH8.

Conclusion: The MOEs indicate a low concern for consumer health at the average estimated dietary exposures. The cancer risk of alkylated PAHs contributed to 66% for the total risk (1.9×10^{-5}). The cancer risk was underestimated because of the lack of toxicity data for alkylated PAHs. There is a need for further study to derive the toxic reference values for alkylated PAHs.

PP-30-132

Effect of Calcium and Sodium Intake on Blood Lead Levels in Pregnancy: Mothers and Children's Environmental Health Study

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Background/Aims: Effects of nutritional status in altering the lead toxicity have been recognized. Many researchers reported that high calcium intake has a beneficial effect on reducing blood lead concentration. Dietary sodium influences the calcium metabolism. Thus, sodium intake may modify the effect of calcium on lead levels. We evaluated the effect of dietary sodium on the relationship between calcium intake and blood lead levels in Korean pregnant women.

Methods: A total of 786 women at 12–28 weeks of gestation were recruited from hospitals in 3 different cities (Seoul, Cheonan, and Ulsan). Intakes during pregnancy were assessed by a 24-hour dietary recall, covering the use of dietary supplements. Blood lead levels were analyzed by the atomic absorption spectrophotometry.

Results: Total calcium intake was negatively correlated with blood lead ($r = -0.083$, $P < 0.05$).

Conclusion: These data suggested that high sodium intake may mitigate the benefit of calcium on blood lead during pregnancy. Further study is needed to elucidate the interaction between calcium and sodium and its effect on blood lead concentration in pregnancy.

HEALTH EFFECTS OF GLOBAL ENVIRONMENTAL CHANGES - SOMATIC AND PSYCHOLOGICAL EFFECTS

PP-30-133

Dietary Pattern Modifies the Relationship Between Blood Lead Levels and Attention Deficit Hyperactivity Disorder in Children

Se-Young Oh,[1] Mina Ha,[2] Dongmug Kang,[3] Su Young Kim,[4] Joon Sakong,[5] Jong-Han Leem,[7] Chul Gab Lee,[9] Min Sun Park,[8] Ho Kim,[9] Hojang Kwon,[2] and Yun-Chul Hong[10] *[1]Department of Food and Nutrition, Research Institute of Human Ecology, Kyung Hee University, Seoul, Republic of Korea; [2]Department of Occupational and Environmental Medicine, Inha University Hospital, Incheon, Republic of Korea; [3]Department of Family Medicine, Seoul National University Hospital, Seoul, Republic of Korea; [4]Department of Epidemiology and Biostatistics, Seoul National University School of Public Health, Seoul, Republic of Korea; [5]Department of Preventive Medicine, Dankook University College of Medicine, Cheonan, Republic of Korea; [6]Institute of Environmental Medicine, Seoul National University College of Medicine, Seoul, Republic of Korea; [7]Department of Preventive and Occupational Medicine, Pusan National University, Pusan, Republic of Korea; [8]Department of Preventive Medicine, Jeju University College of Medicine, Jeju, Republic of Korea; [9]Department of Preventive Medicine, Yeungnam University College of Medicine, Daegu, Republic of Korea; and [10]Department of Occupational Environmental Medicine, Chosun University, Gwangju, Republic of Korea.*

Background/Aims: Lead exposure and dietary intake appear to play a role in attention deficit hyperactivity disorder (ADHD) in children, yet little is known about the modifying role of dietary intake regarding the association between blood lead levels (BLL) and ADHD.

Methods: As part of the CHEER (Children's HEalth and Environmental Research), usual dietary intake of ~3300 children aged 7–9 years was assessed by a food frequency questionnaire, from which 45 food groups were created. Based on the factor analysis of the food groups, we identified 4 dietary patterns such as the Korean healthy, Sweets, Animal foods, and Refined grains. The Dupaul's ADHD rating scale was used to assess problem behaviors. Participants were divided into tertiles based on each dietary pattern scores. Interactions between dietary pattern and BLL

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were estimated by the analyses of covariance after controlling for main effects of intake variables, log transformed BLL and potential confounders.

Results: Geometric mean of BLL was 1.7 μg/mL. Regarding the Korean healthy pattern, there was a lower increase of inattention symptoms in the highest tertile group compared with the lowest tertile group (β coefficient = 0.810, P = 0.0152, P-interaction = 0.0289). Dietary patterns of the Sweets, Animal foods, and Refined grains did not modify the relationship between BLL and ADHD symptoms.

Conclusion: This study suggests that the Korean healthy diet may limit the influence of lead exposure on ADHD in children with the low level lead exposure.

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PP-30-134

The Association Between Blood Mercury Level and Blood Pressure Differs by the Type of Fish Consumed in Children

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Background/Aims: The balance of contaminant risk and nutritional benefit from fish consumption is not clear. Mercury exposure, which is related to fish consumptions, has been shown to play a role in blood pressure. The objective was to assess the association of blood mercury levels (BML) with blood pressure (BP) by the type of fish consumed in children.

Methods: We assessed BML and BP of ~3200 children aged 7–9 years from the nationwide cohort study, the Children's HEalth and Environmental Research (CHEER). Children's dietary intake was measured by a food frequency questionnaire, from which the intake frequencies of different types of fish were calculated. Children were dichotomized into 2 groups based on BML and the level of each type of fish consumed. Multivariate analyses were performed to examine the interaction between fish intake and BML on BP.

Results: We found a positive association between BML and BP. When we stratified our data by BML and fish intake, log transformed systolic and diastolic BP were higher (P for difference = 0.01, P for interaction = 0.06–0.07) in the high BML group (GM = 3.0 μg/L) than in the low BML group (GM = 1.1 μg/L) among the children with the low level of blue fish intake (<once per week). For the high blue fish intake group, there was no association between BML and BP. Consumption of white and shell fishes did not modify the association of BML with BP.

Conclusion: The role of fish in the association between BML and BP depends on the level and type of fish consumed.

PP-30-135

Empirically Derived Dietary Patterns Associated With Attention-deficit/Hyperactivity Disorder in Children

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Background/Aims: Prevailing dietary patterns and their association with problem behaviors are poorly understood for Korean children. Our purposes were to identify major dietary patterns and to examine their association with symptoms of attention-deficit/hyperactivity disorder (ADHD) among school age children.

Methods: For 803 children aged 8–11 years, the severity of the symptoms of ADHD was evaluated by the teacher and parent versions of ADHD Rating Scales (ARC) that had 18 items with a 4-point rating ranging from 0 to 3. Dietary intake was assessed by semiquantitative food frequency questionnaire, from which 31 food groups were created and entered into a factor analysis. Based on relative intake frequency, we identified 4 dietary patterns such as the Korean healthy, Sweets, Animal foods, and Refined grains. Children were divided into 2 groups based on each dietary pattern scores. We estimated the association between dietary patterns and ADHD by the analyses of covariance with adjustment of household income, parental education as well as the child's age, gender, IQ, and total energy intake.

Results: In the multivariate analyses, the Korean healthy pattern was associated with fewer symptoms of inattention (P = 0.02) and hyperactivity (P = 0.04) evaluated by the child's parent. Conversely, the Sweet pattern correlated with more hyperactive problems (P = 0.0082) in the teacher-rated ARC. The symptoms of ADHD did not differ by the intake levels of other dietary patterns including the Animal foods and Refined grains.

Conclusion: These findings suggest major dietary patterns are predictors of ADHD in children.

PP-30-136

Impact of Environment Conditions on Hypertension Occurrence in Human Population

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Background/Aims: Arteritic hypertension is considered to be a serious medical, social, and economical problem. The creation and process of the disease is influenced by many factors such as age, sex, body weight, food, genetic predisposition, life style, and environment.

Methods: The presence of arteritic hypertension for men and women in dependence on age, sex, blood pressure, BMI, and cholesterol concentration in the region of East Slovakia was determined. The method of anonymous questionnaire to study some of risk factors of arteristic hypertension was used. The research sample comprised of 158 participants (102 women, 56 men) at the age of 18–65 years from Prešov region.

Results:

1. Men older than 46 years showed normal values of blood pressure in 58% of this measured category.

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2. 67% of examined women younger than 46 years had normal values of blood pressure.
3. In case of women >46 years, normal values of blood pressure were determined only in 38%.
4. Percentage representation of BMI values for men <46 years was 17% of normal weight; 14% of men older than 46 years showed normal weight.
5. BMI value for women younger than 46 years was 58% in normal weight, obesity and very heavy obesity did not occur. Women older than 46 showed the following BMI values: normal weight (13%), obesity and heavy obesity (48%).

Conclusion: The results obtained in the research provide information about prevalence and incidence of hypertension within the observed population and region. They reveal the significant influence of current lifestyle on occurrence of hypertension as well as the level of interest of observed population about precautionary measures.

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VARIOUS METHODOLOGIES IN ENVIRONMENTAL HEALTH RESEARCH - GIS, MULTIDISCIPLINARY APPROACH

PP-30-183

Cohorts: Their Interest and Role in Environmental Health Surveillance

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Background/Aims: Cohort studies were developed primarily in the context of etiologic research, for which they have become an invaluable tool. Their place in surveillance is being discussed.

Methods: A review of the literature and an assessment of the experience of the French Institute for Public Health Surveillance were conducted.

Results: In the field of surveillance, cohorts are neither the most effective nor the most cost-effective tools. Surveillance is based primarily on other tools: reporting systems, disease registries, sentinel networks, analysis of databases, and repeated cross-sectional surveys. Cross-sectional surveys should not be confused with cohorts. These 2 approaches are not competing, but are complementary. Cross-sectionnal surveys produce baseline data on representative samples, which contribute to evaluate the loss of representativeness in cohorts. On the other hand, cohorts provide knowledge on the exposure-effect relationships, which is necessary to interpret in terms of health risks, the level of biomarkers, or the prevalence of risk factors reported in cross-sectional surveys. Cohorts have also a direct usefulness in surveillance. They are used to measure diseases' incidence in the general population or in specific groups; to monitor the occurrence of health effects in populations exposed to an identified risk, especially after a natural or industrial disaster or after the detection of an environmental or occupational exposure; and to assess and follow-up time-related exposure-risk relationships. Cohorts have several limitations in terms of surveillance. These limitations are mainly due to their initial lack, or decline over time, of representativeness. They do not contribute to monitoring temporal trends over the long-term when the cohort is "closed," in other terms, when the same subjects are followed throughout the study without any new inclusions.

Conclusion: Cohorts are however useful in surveillance, particularly for monitoring the health of workers and investigating health effects following accidental or chronic exposures.

PP-30-184

Individual Exposure to Air Pollution and Lung Function in Korea: Spatial Analysis Using Multiple Exposure Approaches

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Background/Aims: Interpolation methods can estimate individual-level air pollution exposures from ambient monitors; however, few studies have evaluated how different approaches may affect health risk estimates. We applied multiple exposure estimation methods for several air pollutants. We investigated how different exposure methods may influence health effect estimates in a case study of lung function data, forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC), for 2102 cohort subjects in Ulsan, Korea for 2003–2007.

Methods: Measurements from 13 monitors for particulate matter <10 μm (PM_{10}), ozone, nitrogen dioxide, sulfur dioxide, and carbon monoxide were used to estimate individual-level exposures by averaging across all monitors; nearest monitor; inverse distance weighting; and kriging. We assessed associations between pollutants and lung function in linear regression models, controlling for age, sex, and body mass index.

Results: Cross validation indicated that kriging provided the most accurate exposure estimates. FVC was associated with all air pollutants under all exposure methods. Only ozone was associated with FEV1. An 11 ppb increase in lag0-2 8-hour maximum ozone was associated with a 6.1% (95% confidence interval: 5.0, 7.3%) decreased in FVC and a 0.50% (95% confidence interval: 0.03, 0.96%) decrease in FEV1, based on kriged exposures. Central health effect estimates were generally higher using exposures based on averaging across all monitors or kriging. Results based on the nearest monitor approach had the lowest variance.

Conclusion: Results suggest that spatial interpolation methods may provide better estimates than monitoring values alone by reflecting the spatial variability of individual-level exposures and generating estimates for locations without monitors.

PP-30-185

The Classification and Coding of the Foods in Chinese Dietary Exposure Assessment Database

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Background/Aims: To establish the basis for Chinese dietary exposure assessment database by classifying and coding the data from the national dietary survey and pollutant surveillance.

Methods: The method that combined CODEX food classifying and coding of Codex Alimentarius Commission (CAC) with Chinese food classification of food composition table, was applied to classify and code the data of 18,10,703 Chinese dietary consumption and 4,87,819 pollutant surveillance. The coding system was according to the first 2 letters of the respective food group that represent the type or source of food, the last 4 digits represent the serial number of the food in the CAC food classification. If the food can be found in CAC food code system, its original food code is used. The new codes corresponding with the foods, which are not exist in CAC food code system, is added according to CAC coding methods.

Results: Dietary consumption data are divided into 6 major categories, 19 types, 75 groups, the agricultural products of pollutant surveillance corresponding to 499 codes. Comparing with CAC food coding system, Chinese dietary consumption data have added F(Candy snacks) and G(Beverages) 2 major categories, 4 types, 33 groups, 302 new codes. Most of the additional groups are processing food groups, which have Chinese Characteristics, such as canned, beverages, candy, meat products.

Conclusion: The foundation of data communication to dietary exposure assessment had been established, and the connection of Chinese food classifying and coding with CAC data had been achieved.

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PP-30-186

A Novel Approach for Characterizing Neighborhood Deprivation

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Background/Aims: How to characterize deprivation is increasingly discussed in the literature, especially in environmental health. A variety of scores for assessing the different aspects of geographic deprivation have been developed, eg, in the United Kingdom, the Index of Multiple deprivation and these variants. These indexes are built upon the same lines, that is, (i) calculation of the score for each domain (access to services, income, employment, health, education, and housing); (ii) attaching weights to each domain score; (iii) summing these scores, characterizing deprivation by a single figure. However, those weights are seldom constructed upon a fully explicit basis. Moreover, it is questionable to combine different deprivation attributes into a single index. We tested another approach to characterize neighborhood deprivation on the basis of domain without weighting and without combining them into single score.

Methods: From locally available data, we grouped 29 relevant variables (social and economic variables; accessibility to health care, sport facilities, parks, public services, and to health care providers) into following 4 domains: socioeconomic disadvantage; social cohesion; physical resources; and public resources. We conducted multiple factor analysis using SPAD software, allowing to construct a specific typology relative to the Strasbourg (France) metropolitan area.

Results: The information contained in the 10 first factors from FMA was used to set up the typology. It allowed summing up the information into 6 deprivation profiles in which all domains play a substantial role. Deprivation is not homogeneous across our study area: socioeconomically disadvantaged population seem having better accessibility to health care, public sport facilities, parks, public services, and feature higher social cohesion as compared to more well-off.

Conclusion: These findings indicate that our data-driven typology approach, comparing populations clustered by profile instead of using a single score, allows to take into account the various dimensions of deprivation characterizing our study area.

PP-30-187

Estimating Environmental Exposure to Pesticides Used on Canadian Golf Courses

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Background/Aims: Management of golf turf requires intensive fertilizer and pesticide use to maintain functional playing surfaces. Although regulations to reduce pesticide application for cosmetic purposes are being enacted in many Canadian jurisdictions, golf courses often remain exempt. As part of a National Carcinogen Surveillance Project (CAREX Canada), we are developing a method to estimate numbers of Canadians environmentally exposed to certain pesticides used on golf courses.

Methods: No single Canadian golf course database exists that is complete in its listing of courses or locations. The first step was to compile a database of courses in a Geographic Information System (GIS). Second, information on golf course pesticide practices was identified to determine types of pesticides applied and amounts. Finally, using GIS techniques, we connect exposure information with census data to estimate the population at risk of environmental exposure across provinces. Environmental exposure may occur in a variety of ways, eg, playing on recently treated surfaces, drift when living in close proximity, or through contaminated water sources.

Results: We identified 2339 golf courses Canada-wide from (1) DMTI Spatial, (2) Dun and Bradstreet, and (3) canadagolfguide.com. Based on a best management practices survey (CGSA, 2008), we identified use of 3 IARC Group 2B (possible) carcinogens: 2,4-D and MCPP (phenoxy herbicides) and chlorothalonil (fungicide). Additional survey information related to average course size, areas of application, and number of applications annually was used with corresponding pesticide product labels (PMRA) to calculate annual average application amounts for a typical course. For example, an average course applies 702 kg of chlorothalonil annually. Preliminary GIS analyses indicate approximately 13,000 Canadians live <50 m of a golf course. Further analyses examine application amounts and exposed populations at the watershed level.

Conclusion: This research provides necessary surveillance information for characterizing the extent of environmental exposure to widely used suspected carcinogenic pesticides in the golf industry.

PP-30-188

The Validity of the Stellman Exposure Opportunity Index Model

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Background/Aims: The Stellman Exposure Opportunity Index (EOI) model of Columbia University was designed to characterize the exposure risk to the herbicides used during the Vietnam War. The Stellman EOI model uses a geographical information system considering proximity in time and space to the herbicides spray mission. The purpose of this paper is to provide available information on the debate of the Stellman EOI model and to discuss the appropriateness of using the Stellman EOI as a proxy of the herbicides exposure risk.

Methods: We analyzed the algorithm of the Stellman EOI model and reviewed relevant published literature. We compared the Stellman EOI model with the AgDRIFT model, which is a validated exposure model for assessing airplane spray exposure. We further reviewed the Stellman EOI for the sensitivity of the Stellman EOI model and the appropriateness of using the model for estimation of exposure opportunity in Vietnam veterans.

Results: Peer reviewed papers demonstrated that significant discrepancies exist between the scope of spray affected areas by the Stellman EOI modeling and the potentially affected areas by the AgDRIFT model. The gradient of the EOI assigned by the Stellman EOI model was inappropriate as compared with the probable exposure gradient by AgDRIFT model. Stellman EOI showed excessive variations across spray missions that were not actually plausible.

Conclusion: The Stellman EOI model has significant flaws in estimating the risk of exposure to the herbicides used during Vietnam War. The use of the Stellman EOI model in any epidemiological study of Vietnam veterans should be viewed with skepticism. Without correction of the factors relating to the systemic errors of the Stellman EOI model, any study relying on the Stellman methodology should be considered invalid.

PP-30-189

The Use of a Distance-weighted Directional Buffer Function in Land Use Regression Modeling for Urban Air Quality Assessment of Windsor, Ontario, Canada

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Background/Aims: Land-use regression (LUR) model is increasingly being used in urban air quality evaluations. When developing a LUR

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model, usually a number of variables with different buffer distances were included, and eventually the best variables were selected for the LUR model by step-wise regression. The selected variable, for example, the length of highway within 200 m also indicated that all the highways within the distances of 200 m have equal effect on the calculating site of the pollutant concentrations, and the effects of the highways beyond the distance of 200 m are excluded. This kind of method, however, ignored the fact that the variables with closer distance have more effects on the concentrations.

Methods: Each buffer was assigned a weight based on their distance to the calculating sites, that is, the buffer closer to the calculating site has a higher weight. The distance weights were defined by an exponential function created by a semivariogram in geographical information system. In addition, each buffer was also divided into 8 directional sectors, and each sector was weighted by the frequency of wind directions. The buffers of the same environmental factor were combined as one variable. A regular linear regression was applied to simulate the exposure model.

Results: This new method was successfully applied to estimate the intra-urban variations of NO_2 concentration in the City of Windsor, Ontario, Canada. There were altogether 19 environmental variables used for the regression, including 12 traffic variables, 5 land use variables, and 2 census variables. Regular multivariate linear regression outputted a model with only 4 variables and an R^2 of 0. 62.

Conclusion: The distance-weighted directional buffer seamlessly embedded the effects of distance-dispersion and wind into the simulation, and can be used to estimate the intraurban spatial variation of the air pollutions.

PP-30-190

Using GIS to Evaluate Spatial Accessibility and Delivery of Health Resources in Niigata Prefecture, Japan

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Background/Aims: Health care in Japan is a hybrid system funded by job-based insurance premiums and taxes. In Japan, all citizens are covered by the national insurance system. It is estimated that by 2050, almost 40% of Japanese population will be ≥65 years. Challenges could not be any higher for the government and the ministries concerned with healthcare. A recent analysis by McKinsey & Co, a consulting firm, suggests that demand for medical care in Japan will triple in the next 25 years. In dealing with the above challenges, there has been an ongoing campaign by the government of Japan to consolidate small municipalities and reduce administrative costs. In connection with this campaign, Niigata prefecture has been actively engaged in centralizing and rationalizing certain services among which are the health services. However, the methods used to select which hospitals or services to close have, to some extent, ignored one important aspect of health service accessibility and delivery; the spatial aspect. In this study, we used a multi-analysis approach that incorporates the spatial analysis in decision making for health service delivery and accessibility to assess which of the 2 prefectural hospitals has less effect on health services in the city of Tokamachi, Niigata, Japan.

Methods: The methods used were ArcGIS 9.3 tools to import city boundaries, prefecture contour, census blocks, and demographic information, road networks, and speed limits. A multi-approach analysis that incorporated statistics, epidemiology, geographical information system, and spatial analytics was used to find which of the 2 prefecture hospital will have less impact on services if closed.

Results: One hospital had a clear spatial advantage when population locations were related to hospital location and services.

Conclusion: We suggested one hospital to close and ways to optimize delivery of the services from the remaining hospital.

PP-30-191

Geographical Information System Time-Activity and Population Exposure Modeling

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Background/Aims: Although it is increasingly recognized that environmental concentrations do not necessarily equate to individual exposure, concentrations at place of residence are often used to approximate exposure. However, individual exposure can vary, depending on circumstances such as the amount of time spent indoors and outdoors (Jarup 2004). Furthermore, environmental pollutants and exposures vary spatially and temporally with, for example, different levels during day and night (Briggs 2005). A better approximation of exposure can be obtained through time-activity modeling, using a mixture of individual level data and statistical (aggregated) data from time-activity surveys.

Methods: A model has been programmed in a geographical information system (ESRI ArcGIS) using network analysis tools. The model can use geocoded data for start and end locations of each trip (X/Y), start and end times of each trip, trip mode, travel speed, route, and destination type. Using these data, the model is able to reproduce the time-activity sequence. However, in many cases much, if not all, of these data will not be known and so the model can probabilistically impute, on the basis of available statistical information, any of these data. These statistical data comprise generalized distributions for the study population (eg, national surveys).

Results: Using data collected as part of a study to analyze the effect of traffic-related air pollution on the journey to school (Walker et al, 2009), model results have been validated. Results using 31 time-activity diaries, including actual routes taken by school children (captured using global positioning system technology), showed the model to be a reasonable predictor of routes.

Conclusion: This research demonstrates the difference obtained in exposure values from fixed home location in comparison with modeled spatio-temporal data. These results allow some quantification of exposure misclassification that may be introduced into small-scale spatial epidemiological analysis.

PP-30-192

Development of a Dust Generator Using Soil Sample

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Background/Aims: Soil dust can be generated during field operations or occurred naturally. Depending on its constituent, exposure to soil dust can cause health effects. Field sampling of soil dust can be significantly affected by weather and soil conditions. Therefore, we developed a dust generator which can generate soil dust in controlled conditions. The device can provide releasability of dust from soil samples.

Methods: The soil dust generator includes a rotating chamber where soil samples are dispersed by mechanical stirring and a settling chamber where airborne soil dust samples are collected. Optimal operating conditions are determined by consistent dust generation rate and enough soil dust samples for weighing and analysis.

Results: Operation time of 10 minutes was selected because of consistent dust generation rate in various conditions. The shortest time was considered because of potential humidity change over operation time. With the rotation speed of 30 rpm, generation rate was decreased over operation time. Since quantities of soil dust were not sufficient with rotation speed of 10 rpm, we selected the rotation speed of 20 rpm. Increase of soil mass was associated with dust level. While soil mass of

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1 g did not generate enough, dust concentrations with soil mass of 3 g were often more than 1500 $\mu g/m^3$ that was concerned for overloading in filter sampling. The optimal operating conditions for the dust generator with 30 Lpm of flow rate were 2 g of soil sample, 20 rpm of rotating speed and 10 minutes operation time. The operation conditions provided consistent dust generation rate in different soil types, when we evaluated the dust generator with the common soil types in Korea (Loam, Sandy loam, Silt loam). Dust generation rate was increased with increase of clay proportion.

Conclusion: We expect to utilize the dust generation system to determine releasability of specific ingredient like asbestos fiber in soil sample.

PP-30-193

Application of Participant-based Approach for Residential Air Quality Monitoring

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Background/Aims: Exposure to hazardous pollutants during pregnancy may cause critical reproductive health outcomes. Collecting residential exposure data has been hampered by the cost and participant burden in health studies of indoor air pollution. This study utilized a participant-based approach to measure residential volatile organic compounds concentration.

Methods: Four hundred thirteen women were recruited from 3 major hospitals in Seoul and 411 agreed to participate. A passive sampler (OVM 3500, 3M) with instruction and a questionnaire were given to the participants. They were asked to deploy the sampler for 3 to 5 days and return by pre-stamped envelope.

Results: A total of 345 participants (83.9%) completed the air sampling and returned the sampler and 16.1% did not return either the sampler or questionnaire. Among the 345 participants who completed sampling, 3 participants returned the sampler but took more than 2 months and 22 participants exposed the sampler for more than 8 days. Among the returned samplers, 92.8% complied with our monitoring quality criteria. The compliance rates were 93.3%, 91.1%, and 94.4% in the 3 hospitals. The mean total volatile organic compounds concentration was 523 $\mu g/m^3$; 38.4% of residential level exceeded standard of 500 $\mu g/m^3$ for public use indoors in Korea. The mean concentrations of benzene, toluene, ethyl benzene, and xylenes were 1.0 $\mu g/m^3$, 53.0 $\mu g/m^3$, 4.8 $\mu g/m^3$, and 7.7 $\mu g/m^3$, respectively.

Conclusion: The findings suggest that participant-based sampling approach may be a feasible and cost-effective alternative to residential exposure assessment.

WORK AND ENVIRONMENT

PP-30-194

Personal Exposure to Selected Volatile Hydrocarbons for Graduate Students Attending Colleges of Natural Sciences and Social Sciences

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Background/Aims: The present study examines whether in-campus personal exposure to volatile hydrocarbons for graduate students at College of Natural Sciences (GSNSs) and graduate students at College of Social Sciences (GSSSs) is different or not, due to their different campus activities.

Methods: Personal air samples were collected from 20 graduate students at Kyungpook National University. The participants were all nonsmokers, and were subdivided into following 2 groups: 10 GSNSs (7, Chemistry Department and 3, Chemical Engineering Department) and 10 GSSSs (6, Sociology Department and 4, Psychology Department).

Results: Of 28 compounds, 8 and 9 in personal samples of GSNSs and GSSSs, respectively, were sometimes undetected. The personal concentrations of 5 chlorinated hydrocarbons (chlorobenzene; 1,2-dichloropropane; perchloroethylene; 1,1,1-trichloroethane; and trichloroethylene) and 6 aromatics (benzene; ethylbenzene; styrene; toluene; m-, p-xylene; and o-xylene) were significantly higher for GSNSs than for GSSSs. Consistently, the indoor levels of these compounds were higher for GSNSs (in paper-research and laboratory rooms) than for GSSSs (in paper-research rooms). However, the personal concentrations of 2 aromatic hydrocarbons (1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene) were higher for GSSSs, whereas for the other target compounds, the personal concentrations were similar. The personal concentrations of those compounds were significantly correlated with both the paper-research and laboratory room concentrations for GSNSs and with the paper-research room concentrations for GSSSs. For certain compounds, outdoor sources are also major contributor to the personal exposure of both GSNSs and GSSSs.

Conclusion: It was suggested that multiple indoor sources in paper-research rooms, such as office equipments and building finishing materials, and air fresheners, were the main personal sources for GSNSs, whereas building finishing materials were the main personal sources for GSNSs.

PP-30-196

Air Monitoring of Solvents in Nail Salon Shops in California.

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Background/Aims: Nail salon workers routinely handle cosmetic products that contain a multitude of hazardous compounds and work in poorly ventilated spaces. Moreover, in recent decades, the workforce has been mainly comprised of Vietnamese immigrants, who, due to their lower English proficiency, often lack adequate training in handling hazardous compounds.

Methods: We conducted repeated personal air monitoring measurements and surveys with 80 Vietnamese women during their work-shifts at 20 different nail salons in Alameda County, California to measure levels of 3 volatile organic compounds: toluene, ethyl acetate, and isopropyl acetate. We used multilevel linear mixed effects models with workers nested within salons to assess exposure variability and to identify significant predictors of exposure. In addition, we conducted stationary air monitoring using summa canisters in 3 participating salons for numerous solvents.

Results: For the personal monitoring (n = 167), the arithmetic mean in parts per million (standard deviation) for toluene, ethyl acetate, and isopropyl acetate were 0.134 (0.083), 0.515 (0.589), and 0.041 (0.014), respectively. Within-worker, between-worker, and between-salon variability were 41%, 15%, and 44%, respectively. The intraclass correlation coefficient between workers measured at the same time in the same salon was 0.62, strongly suggesting that common exposures exist within nail salons. Significant predictors of exposure included number and types of nail care services, salon size, and ventilation characteristics. Toluene concentrations were lower from stationary monitors (0.009–0.058 ppm) than personal monitors, presumably because workers are closer to the source of these compounds. Interestingly, our stationary monitors detected methyl methacrylate, a banned compound, in all 3 salons. Overall, measured levels of toluene and methyl methacrylate were higher than the US Environmental Protection Agency recommended 24-hour ambient air level.

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Conclusion: The presence and levels of these compounds suggest a need for salon- and worker-level interventions to reduce workplace exposures as well as epidemiologic studies to understand health impacts.

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PP-30-197

Accidents Associated With Education or Research Among University Students

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Background/Aims: The purpose of this study is to assess the accidents due to education or research activities among university students, and thus provide information to the related agencies to set policies of prevention and management.

Methods: We conducted a questionnaire survey on a stratified random sample of students of all universities in Taiwan, which was obtained through dividing the colleges into 6 categories. All participants were asked to recall the accidents occurred during participating in class or research activities in the 1-year period before the survey. After being filled out, the questionnaires were read by a reading machine and analyzed by using SAS and SUDAAN statistical software.

Results: The weighted response rate of the questionnaires survey is 66.2%. The results showed that 3.55% (standard error = 0.18%) of the students had accidents in the past year. Accidents were not associated with sex or grade, but were associated with the category of college.

Conclusion: The results showed that accidents were prevalent in universities in Taiwan. Mechanical injuries should be of the highest priority in prevention and management.

PP-30-198

Validating Historical Beryllium Exposure Estimates at a Beryllium Manufacturing Facility

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Background/Aims: Beryllium exposure may lead to sensitization and chronic beryllium disease. Exposure-response relationships have been inconsistent, which may, in part, be because of lack of accurate and precise estimates of historical exposures. The purpose of this work was to create individual exposure estimates using work histories and a job-exposure matrix for a cohort of workers hired after 1 January 1994 at a beryllium production facility and surveyed for beryllium sensitization and chronic beryllium disease in 1999.

Methods: Baseline exposure estimates (BEE) for the job-exposure matrix were generated using personal cassette samples (n = 4026) collected for all jobs during a sampling campaign in 1999. Historical exposure estimates (HEE) were generated for all job and year combinations by applying fractional annual change in area-sample exposure (1994–1998) to the 1999 BEEs. Reliability of the BEEs and HEEs was evaluated by comparing with a validation dataset of independently collected personal cassette samples between 1999 (n = 147) and 1994–1998 (n = 285), respectively. Precision, bias, and total agreement of BEEs and HEEs were assessed using correlations, Bland-Altman plots, and concordance correlation coefficients (CCC), respectively. Fractional annual change was compared with information on process changes and engineering controls instituted between 1994 and 1999, which were obtained from detailed monthly reports and interviews with facility engineers.

Results: BEEs and HEEs underestimated measured exposures in their respective validation datasets by 4% and 25%, respectively. The CCC, which reflects deviation of the fitted line from the concordance line, showed much better agreement for both BEEs (CCC = 0.79, accuracy = 0.98, precision = 0.80) and HEEs (CCC = 0.65, accuracy = 0.99, precision = 0.67). Percent bias did not change with exposure levels, process areas, or year. The fractional annual change in exposure was consistent with process changes, such as implementation of enclosures and engineering controls reported in monthly reports for most process-areas.

Conclusion: The method used for historical reconstruction of exposures was reasonably reliable and can be used in epidemiologic studies to evaluate quantitative exposure-response relationships.

PP-30-199

Visual Function Abnormality Among Light-on Test Workers in TFT-LCD Industries: A 3-year Longitudinal Study

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Background/Aims: To ensure the display of quality of liquid crystal display (LCD) panels, the light-on test workers should look at screens and are exposed to flickering in clean rooms for long working hours. The aim of this study was to evaluate the visual influence among the light-on test operators.

Methods: In 2005, we conducted a cross-sectional study to collect the results of annual ophthalmic survey of light-on test workers of a thin film transistor LCDcompany in southern Taiwan. In addition, all the participants fulfill a questionnaire about ophthalmic symptoms. The questionnaire included demographic data, previous eye disease, and self-reported ophthalmic symptoms. The 51 light-on test workers who received the same examination in 2001 and 2004 were recruited as longitudinal study population. We calculated the prevalence of eye discomfort syndrome and compared the abnormality rate of ophthalmic test between 2001 and 2004.

Results: The overall prevalence of eye discomfort was 66.1% among the light-on test workers. The major self-reported eye discomfort symptoms were eye dryness, eye itching, and red eyes. The prevalence of blurred vision at near distance, double vision, and increase discharge were significantly higher in LCD light-on test stations than in LCM light-on test stations. Ophthalmic test showed there were 174 workers (16.9%) had tear secretion dysfunction and 13.6% of subjects had visual discrimination dysfunction. The visual discrimination dysfunction was significantly higher in LCM Light-on test stations than in LCD light-on test stations. In addition, contact lens use was a potential predictor for chronic conjunctivitis. The results of 3-year longitudinal study showed the employment duration, and wearing contact lens during work; work stations did not relate to the abnormality of visual function among 51 light-on test workers.

Conclusion: The 3-year follow up results showed no influence on the visual function, and further follow-up to evaluate the long-term health effects of the light-on test is necessary.

PP-30-200

The Glomerular Filtration Rate and Metabolic Syndrome Among High-tech Workers in Southern Taiwan

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Background/Aims: Metabolic syndrome is highly correlated with cardiovascular diseases. In previous studies, the prevalence of metabolic syndrome was found to be elevated among shift workers, and some studies found that a lower glomerular filtration rate (GFR) was related to cardiovascular diseases. Therefore, we conducted a study to evaluate whether GFR is associated with metabolic syndrome among workers in the high-tech industry.

Methods: We recruited workers working in an industrial park in southern Taiwan during their routine annual health examination between 1st July and 31st August, 2009. Participants accept blood sampling and received anthropometric measurements. The GFR was categorized using the Modification of Diet in Renal Disease system.

Results: A total of 15,750 workers participated in this study, and the prevalence rate of metabolic syndrome was 3.1%. We observed positive associations between metabolic syndrome and gender, age, BMI, cholesterol, GOT, GPT, uric acid and GFR (all with $P < 0.05$). On further analyses using logistic regressions, we found BMI, cholesterol, GOT, GPT, uric acid, and GFR were predictors of metabolic syndrome. After adjusting for other factors, we found cholesterol (adjusted odds ratio [AOR] = 2.35, 95% confidence interval [CI]: 1.82–3.05), GOT (AOR = 1.91, 95% CI: 1.43–2.56), GPT (AOR = 1.91, 95% CI: 1.51–2.43), uric acid (AOR = 1.64, 95% CI: 1.31–2.05), and GFR (chronic kidney disease [CKD]-1 AOR = 5.29, 95% CI: 2.96–9.47; CKD-2 AOR = 3.47, 95% CI: 1.99–6.05; CKD-4 AOR = 199.57, 95% CI: 2.59–15325.33), were independent predictors of metabolic syndrome.

Conclusion: In the high-tech industry, metabolic syndrome is associated with cholesterol, GOT, GPT, uric acid, and GFR. As renal function may increase the risk of metabolic syndrome and thus cause cardiovascular disease, early detection of renal function impairment may facilitate the prevention of further damages to the cardiovascular system.

PP-30-201

Visual Fatigue During Inspection With and Without Lens

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Background/Aims: Electronic manufacturing is increasing in many countries, including Thailand. High-quality products have to be passed through various processes such as molding, soldering, and assembling. Especially, inspection is necessary process to warrantee product quality for clients. In this process, the workers may be exposed to visual fatigue caused by minute parts, continuous work period, and individual factors.

The purpose of this study was to investigate visual fatigue and symptoms caused by inspection using or not using convex lens among female workers (age, 20–40 years) in electronic manufacturing.

Methods: Thirty of 90 workers passed the screening criteria (E-chart and TITMUS 2A vision instrument). The screened workers were divided into 2 groups; 15 persons work with lens and the others without lens tested critical flicker frequency (CFF) by digital flicker CE-10 and using questionnaires to survey health symptom.

Results: The result shows that the CFF mean value of before and after work (B/A CFF work) in the former and the latter group were 36.39 ± 1.57/34.93 ± 1.19 and 38.26 ± 1.72/36.23 ± 1.34 cycle/s, respectively. B/A CFF work in 2 groups; using lens and not using groups; were different significantly ($P < 0.05$). Considering age, CFF results implied that age affects visual fatigue; the workers are 35 up years have the highest B/A CFF of all (age 20–25, 26–30, and 31–35, respectively). A questionnaire administered to determine the effect on the health of workers indicated that 33.33% of workers feel temporal bone strain; 29.16% from eye strain; 19.44% bridge pain; and 18.05% pain of between eyebrows.

Conclusion: This study concluded that continuous work and age influence worker visual fatigue during inspection with convex lens.

PP-30-202

Computer-adaptive Assessment of Individual Mental Perceptions of Job Contents on a Website for Workplace Employees

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Background/Aims: To develop a web-based computer adaptive testing (CAT) application for efficiently examining workers' perception of job contents, we determined whether the 37-item Job Content Questionnaire (JCQ-37) could evaluate job satisfaction of the individual employees as a single construct.

Methods: The JCQ-37 makes data collection through CAT on the Internet easy, viable, and fast. A Rasch rating scale model was applied to analyze data from nearly 300 hospital employees who were randomly selected in 2008 and 2009 for a job satisfaction survey.

Results: Each item of the JCQ-37 was examined and the model fitted fairly well. Cronbach's alpha coefficients for the 2 independent surveys were 0.94 and 0.96, respectively. Each item corresponding to job satisfaction in specific groups was evaluated using a skewness coefficient and its 95% CI through item-by-item analysis.

Conclusion: A visual representation of the skewness 95% CI for group comparison by an item-by-item approach was performed to justify whether any item response pattern had deteriorated or had been distorted between groups in the 2-year period. A Web-CAT for a logit cut-point less than −0.37 for JCQ-37 was determined to help improve job content perception and promote mental health in both, workplace and community.

PP-30-204

Safe and Healthy Work Environments: An Assessment of Physicians' Level of Satisfaction in Pakistan

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Background/Aims: The safety and well-being of healthcare providers is rarely prioritized in developing countries. In resource-poor environments, safety may be compromised, which can expose workers to greater risks like communicable diseases. Poor health provider safety can also increase stress and decrease motivation. Unfortunately, little is known about unsafe working environments, particularly in conflict areas. In this study, we explored physicians' satisfaction regarding safety and occupational health in busy hospital settings in Pakistan.

Methods: A stratified random sample of 360 physicians was selected from public primary, public secondary, and public and private tertiary health facilities in the Lahore district, Pakistan. An equal number of male and female respondents were chosen from each setup. Pretested, semi-structured, self-administered questionnaires were used. The physicians were asked to rate their satisfaction regarding occupational health and safety in their current jobs.

Results: Overall, more than half of the physicians (58%) reported that they were less satisfied or dissatisfied with the amount of workplace, personal safety, and security available. A much higher percentage of females reported being dissatisfied (82%). Fewer physicians in private setups (11%) were dissatisfied compared with those in public setups (74%). Concerning general occupational health satisfaction, 70% of physicians reported being less satisfied or dissatisfied. Additionally, 79%

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of physicians in the study were less satisfied or dissatisfied regarding workplace health safety measures against diseases.

Conclusion: Satisfaction with safety measures was generally low, particularly among women and physicians in public setups. Recent security issues in the region and the absence of adequate responses from mangers and policymakers may also be compounding the issue. These findings suggest that issues related to personal health and safety should be addressed, especially in conflict areas. Failure to do so may result in illnesses, burnout, or the immigration of physicians, particularly women, from already overburdened health systems.

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PP-30-205

Varicose Veins in Hairdressers and Associated Risk Factors

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Background/Aims: Varicose veins constitute not just cosmetic problems but also clinical symptoms such as pain in the affected limb. It may affect the daily life and even require surgical treatment. Whereas an occupation associated with orthostasis has been recognized as a risk factor of varicose veins, epidemiological studies on working populations are limited. We conducted a study of hairdressers in Taiwan to evaluate the association between long-term standing and varicose veins.

Methods: We recruited participants among the members of a hairdressers union in southern Taiwan and conducted a questionnaire survey. Data on demographic characteristics, body weight and height, work history, medical history, and other possible related factors were collected from each participant.

Results: A total of 182 hairdressers participated in the survey, and 42 (23.1%) had varicose veins. In addition to age ($P = 0.032$) and a family history of varicose veins ($P = 0.014$), standing for doing housework ($P = 0.030$), number of years of working as a hairdresser ($P = 0.005$), and number of hours of standing at work ($P = 0.008$) were significant predictors of varicose veins.

Conclusion: Standing while working as a hairdresser appeared to be a risk factor of developing varicose vein. In addition, an old age and a family history of varicose veins were also associated with increased risk of developing varicose veins.

PP-30-207

Epidemiology of Respiratory Symptoms and Changes in Biological Parameters Over 5 Years in Japanese Workers Engaged in Toner Manufacturing

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Background/Aims: After some cases of siderosilicosis caused by toner were reported in the Lancet in 1994, some further studies reported granulomatous pneumonitis due to toner. However, few epidemiological studies discussing the effects of toner exposure on human health have been reported. This study aims to examine the relationship between work that involves exposure to printer/copying machine toner and development of respiratory disorders.

Methods: A total of 1504 male workers between 19 and 50 years were selected from workers engaged in production of supplying materials, including toner in Japan. Subjects were divided into 2 groups: 768 subjects with exposure to toner via toner manufacturing and development, machine development, production and maintenance, and recycle process; and 736 nonexposed referents. In addition to annual health check, toner exposed state, respiratory symptoms, and various biological parameters such as pulmonary function and biochemical markers were examined. This report describes the annual results of a cross-sectional analysis and longitudinal survey for first 5 years.

Results: Cross-sectional analysis showed significantly higher prevalence of respiratory symptoms in toner-exposed workers than nonexposed workers. In the longitudinal study, regarding the prevalence rate of most respiratory symptoms, especially acute or mild symptoms, difference between the 2 groups reduced year-on-year and the number of items that showed significant difference declined. Pulmonary function, blood cells, and biochemical markers did not consistently prove that tendency depends on toner exposure over the first 5 years.

Conclusion: In this study conducted over 5 years, it became clear that exposure to toner did not result in clear harmful effects, but harmful effects caused by smoking on respiratory function, blood cells, and biochemical markers were much stronger. However, since difference in prevalence of respiratory symptoms might be due to information bias, to truly shed light on the effects of toner-exposure, it is important to continue the current 10-year cohort study.

CHILDREN'S ENVIRONMENTAL HEALTH - NATIONAL AND INTERNATIONAL CHILDREN'S STUDIES

PP-31-036

Impact of Air Pollution on Respiratory Health of Asthmatic Primary School Children

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Background/Aims: Objective of this research was to study the associations between exposure to air pollution and respiratory health among asthmatic primary school children living in the areas.

Methods: A total of 207 respondents involved in this study, of whom 87 were children from the urban area, 67 children from the industrial area, and another 53 children from the rural area. The selection of respondents was based on purposive sampling method, in which only asthmatic children were included. Medical records were obtained from the school administration. Children aged 2 to 5 years were involved and written consent from their parents was obtained. A self-administered ISAAC Questionnaire was given to the children to be completed by their parents. Peak expiratory flow measurements were measured using a peak flow meter (Mini Weight model AFS CE 0120) on Monday, Wednesday, and Friday before and after school. Urinary oxidative stresses (8-hydroxy-2′-deoxyguanosine) among respondents were measured. Daily ambient air pollutants (particulate matter [PM_{10}], CO, SO_2, and NO_2) data were obtained from the Department of Environment, Malaysia.

Results: Prevalence of asthma from school medical record was higher in urban and industrial children compared to rural children. In 2008, the annual mean concentration of PM_{10} in industrial area (64.922 $\mu g/m^3$) was slightly higher than Malaysian guideline, and the level for urban and rural area were 48.687 $\mu g/m^3$ and 23.464 $\mu g/m^3$, respectively. Sulfur dioxide was significantly higher in industrial area with a mean concentration of 0.003 ppm as compared to in urban area with a mean concentration of 0.002 ppm. Higher levels of CO was recorded in urban area (1.305 ppm), followed by the industrial area (0.873 ppm) and the rural area (0.680 ppm). Similarly, higher levels of NO_2 was recorded in the urban area (0.029 ppm), followed by the industrial area. There was an association between the prevalence of respiratory and allergy symptoms with locations. Urban children had more respiratory symptoms such as breathing difficulty ($\chi^2 = 9.34$, $P < 0.001$), chest tightness ($\chi^2 = 9.66$,

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$P = 0.047$), and wheezing ($\chi^2 = 12.01$, p = 0.029). Allergy symptoms such as for skin rashes, nasal symptoms, and itchy and watery eyes and nose were also higher among urban children. From the general linear model, results showed a significant influence of specific day and PEF reading before school on the PEF reading after school. The concentration of oxidative stress was high among the urban children with mean concentration of 8-hydroxy-2′-deoxyguanosine (5.072 ng/mg Cr) followed by the industrial children (3.587 ng/mg Cr) and the rural children (3.090 ng/mg Cr). Severity of asthma among respondents was classified according to PEF variability, day and night symptoms, and respiratory score. Most of the children had mild and moderate asthma. Multiple linear regressions test used, where age and gender were controlled, showed that the urban children had greater risk for developing severe asthma (odds ratio [OR] = 2.47, 95% confidence interval [CI]: 1.02–5.90), since the exposure to PM_{10} was high (OR = 2.43, 95% CI: = 1.08–5.73). Pollen, pets, and mold were also associated with the asthma severity (OR = 2.34, 95% CI: 1.25–4.56), (OR = 2.23, 95% CI: 1.06–4.70), and (OR = 2.20, 95% CI: 1.20–4.38), respectively. From the logistic regression model, factors that significantly influenced the severity of asthma were pollen and the education of father.

Conclusion: This study provides confirmatory evidence that the asthmatic children who live in the urban and industrial area having a greater risk of developing more severe asthmatic conditions due to the influence of air pollutants as well as pollen.

PP-31-037

Cost-effectiveness of Screening in an Outbreak

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Background/Aims: The cost-effectiveness of renal screening in the melamine outbreak is controversial. Since traces of melamine were detected in top-selling US infant formulas, it is interesting to know if screening should be initiated in populations outside Mainland China. Therefore, we objectively evaluated the cost-effectiveness of screening by decision tree analysis.

Methods: In the diagnosis processes of children with nephrolithiasis in Taiwan, children first receive urinary analysis (sensitivity: 42.5%) and ultrasonography examinations (sensitivity: 81%; specificity: 97%), and then computed tomography scanning (sensitivity: 95%; specificity: 95%) for those positive for ultrasonography examinations. According to the costs from the Taiwan National Health Insurance global budget for urinary analysis (2.3 USD), ultrasonography examination (26.7 USD), and computed tomography scanning (115.2 USD), we calculated the cost for total-screening and nonscreening with diagnostic rates and treatment costs by decision tree analysis. The cost-effective ratio between total-screening and nonscreening for children at risk of melamine exposure was then derived.

Results: The average screening cost was 2.84 USD per child. Only mild symptoms were observed in most children with nephrolithiasis diagnosed through screening, with 23.7% of the children requiring hospitalization and 0.01% needing renal dialysis and intensive care unit care. The average treatment cost for these screened children was around 30.2 USD per child. However, the nonscreened children who failed prompt diagnosis of nephrolithiasis seemed to have more severe symptoms, with 7.1% needing stone operations and 85.7% requiring intensive care unit care and renal dialysis. The diagnosis and treatment costs for these nonscreened children were 144.2 USD and 1636.8 USD per child, respectively, which are much higher than those for the screened children. Therefore, we recalculated the cost with the incidence rate (12/1129, 1.06%) in Taiwan, and the cost-effective ratio between screening and nonscreening was 0.81.

Conclusion: It is effective to initiate renal screening programs to determine the children at risk.

PP-31-038

Correlation of Uranium Concentration in the Hair and Incidence of Goiter Among Children

Gulnara Toichueva *Institute of Medical Problems of the National Academy of Sciences of the Kyrgyz Republic, Osh, Kyrgyzstan.*

Background/Aims: To study the correlation of uranium hair concentration and prevalence of goiter among children.

Methods: A total of 41 children (29 girls and 12 boys) living in 10–12 km downstream the tailing pits and dumps were subjected to clinical and laboratory analyses. Neutron activation analysis was performed for detecting microelements and radioactive nuclides in hair samples taken from occipital region of children's head. All measurements were obtained with the use of standard y-spectrometer facility with radiation detector connected with computer.

Results: According to uranium concentration levels in the hair, all children were allocated into 2 groups. Group I comprised 9 children with uranium hair concentration >0.05 μg/g. Group II consisted of 32 children with uranium hair concentration <0.05 μg/g. The results of the study are as follows: from a total of 41 children, 18 (14 girls and 4 boys) had goiter. Of them, first-degree goiter was encountered in 7 children (4 girls, 3 boys) and second-degree goiter in 11 (10 girls, 1 boy). Uranium concentration values (0.05–0.2 μg/g) in hair samples were recorded in all 41 children. Of total, 9 children (20.45%) had uranium hair concentration level >0.05 μg/g, 4 children had >0.1 μg/g, and the rest of children had >0.06 μg/g. In Group I, goiter was encountered in 8 (7 girls, 1 boy) of 9 children. Uranium hair concentration levels exceeded 0.06 μg/g. In group II, goiter was recorded in 10 (7 girls, 3 boys) out of a total 32 children. First-degree goiter was found in 3 girls and 2 boys, second-degree goiter—in 4 girls and 1 boy. Uranium hair concentration levels (>0.06 μg/g) were encountered in 100% of children.

Conclusion: Thus, uranium hair concentration level is correlated with the incidence of goiter among children.

PP-31-039

Environmental Tobacco Smoke Exposure and Child Neurodevelopment

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Background/Aims: About 30% of children is exposed to tobacco smoke compounds during prenatal period and more than 50% in postnatal one. Such exposure has serious health consequences including negative effect on child neurodevelopment. The aim of the study was to assess children's ETS exposure during prenatal period and within first 2 years of life and to evaluate the influence of prenatal and postnatal ETS exposure on children's neurodevelopment.

Methods: The study population consisted of children with well-assessed prenatal exposure to environmental tobacco smoke (3 times analysis of cotinine level in saliva of pregnant women). Assessment of child ETS exposure after birth was based on questionnaires conducted with mothers, confirmed by biochemical verification of cotinine level in child urine. The cotinine level in biological samples was analyzed using Liquid Chromatography (high performance liquid chromatography) with Tandem Mass Spectrometry. The Bayley Scale for Infant and Toddler Development-III was used for the evaluation of child neurodevelopment.

Results: Multivariative analysis (including gender, birth order of the child, and parental educational status) indicated the statistically significant association between child prenatal ETS exposure and cognitive development ($b = -4.0$; $P = 0.04$). ETS exposure has also negative impact on motor ($b = -2.7$; $P = 0.2$) and language ($b = -3.4$; $P =$

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0.08) abilities of the child, although the results were not statistically significant. The same association was observed for child exposure within 2 years of life.

Conclusion: Maternal smoking was found to be related to a decrease in child neurodevelopment, although it is impossible to separate the prenatal from postnatal exposure. All efforts should be taken to eliminate the child ETS exposure.

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PP-31-040

A High Morbidity of Preschool Children in Ostrava Hot Spot of PM_{10} Pollution

Miroslav Dostal, Eva Schallerova, and Radim J. Sram *Institute of Experimental Medicine, Prague, Czech Republic.*

Background/Aims: Ostrava, the second largest urban agglomeration in the Czech Republic, is the most polluted region in European Union by particulate matter and carcinogenic polycyclic aromatic hydrocarbons (c-PAHs). The highest annual values of particulate matter (PM_{10}) have been reported from the monitoring station in Ostrava city district of Radvanice a Bartovice (RaB). In the years 2001–2008, they were in the range 47–65 $\mu g/m^3$ with median 62 $\mu g/m^3$. To assess morbidity of preschool children living in and nearby RaB and registered with the pediatric office in RaB.

Methods: All 86 children of the Czech etnicum born in 2001 and 2002 were included in the study (with informed consent of parents). Complete lists of ICD-10 codes of illnesses they suffered from birth to 6 years were obtained from the pediatrician.

Results: Illnesses with the highest cumulative incidence per child (confidence interval [CI]) in the first 2 years of life were J02, J06—acute upper respiratory infections: CI = 4.8; J03—acute tonsillitis: CI = 1.9; B34—viral illnesses: CI = 1.9; A08—intestinal infectious diseases: CI = 1.7; H10—conjunctivitis: CI = 0.9; J12—pneumonia: CI = 0.3. In age group 2–6, incidence of acute tonsillitis and viral illnesses remained at the same level, whereas the frequency of other illnesses decreased. Allergies: 27 children (31%) had doctor/allergist diagnosed asthma bronchiale. Asthma bronchiale was combined with atopiform dermatitis in 13 children, with atopic rhinitis in 4 children and with both atopiform dermatitis and atopic rhinitis in 9 children.

Conclusion: Incidence of acute illnesses at the age 0–2 years as well as the prevalence of asthma bronchiale at the age of 6 years are extremely high and require detailed studies on effects of air pollution on health of children in Ostrava.

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PP-31-041

A High Morbidity of Preschool Children in Ostrava Hot Spot of PM_{10} Pollution

Miroslav Dostal Eva Schallerova Radim J. Sram *1Institute of Experimental Medicine, Czech Academy of Sciences, Prague, Czech Republic.*

Background/Aims: Ostrava, the second largest urban agglomeration in the Czech Republic, is the most polluted region in European Union by particulate matter and carcinogenic polycyclic aromatic hydrocarbons (c-PAHs). The highest annual values of particulate matter (PM_{10}) have been reported from the monitoring station in Ostrava city district of Radvanice a Bartovice (RaB). In the years 2001–2008, they were in the range 47–65 $\mu g/m^3$ with median 62 $\mu g/m^3$. To asses morbidity of preschool children living in and nearby RaB and registered with the pediatric office in RaB.

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Results: Illnesses with the highest cumulative incidence per child (confidence interval [CI]) in the first 2 years of life were as follows: J02, J06—acute upper respiratory infections: CI = 4.8; J03—acute tonsillitis: CI = 1.9; B34—viral illnesses: CI = 1.9; A08—intestinal infectious diseases: CI = 1.7; H10—conjunctivitis: CI = 0.9; and J12—pneumonia: CI = 0.3. In age group 2–6, incidence of acute tonsillitis and viral illnesses remained at the same level, whereas the frequency of other illnesses decreased. Allergies: 27 children (31%) had doctor/allergist diagnosed asthma bronchiale. Asthma bronchiale was combined with atopiform dermatitis in 13 children, with atopic rhinitis in 4 children and with both atopiform dermatitis and atopic rhinitis in 9 children.

Conclusion: Incidence of acute illnesses at the age 0–2 years as well as the prevalence of asthma bronchiale at the age of 6 years are extremely high and require detailed studies on effects of air pollution on health of children in Ostrava.

Supported by Ministry of Environment of the Czech Republic Project AIRGEN (No. SP/1b3/8/08)

PP-31-043

Environmental Health Risks in European Birth Cohorts

Mark Nieuwenhuijsen, Maribel Casas, and Martine Vrijheid *CREAL, Barcelona, Spain.*

Background/Aims: There are many pregnancy and pregnancy and birth cohorts in Europe, with sample sizes ranging from a few hundred to tens of thousands. These cohorts are currently collecting a wealth of information on environmental exposures and child health outcomes, but the data are often of fragmented nature, and there is little coordination to structure and consolidate scattered research. The overall aim of the Environmental Health Risks in European Birth Cohorts project is to advance knowledge on specific environment and health causal relationships by evaluating existing tools and data on exposures and outcomes within the European birth cohorts, supporting database building, and developing recommendations for future research.

Methods: We searched for all pregnancy and birth cohorts on environment and health in Europe through the literature, research organizations, personal contacts, and the birthcohorts.net website, and sent out a questionnaire to all of them for information on environmental risk factors and health outcomes.

Results: We found over 35 cohorts and information on more than 400,000 children from across Europe. We have created an inventory of all existing pregnancy and birth cohorts in Europe with data on environmental exposures. This inventory will be available as a web-based searchable database to other researchers and policy makers. Further, working groups are evaluating European birth cohort research in specific exposure areas such as air and water pollution, heavy metals, pesticides, persistent organic pollutants, and chemicals of emerging concern, and in specific outcome areas such as reproductive outcomes, respiratory health, neurodevelopment, cancer, and growth and obesity. Case studies examine areas in which pooling of data across cohorts may be feasible (for example, PCBs and birth outcomes)

Conclusion: Information on environment and health for European pregnancy and birth cohorts is for the first time in one place presented on behalf of the Environmental Health Risks in European Birth Cohorts consortium.

PP-31-044

Impact of Carcinogenic Polycyclic Aromatic Hydrocarbon Exposure to Children Respiratory Morbidity

Radim J. Sram, Miroslav Dostal, Helena Libalova, Pavel Rossner, Jr and Eva Schallerova *Institute of Experimental Medicine AS CR, Prague, Czech Republic.*

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Background/Aims: Ostrava region in the Northern Moravia (Silesia) is the most polluted region in the Czech Republic by carcinogenic polycyclic aromatic hydrocarbons (c-PAHs) as benzo[a]pyrene (B[a]P). Sources of this pollution are especially steel industry and coke oven. In the most polluted district of Ostrava City Bartovice (OB) in the year 2008 was B[a]P 9.3.

Methods: In each district was selected 100 children aged 8–12 years with dg of AB and 100 controls (total 400 children). As biomarkers were measured 8-oxodG, lipid peroxidation, protein oxidation, and gene expression profiles in lymphocytes (using Illumina HumanHT-12 BeadChip).

Results: AB is diagnosed in OB children almost in 60% up to 3 years (vs. 25% in PRA), respiratory morbidity in preschool age with AB 5 times/yr almost in 100% (vs. 30% in PRA). Oxidative damage in urine by 8-oxodG was significantly increased in OB (Odds Ratio = 2.27, $P < 0.001$, 95% Confidence Interval: 1.40–3.70). Gene expression profiles for AB are different in these regions, probably indicating a different mechanism of disease to be induced.

Conclusion: Preliminary data may be understood: AB diagnosed in children living in region with a very high exposure to c-PAHs from ambient air may indicate that the disease is the result of this very specific and high exposure to c-PAHs.

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PP-31-045

Relationship Among Attention Deficit Hyperactivity Disorder, Dietary Habits, and Obesity

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Background/Aims: Attention deficit hyperactivity disorder (ADHD) is one of the most common psychiatric disturbance of childhood, estimated to affect 5%–10% of school-age children. The fact that the high rate of ADHD patients (26%–61%) was given weight loss treatment suggested an association between ADHD and obesity. The aim of this study was to reveal the connection among overweight/obesity, dietary habits, and ADHD symptoms.

Methods: In 2007, the Environmental Health Center (Neurodevelopment) at Dankook University Hospital examined 12,362 children (6,018 boys, 6346 girls) from 27 elementary schools in Cheonan, South Korea. Parents completed the DuPaul Parents and Teacher Rating Scales for ADHD symptoms. Dietary intakes were measured by a semi-quantitative food frequency questionnaire, from which we have constructed daily intake frequencies of 7 food groups. Using a validated mini-dietary assessment tool, we assessed eating habits of children regarding meal balance and regularity. The full set of hypothesize relationships was tested using covariance structural modeling with asymptotically distribution free estimation. Before testing the structural model, we performed a confirmatory factor analysis.

Results: Age of the children ranged from 5 to 13 years (Mean = 9.38, Standard Deviation = 1.7 years). The mean of ADHD score was 7.92. The mean of participants' body mass index was 17.68 kg/m^2. The data were well fit by the model. ADHD had a significant indirect effect on obesity that we mediated by positive affect (standardized $\beta = 0.1$, $P = 0.03$) but not direct effect. Dietary habits were more associated with obesity than diet. Overeating was strongly positive effect on obesity (standardized $\beta = 0.35$, $P < 0.0001$).

Conclusion: ADHD had direct effect on diet and dietary habits and these had direct effect on obesity. So, ADHD had indirect effect on obesity. We suggested that patients with obesity and ADHD might benefit from common therapeutic strategies.

PP-31-046

Child-specific Health Risk Assessment of 25 Indoor Air pollutants in Child-care Facilities and Indoor Playgrounds

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Background/Aims: Children's exposures to environmental contaminants are expected to be different and, in many cases, much higher than adults. Differences in the behavior of children, particularly the way in which children interact with their environment, may also have a profound effect on the magnitude of exposures to contaminants. Especially, children's facilities are an important indoor environment for children and exposure area with potential harmful health effects for children who spend most of their daily life. Therefore, the present study was performed to assess the levels and characteristics of several pollutants in indoor environments, and to predict the child-specific health risk of indoor pollutants at children's facilities.

Methods: The levels of 25 indoor pollutants (8 volatile organic compound [VOC], 3 aldehydes, 5 metal, 2 pesticides, 4 retardants, 3 phthalates) were assessed in indoor samples (dust, respiratory particulates, vapor, surface) at various children's facilities (40 day-care houses, 42 child-care centers, 44 kindergartens, and 42 indoor playgrounds) in summer (July–September, 2007), winter (January and February, 2008), and spring (March–April, 2008) periods. We analyzed using gas chromatography-mass spectrometry for VOCs, pesticides, inductively coupled plasma for metals, and phthalates, and high-resolution gas chromatography/high-resolution mass spectrometryfor polybrominated diphenyl ethers.

Results: The levels of VOCs, aldehydes, polybrominated diphenyl ethers, and pesticides showed the seasonal variations, but the levels of phthalates and metals in summer period were similar to those in winter periods. The excess cancer risks of 9 carcinogens for children were 10–3–10–5 level in all facilities and excess cancer risks of dichlorvos and formaldehyde were more than 10–4 level, respectively. The 14% in the subject facilities were exceed to 1.0 of hazard index for 16 noncarcinogens. The exposure of dichlorvos could be done through various routes such as inhalation, hand-to-mouth, and skin contact, and major route of formaldehyde was inhalation for child in indoor environment.

Conclusion: The dichlorvos and formaldehyde were selected as the major concern pollutants and need the risk reduction management plan at children's facilities.

PP-31-047

Children Health First, Eliminate Lead in Paint Campaign in Nepal

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Background/Aims: The 2002 World Health Organization report identified that lead exposure is 1 of 20 leading selected risk factors of global burden of disease. It affects more than 40 million children worldwide, of whom more than 97% live in developing countries. The primary source of lead exposure among children is from lead-based paints and lead-contaminated dust and soil. The study aimed to highlight the level of lead in paint and its consequences.

Methods: A well designed and deliberate study of lead in paint has been conducted in Nepal. Total 24 paint samples of International, Multinational, and Nepalese brand and of different types such as distemper, emulsion, enamel, and varnish were collected from the Nepalese market. Brands labeled lead-free as well as Nepalese Standard trademarked has also been included in the study. Dry samples of paints were prepared for laboratory analysis by painting on glass, drying, and scraped off.

Samples were analyzed as according to Standard Operating Procedures for lead in Paint by Hotplate or Microwave-based Acid Digestions and Inductively Coupled Plasma Emission Spectroscopy, EPA, PB92-114172, September 1991; SW846-740 (US EPA, 2001) at accredited laboratory named Delhi Test House, New Delhi, India.

Results: Laboratory analysis report shows that 11 (91.6%) of 12 enamel samples contain high concentration of lead ranges from 817.29 to 73966.44 ppm. Distemper and emulsion sample also contains lead but in very small quantity. Sample labeled lead-free also have higher concentration of lead (maximum, 817.29 ppm). Similarly, samples with Nepalese Standard trademarked do contain very high lead level up to 3136.22 ppm.

Conclusion: With this shocking result and well-known source of injury to human health, particularly to the health of children and of workers in lead industries, a mass awareness and advocacy campaign have been planned to address these issues to protect our children, and to opt to eliminate lead in paint in Nepal is the ultimate goal.

PP-31-048

Spatial Relations Between Tobacco Pipe Use and Infant Mortality in Cambodia

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Background/Aims: Tobacco smoke is a major indoor air pollutant in industrialized and developing nations. Links have been found between prenatal maternal smoking and adverse health effects as well as between children's environmental tobacco smoke (ETS) exposure and adverse outcomes. The Southeast Asia and Western Pacific regions hold half of the world's children, and Cambodia has one of the highest prevalences of smoking worldwide. This study examined the relationship between tobacco pipe use and premature deaths of children born to Cambodian women.

Methods: Multivariate logistic regression using SAS 9.2 and SUDAAN was applied in observing relationships between the prevalence of infant deaths and the mother's exposure to ETS. ArcGIS 9.2 was used to visually represent the findings.

Results: This study showed no statistically significant relationship between prenatal exposure to ETS and infant deaths within the first year of life. The OR for combined ETS exposure (ie home, work, public place) was 0.91 (0.71–1.18), $P = 0.48$. ORs for home, work, and public place were each 1.00. GIS mapping showed that Rotana Kiri had high water pipe use, high ETS, and high infant mortality.

Conclusion: Several components were not considered but may have influenced the observed results. These factors include the use of household wood-burning fires and stoves, and medical conditions of the mother, such as lupus, diabetes, and HIV/AIDS. This study also yielded findings that warrant further investigation. GIS maps showed higher numbers of chewing tobacco users within central provinces of Cambodia. Additionally, there were areas with higher infant deaths and fewer tobacco users. Further analyses may offer insight on these observations and determine what constituents contributed to the mortalities. Highest infant mortality, highest ETS, and water-pipe all occurred in Rotana Kiri. Although there was no national association, there may be an important spatial association between ETS and water-pipe use across Cambodia.

PP-31-050

CYP1A1 Modifies the Effect of Maternal Exposure to Environmental Tobacco Smoke on Child Behavior

Chia-Jung Hsieh, Suh-Fang Jeng, Yi-Ning Su, Hua-Fang Liao, Wu-Shiun Hsieh, Kuen-Yuh Wu, and Pau-Chung Chen *National Taiwan University, Taipei, Taiwan.*

Background/Aims: Maternal environmental tobacco smoke (ETS) has been identified as a key risk factor for problem behavior in children, but the role of genetic susceptibility is not clear. The purpose of this study was to examine the metabolic genetic modification effect of exposure to ETS in nonsmoking mothers on child behavior at 2 years of age.

Methods: A prospective cohort study was conducted among 191 mothers who gave births between 2004 and 2005 and their infants in Taiwan. The mothers completed a questionnaire before delivery in which they provided information on exposure to ETS during pregnancy. Four metabolic genes, *CYP1A1 MspI*, *CYP1A1 Ile462Val*, *GSTT1*, and *GSTM1* were isolated from both maternal and infant DNA samples. Children's behavior problems at 2 years of age were reported by their mothers using the Child Behavior Checklist/11/2-5. Multiple linear models were used to estimate the effects of ETS and genotype on child behavior.

Results: Maternal ETS exposure was associated with the anxious score. The ETS-exposed group with both the *CYP1A1 MspI* and *CYP1A1 Ile462Val* variants had higher scores, as reflected in total Child Behavior Checklist score as well as scores on the internalizing scale and its emotional sub-domain, the anxious scale, and the externalizing scale and its aggressive subdomain.

Conclusion: Child behavioral problems may be associated with prenatal ETS exposure, and this effect may be modified by infant *CYP1A1 MspI* and *CYP1A1 Ile462Val* genes.

PP-31-051

Longitudinal Study on Blood Lead Concentration and Children's Neurobehavioral Performance

Joon Sakong,[1] Ho-Jang Kwon,[2] Mina Ha,[2] Yun-Chul Hong,[3] Chul-Gab Lee,[4] and Dong-Muk Kang[5] *[1]Yeungnam University, Daegu, Republic of Korea; [2]Dankook University, Chunan, Republic of Korea; [3]Seoul National University, Seoul, Republic of Korea; [4]Chosun University, Gwangju, Republic of Korea; and [5]Busan National University, Busan, Republic of Korea.*

Background/Aims: Many environmental health hazards contribute to learning difficulties, such as reduced intelligence and cognitive development of young children. Lead is a pervasive environmental contaminant with the developing brain being the main target for lead toxicity. The aim of the study was to evaluate the longitudinal effects of lead on the neurobehavioral performance of Korean children.

Methods: In 2006, within a larger children's environmental disease surveillance program, 4 computerized neurobehavioral tests were undertaken in 1077 children aged 7 years residing in Seoul, Busan, Daegu, and Gwangju. Two years later, 595 children had follow-up including blood lead concentration and neurobehavioral tests. The blood lead concentration was measured as a marker of environmental exposure using electrothermal AAS. The computerized neurobehavioral tests included 4 subtests from the Korean Computerized Neurobehavioral Tests for Children (simple reaction time, choice reaction time, digit addition,

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and symbol digit). Generalized estimating equations fitting was used for all the regression models.

Results: After adjusting for gender, educational level of the mother, socioeconomic status, and computer familiarity, change of performance for all neurobehavioral tests were inversely related to blood lead concentration. Blood lead concentration was a consistent predictor of changes in neurobehavioral performance of children over time. On average, for the choice reaction time and symbol digit, the performance declines associated with a 1 μg/dL difference in blood lead were comparable in magnitude to the 40–50 days difference.

Conclusion: These results support the hypothesis that lead exposure might be associated with detectable neurobehavioral deficits in children aged 7–9 years. However, further study will be needed to clarify the effect of lead on the neurobehavioral performance of children.

PP-31-053

Influence of Environmental Exposure on Blood Lead Levels of Young Children in Seoul, Korea: A Pilot Study

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Background/Aims: Lead exposure is associated with impairment of nerve system. In particular, children are at the greatest risk due to their proximity to the floor and nature for placing hands in their mouths. Further research is necessary for better understanding of lead exposure in children. However, little is known about blood lead levels of younger children in Korea. The objective of this study was to characterize lead levels in blood of children; and to investigate the environmental factors associated with blood lead levels.

Methods: We took blood samples from 68 children (5–9 years) who resided in an industrial complex (n = 19) and residential areas (n = 49) in Seoul, and did not have any disease and clinical symptoms related to lead poisoning. Frozen samples were moved to the laboratory and kept in freezer before analysis. Graphite furnace atomic absorption spectrometry was used for analysis followed by pretreatment with 0.1% Triton X-100 and standard solution. Statistical analyses (SPSS, version 12.0) were performed to compare lead concentrations between an industrial complex and residential areas. The multiple logistic regression was performed to investigate the influence of environmental factors (house types, distance between house and vehicle road, types of drinking water, smoking of housemate, time spent outdoor, and ground types in the playground) on blood lead levels.

Results: Mean age of subjects was 74.6 months. Blood lead levels ranged from 0.3 to 2.2 μg/dL, and mean was 1.1 $\pm$ 0.4 μg/dL. Environmental variables and sex were not significantly associated with blood lead levels in this study. However, lead levels for residential areas (mean: 1.2 μg/dL [range: 0.5–2.2]) were significantly higher than those for an industrial complex (mean: 0.8 μg/dL [0.3–1.4]) ($P < 0.01$).

Conclusion: This result may suggest that exposure to lead may often occur through lead-contained materials (eg, toys, food, and house dust originated from lead-based paint), as well as polluted soil and air.

PP-31-054

Environmental Tobacco Smoke Affects Fetal Growth in Korea

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Background/Aims: Environmental tobacco smoke (ETS) is persistently suspected to be harmful to outcomes of pregnancy, but few studies have been conducted to determine the relationship between ETS exposure and early fetal growth.

Methods: Between January 2009 and February 2010, a total of 3515 pregnant women who were given ultrasonography between 20 to 22 weeks of gestation have been recruited in Seoul metropolitan area and nearby 2 cities, and 1331 women were finally analyzed after we exclude women with missing data. Biparietal diameter, head circumference, abdominal circumference, and femur length of fetuses were measured by ultrasound. In addition, information for environmental and occupational exposure histories was collected through a structured questionnaire.

Results: Student *t* test for women exposed to ETS showed that the 4 fetal growth indices were significantly lower than in women not exposed to ETS, and multiple regression analysis showed similar findings after controlling for age, smoking, and drinking habits of mother ($P < 0.01$).

Conclusion: Our findings indicate that ETS significantly affects early fetal growth measured at 20 to 22 gestational weeks.

PP-31-055

A Survey Into Basic School Pupil Lifestyle

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Background/Aims: The article studies key areas of lifestyle by basic school pupils of adolescent age. The aim of the study was to discover whether an appropriately applied physical activity helps to develop an appropriate nutritional and physical behavior and whether it minimizes the occurrence of the addictive behavior by the pupils. Pupils of schools with expanded curricula showed better nutritional and physical behaviors and less smoking or drinking alcohol.

Methods: The study questioned 204 basic and grammar schools pupils through an anonymous questionnaire consisting of 15 questions with close-ended answers. Of the sample of respondents, 89 were students of schools with expanded physical education curricula and 115 were students of schools with regular curricula.

Results: The questionnaire consisted 15 questions. A $P < 0.001$ (x2) was statistically significant.

Conclusion: As a result, we could claim that a process of preventing an appropriate lifestyle from negative factors may be significantly empowered by an existence of expanded physical education curriculum. Increasing the amount of physical activities within regular basic schools curricula, the children' health and their addiction resistance may be positively enhanced.

PP-31-056

Creating a National Register of Childhood Type 1 Diabetes Using Routinely Collected Hospital Data

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Background/Aims: In England, there is currently no national register of childhood onset insulin-dependant (type 1) diabetes mellitus. Earlier studies have attempted to use hospital data to assess diabetes incidence and prevalence; however, hospital records have improved in quality since the introduction of National Health Service reforms in April 1991, and an updated assessment of the validity of this data source as a proxy for a national register is long overdue. Our aim was to assess the feasibility of using hospital admissions data as a surrogate for a childhood diabetes register across England.

Methods: Hospital Episodes Statistics data from England for the period between 1992 and March 2006 referring to children aged 0–14 years with type 1 diabetes diagnosis were cleaned to remove re-admissions to approximate an incident dataset. The cleaned data were validated against regional population-based diabetes register data, available for Yorkshire and Oxfordshire.

Results: There were 32,665 unique cases of type 1 and type unknown diabetes for the period April 1992 to March 2006. The validation with the regional register data indicated that the hospital derived data improved in quality over time, and that data quality was better for younger cases (0–9 years) than for older cases (10–14 years). Overall incidence was 24.99 (95% CI: 24.71–25.26) per 100,000 population. Basic trends in the age distribution, seasonality of onset, and incidence matched well with previously reported findings.

Conclusion: We were able to create a surrogate register of childhood diabetes for England based on national hospital admissions data, containing ~2300 cases per year, and geocoded to a high resolution. For younger cases (0–9 years) and more recent years (from 2000 when a unique personal identifier was introduced), these data may prove to be a useful resource for epidemiological studies exploring the determinants of childhood diabetes.

PP-31-057

Environmental Lead Exposure and Attention-deficit/Hyperactivity Disorder in School-aged Children

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Background/Aims: The aim of this study was to examine the association of lead in blood with signs and symptoms of attention-deficit/hyperactivity disorder (ADHD) in Korean children.

Methods: A total of 1089 children, aged 8–11 years, participated in our study. Children underwent a standardized Korean version of a computerized continuous performance test called ADHD Diagnostic System (ADS), which includes 4 major variables of (1) omission errors; (2) commission errors; (3) response times for correct responses; and (4) the standard deviations of these response times. Parents and school teachers of the participating children administered ADHD Rating Scale (ARS) to evaluate symptoms of ADHD in our subjects. The intelligence quotients of the children and their mothers were also determined. Blood lead levels were cross sectionally measured in our child participants. Multiple linear regressions analyses were performed to assess whether scores of the ADS or ARS were predicted by blood lead level when age, gender, residential region, paternal education level, and the intelligence quotients of the child were adjusted.

Results: The blood lead concentration predicted the scores of the ADS as well as the parental and the teacher's ARS rating scores. Commission errors and the standard deviations of the correct response times were the 2 major variables of ADS predicted by blood lead concentration (β = 0.076, P = 0.022; β = 0.078, P = 0.022, respectively). In addition, both the parent- and teacher-rated ARS subscores of hyperactivity-impulsivity, but not of inattention, were predicted by the lead level (β = 0.086, P = 0.008; β = 0.096, P = 0.003, respectively).

Conclusion: The results of our study suggest that lead exposure is associated with ADHD in school-aged children, and more specifically, with symptoms of hyperactivity-impulsivity rather than inattention.

PP-31-058

Environmental Exposure to Bisphenol A in Relation to Learning Abilities in Korean Children

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Background/Aims: We aimed to investigate the association between urinary concentration of bisphenol A and learning abilities in Korean children.

Methods: The participating 1089 children (571 boys, 518 girls; age, 8–11 years; mean age = 9.05 years) were recruited from 4 different cities in Korea. Subjects performed a standardized Korean version of Learning Disability Evaluation Scale (K-LDES), which includes 7 subscales of (1) listening; (2) thinking; (3) speaking; (4) reading; (5) writing; (6) spelling; and (7) mathematical calculations. The intelligence quotients of the participating children and their mothers were determined as well. Urinary concentrations of bisphenol A were cross sectionally measured in the children, along with those of mono-2-ethylheyl phthalate (MEHP), mono-2-ethyl-5-oxohexylphthalate (MEOP), and mono-n-butyl phthalate (MNBP), which are metabolites of phthalate. Pearson correlation analyses were conducted to measure the associations among levels of environmental toxins and scores of K-LDES. Multiple linear regressions analyses were performed to assess which variables of the K-LDES were associated with urinary concentration of bisphenol A. Covariates such as residential region, paternal education level, the intelligence quotients of the child, and levels of all 3 metabolites of phthalate were controlled.

Results: Urinary levels of bisphenol A showed a significant negative correlation with the scores of reading from the K-LDES ($P < 0.01$). Multiple linear regressions analyses then showed that urinary levels of bisphenol A were significantly and negatively associated with the K-LDES scores of listening (β = −0.077, P = 0.027), reading (β = −0.070, P = 0.037), mathematical calculations (β = −0.066, P = 0.043), and the total learning quotient (β = −0.066, P = 0.048).

Conclusion: Our data suggest that environmental exposure to bisphenol A in children is associated with poor learning abilities.

PP-31-059

Association of Childhood Asthma and Attention Deficit Hyperactivity Disorder

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Background/Aims: Asthma is one of the most common chronic diseases of childhood. Attention deficit hyperactivity disorder (ADHD), which is a neurodevelopmental disorder characterized by inattention, hyperactivity and impulsivity behavior, is also a common disorder in prepubertal elementary school children. Recent studies have proposed that behavioral disorders, learning difficulties, and ADHD-like symptoms are encountered in children secondary to asthma and its treatment. On the other hand, there are others that suggest the opposite.

Methods: We investigated the association between history of childhood allergic disorder and ADHD symptoms. In 2007, this school-based population study conducted a survey of 3 elementary schools in the Cheonan city, South Korea. A total of –266 children who replied to questions ISAAC (International Study of Asthma and Allergies in children) including allergic histories, Conners' ADHD Rating Scales, and computerized Continuous Performance Test (CPT) were analyzed.

Results: Mean age was 7.72 ± 0.68 years for asthmatic children (17 male, 8 female) and 7.44 ± 0.70 years for control group (157 male, 155 female). The 2 groups were similar in age, sex, and economic status. The categorized ADHD group (>19 scores of Conners' ADHD rating scale) was correlated with asthma life-long history (odds ratio: 3.23; 95% CI: 1.08–9.68), not associated atopy, allergic rhinitis, allergic conjunctivitis, and history of food and drug allergies. The categorized inattention group (>60 T-scores of omission errors of CPT) and hyperactivity group (above 60 T-scores of commission errors of CPT) were also correlated with asthma life-long history (odds ratio: 2.63, [95% CI: 1.19–5.81]; 2.77 [95% CI: 1.28–6.01]), respectively.

Conclusion: The results of this study suggest the possibility of the association between asthma history, as reported by primary caretakers, and ADHD symptomatology. Complex and possibly multiple pathways may be involved in the association between childhood asthma and ADHD. The development of ADHD-like symptoms may be a result of the burden of a child with a chronic disease such as asthma. On the other hand, ADHD may be an etiological factor in the development of asthma in the child. A shared genetic liability has also been postulated to explain the association between childhood asthma and ADHD symptomatology.

PP-31-060

Residential Environmental Effects for the Reduction of Pulmonary Function of Children

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Background/Aims: Environmental risk factors in residence may cause respiratory disease such as asthma in children and also affect their pulmonary function. The study was to investigate environmental risk factors in residence that affect reduction of pulmonary function.

Methods: Pulmonary function test for forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) was performed using spirometer for all students of an elementary school in Seongbuk, Seoul, with surveying about asthma status and residential risk factors.

Results: It was found that among total 957 students, the number of students who had abnormal pulmonary function was 81 (8.5%), which included 58 (11.7%) males and 23 (5.0%) females. There was a significant difference in pulmonary function (FEV1/FVC)) between the asthma and control groups ($P = 0.001$). In the male physician-diagnosed asthma group, the FEV1/FVC of the case group was significantly lower than the control group and the total physician-diagnosed asthma and self-reported asthma group. The FEV1/FVC of the case group was also significantly lower than the control group. In comparing the socioeconomic factors and residential environment between the normal and abnormal pulmonary function groups, it was shown that there is a significant difference in "gender," "family smoking location," "asthma symptoms," and "asthma diagnosis." It was suggested that the family smoking location and asthma were significant factors for reduction of pulmonary function, even after correcting confounding variables, such as gender and income.

Conclusion: Passive smoking and asthma were the factors influencing reduction of pulmonary function in children.

PP-31-061

Environmental Tobacco Smoke Exposure in Relation to Attention-deficit/Hyperactivity Disorder and Learning Disabilities in School-aged Children

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Background/Aims: The aim of this study was to examine the relationship between environmental tobacco smoke exposure, attention-deficit hyperactivity disorder (ADHD), and learning disabilities in school-aged children.

Methods: Between 2008 and 2009, the current study enrolled 1089 children (571 boys, 518 girls; range, 8–11 years; mean age = 9.05 ± 0.70 years) in 5 South Korean cities. Urine cotinine was used as a biomarker for environmental tobacco smoke exposure. A cross-sectional examination of urine cotinine levels was performed, and scores on continuous performance test (CPT) were obtained from the children. The parents completed the Korean versions of ADHD Rating Scale-IV and Learning Disability Evaluation Scale. The intelligence quotients of the participating children and their mothers were determined as well. The associations between the urine cotinine concentrations, neuropsychological variables, symptoms of ADHD, and learning disabilities were assessed using linear regression analysis. The cotinine concentration was log transformed (ln) to achieve normal distributions of the variables. Path analyses were conducted with AMOS 5.0 to determine the best fitting model.

Results: After adjusting for demographic and developmental covariates, multiple linear regression analysis showed that urinary cotinine levels were significantly and positively associated with the scores of omission errors, commission errors, and response time variability of the CPT ($P < 0.01$). The path analysis model revealed that the association between urine cotinine levels and parental reports on symptoms of ADHD and learning disabilities was mediated by the neuropsychological variables of the CPT. The proposed model showed an excellent fit to the data (RMSEA = 0.038, NFI = 0.986, CFI = 0.991).

Conclusion: Our data suggest that environmental exposure to tobacco smoke might be a contributor to ADHD and learning disabilities in children, and that its effects seem to be mediated by neuropsychological impairments.

PP-31-062

Effects of Vehicle Exhaust on Children's Neurobehavioral Functions Scored by Computerized Neurobehavioral Evaluation System

Juan Qin,[1,2] Jinliang Zhang,[1] Xinyu Wang,[1] Qian Zhao,[1] Yan Zeng,[2] Para Sat,[2] and Ling Liu[1] *[1]Chinese Research Academy of Environment Sciences, Beijing, People's Republic of China; and [2]School of Public Health, Peking University, Beijing, People's Republic of China.*

Background/Aims: Effects of vehicle exhaust on children's neurobehavioral functions scored by Computerized Neurobehavioral Evaluation System.

Methods: Three schools in Beijing which located in the areas with different levels of traffic pollution were chosen based on the counts of passed by automobiles and the monitoring data of ambient air pollution.

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The order of traffic pollution levels at school campus were A1 < A2 < A3. Neurobehavioral functions of children in grade 3 were measured through Computerized Neurobehavioral Evaluation System, which involved following test items: Visual Retention Test (VRT), Visual Simple Reaction time (include VSRT-Prh and VSRT-Nprh), Line Discrimination (LDT), Continuous Performance (CPT). Neurobehavioral ability indexes (NAI) were calculated by recommended equation.

Results: Children's NAI of VRT were 0.74 ± 0.15 in School A1, 0.67 ± 0.20 in School A2, 0.70 ± 0.17 in School A3, respectively. ANOVA indicated significant differences among 3 schools ($F = 4.158$, $P = 0.017$). NAI of VSRT-Prh were 15.63 ± 6.81 in School A1, 14.50 ± 7.53 in School A2, 13.66 ± 6.67 in School A3, but no significant differences existed. NAI of VSRT-Nprh were 14.44 ± 8.13 in School A1, 14.21 ± 7.42 in School A2, 13.96 ± 7.15 in School A3, and no significant differences existed. NAI of LDT were 0.26 ± 0.10 in School A1, 0.30 ± 0.12 in School A2, and 0.30 ± 0.09 in School A3. ANOVA indicated significant differences among 3 schools ($F = 3.577$, $P = 0.033$). NAI of CPT were similar among 3 schools. Multiple regression showed that compared with School A1 children, School A2 had lower NAI in VRT, VSRT-Prh, and VSRT-Nprh, but higher NAI in LDT and CPT; and children in School A3 had significantly lower NAI in VRT and VSRT-Prh ($P = 0.062$ and 0.047) and significantly higher NAI of LDT ($P = 0.026$). There were no significant differences on NAI of VSRT-Nprh between School A1 and School A3.

Conclusion: The study showed that there were correlative relationship between vehicle exhaust exposure and children's NAI of Computerized Neurobehavioral Evaluation System.

PP-31-063

Health Risk Assessment of Aldehydes in the Activities Space of Young Children—Focused on Children's Facilities and Indoor Playgrounds

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Background/Aims: Children's facilities are an important indoor environment for children and exposure area with potential harmful health effects for children who spend most of their daily life. This study was performed to investigate concentration of aldehydes in indoor air at children's facilities.

Methods: The samples of indoor air were collected at various children's facilities (40 day-care houses, 42 child-care centers, 44 kindergartens, and 42 indoor playgrounds) in summer (July–September, 2007), winter (January–February, 2008), and spring (March–April, 2008) periods, and analyzed by HPLC. Indoor air measurement after that assessed the lifetime cancer and non-cancer risk of aldehydes exposure of young children. We estimated the lifetime excess cancer risks of formaldehyde, acetaldehyde, and the hazard quotients of non-carcinogens (benzaldehyde and formaldehyde). Formaldehyde evaluated both cancer and non-cancer risk.

Results: The indoor and outdoor (I/O) ratio of aldehydes exceeds 1.0. It appeared the interior materials have indoor source. Also, the relationship between childcare facilities and formaldehyde level was statistically significant. Aldehydes of health assessment result, formaldehyde average excess cancer risks of young children were 1×10^{-4}–1×10^{-5} level in all facilities. And hazard quotients of 4 non-carcinogens did not exceed 1.0 for all subjects in all facilities.

Conclusion: To better understand results, investigators need to account for the variability of contaminants both within and between children's facilities.

PP-31-064

Indoor Environmental Factors Associated With Asthma and Related Allergies Among School Children in Urban and Suburban Areas in Beijing

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Background/Aims: To study the indoor environmental factors associated with the prevalence of asthma and related allergies in school children.

Methods: Using cluster sampling and the ISAAC questionnaire, we performed an investigation into the indoor environmental factors related to the prevalence of asthma and related allergies among children of grade 1 to grade 4 in several urban and rural schools of Beijing.

Results: The prevalence of wheeze, allergic rhinoconjunctivitis, asthma, and eczema among school children in the past 12 months in urban areas is significantly higher than that in suburban areas ($P < 0.01$). Although the indoor environments are similar in 2 areas, passive smoke and interior decoration have different influence on the prevalence of asthma and related allergies among school children in the 2 areas.

Conclusion: The prevalence of asthma and related allergies among school children is much higher in urban areas than in suburban areas; and the indoor environmental factors such as passive smoke and interior decoration have different effects on the prevalence of asthma and related allergies in 2 areas.

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PP-31-065

Effects of Vehicle Exhaust on Children's Neurobehavioral Functions Measured by Jinyi Test Battery

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Background/Aims: Effects of vehicle exhaust on children's neurobehavioral functions scored by Manual Neurobehavioral Function Test.

Methods: Three schools in Beijing city which are located in the areas with different levels of traffic pollution were chosen, based on the counts of automobiles passed by and the monitoring data of ambient air pollution. The levels of traffic pollution at school campus were A1 < A2 < A3. Neurobehavioral functions of children in grade 2 and grade 3 were measured through Manual Neurobehavioral Function Test (Jinyi psychiatrist test set), which involved following test items: Digit Erase, Digit Symbol, Pursuit Aiming, Sign Register, Connect Number.

Results: Mean scores of Digit Erase were 70.08 ± 17.39 in School A1, 66.18 ± 17.56 in School A2, 65.06 ± 16.30 in School A3; for Digit Symbol, 44.43 ± 9.13 in School A1, 38.42 ± 9.80 in School A2, 40.68 ± 9.61 in School A3; for Pursuit Aiming, 104.05 ± 19.25 in School A1, 92.46 ± 24.90 in School A2, 99.23 ± 25.13 in School A3; for Sign Register, 38.15 ± 5.99 in School A1, 34.78 ± 6.41 in School A2, 36.19 ± 7.25 in School A3; and for Connect Number, 22.26 ± 7.71 in School A1, 19.02 ± 6.53 in School A2, 19.32 ± 7.44 in School A3. Finally, total scores of 5 items were 278.97 ± 42.89 in School A1, 250.87 ± 48.85 in School A2, 260.48 ± 52.05 in School A3. ANOVA showed there were significantly different for both single item score and total scores among 3 schools ($P < 0.05$).

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Conclusion: The study showed that there was correlative relationship between vehicle exhaust and low score of Manual Neurobehavioral Function Test. The results suggested that exposure to long-term low level of traffic exhaust may affect the neural system development of children.

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PP-31-066

The Effect of Blood Manganese Level on Neurobehavioral Function in Early School Age Children

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Background/Aims: Manganese (Mn) is an essential nutrient. Mn sources are water, food, and air, released from the manufacture, use, and disposal of Mn-based products. Excessive exposure to Mn in earlier life can affect neurodevelopment and could possibly be associated with development of neurodegenerative disorders. The objective of this study was to assess the relationship between low level exposure to Mn and neurobehavioral function in early school age children. We also compared the effect of environmental difference on relationship.

Methods: Subjects were recruited from a nationwide school age children's cohort, Children's Health and Environmental Research (CHEER). We selected 628 (city area: 208, industry area: 400 person) first grade children (mean 6.9 ± 0.6 years) from 6 elementary schools in 3 areas, 1 metropolitan and 2 industrial, of Korea out of the elementary schools nation wide. We measured the blood Mn level. Six tests (Simple Reaction Time, Choice Reaction Time, Finger Tapping Speed, Digit Addition, Symbol Digit Substitution), the Korean version of the Swedish Performance Evaluation System, were administered to each group. We conducted a questionnaire survey on the general characteristics, current behavioral features, computer familiarity, environmental exposures including environmental tobacco smoking, and food frequency on the parents of the children.

Results: The mean blood Mn level was 14.9 ± 4.0 μg/L. Neurobehavioral tests result was different between areas, respectively. Finger tapping speed was higher in children with higher blood Mn level, but only showed significantly relationship in industrial area. Result of neurobehavioral tests, Simple Reaction Time, Choice Reaction Time, and Symbol Digit Substitution, increased as blood Mn level was higher after controlling for birth order, paternal education level, computer familiarity, and annual household income factor.

Conclusion: This study suggests that blood Mn level is associated with neurobehavioral function of children. This relationship was prominent only in children living in the industrial areas. These finding may provide further evidence for Mn exposure-health effect relationship.

PP-31-067

The Level and the Changes of Children's Blood Lead Levels Before and After Leaded Gasoline Banned in China

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Background/Aims: To describe the blood lead levels (BLLs) in Chinese children and identify its trends of changes after leaded gasoline was banned in China.

Methods: Articles on children BLLs published from 1994 to 2007 were collected through Chinese Biomedical Disk, Chinese Journal Full-test Database, and other ways. Finally 61 articles, including 32 of rural children, were eligible according to the following criteria: (1) BLLs measured by graphite furnace atomic absorption spectroscopy or inductively coupled plasma mass spectrometry; (2) strict quality control; (3) sample size bigger than 100; (4) children aged from 0 to 14 years old; and (5) no lead pollution sources in the areas where the screened subjects live; and 19 eligible articles of children's BLLs in industrial areas were selected based on the 1–4 criteria above. Then all selected articles were divided into 3 categories according to the time of sampling: (1) sampling prior to the year when the leaded gasoline was banned as "before"; (2) within 3 years after the ban as "the first segment after"; and (3) 4 and more years after ban as "the second segment after."

Results: The mean BLLs of Chinese children were 97.7 μg/L before, 95.4 μg/L in the first segment after, 80.4 μg/L in the second segment after, respectively. The prevalence rates of BLLs ≥100 μg/L were 37.2%, 36.2%, 23.1%, respectively. For rural children, the mean BLLs were 87.5 μg/L before the ban, 72.2 μg/L after the ban; the prevalence rates of BLLs ≥100 μg/L were 28.4% and 18.8%. For children in industrial areas, the means of BLLs were 110.8 and 105.2 μg/L.

Conclusion: The BLLs of children decreased significantly after the ban of leaded gasoline in urban and rural areas of China while those of in industrial area showed little decrease; the BLLs of Chinese children were much higher than those in developed countries. It was urgent and necessary that we should prevent and control the lead pollution and children's lead exposure.

PP-31-068

The Effect of Parental Factors on Their Children's Blood Lead Levels Change

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Background/Aims: This study was performed to estimate the effects of parental factors on blood lead levels among their children.

Methods: We examined the relation between parental factors (eg, parental cotinine level and parental blood lead level) and their children's blood lead levels in a longitudinal study. Sixty-eight children (42 boys and 26 girls) and 101 of their parents were tested for blood lead levels change during the 2 years time period. We also estimated urinary cotinine levels of children and their parents.

Results: Geometric mean blood levels were 2.08, 2.22, 1.87 μg/dL for children (aged, 3–19) with total, male, female, respectively. In the multiple regression model, the change of blood lead level was related to father's smoking status after adjusting for age, sex, parental urinary cotinine level, parental blood lead levels, parental blood lead levels change.

Blood lead levels change in childhood, especially in boys, was significantly associated with father urinary cotinine levels ($P = 0.0012$) and blood lead levels change in their mothers ($P = 0.0006$).

Conclusion: This trend may be attributed to differences in blood lead level change among children, especially boys, because of differing smoking status of the father, and blood lead levels change in the mother.

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PP-31-069

Maternal Drinking and Environmental Tobacco Smoke During Pregnancy and Autism Spectrum Disorder in Children

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Background/Aims: Autism Spectrum Disorder (ASD) is a chronic neurodevelopmental disorder characterized by qualitative problems in social interaction, language and communication, and repetitive and stereotypical behavioral disorders, and its incidence is increasing gradually in Korea. The purpose of this study is to examine how the risk of ASD in school age children is associated with the mother's drinking and exposure to environmental tobacco smoke (ETS) during pregnancy.

Methods: We administered the Korean-version of Autism Spectrum Screening Questionnaire to around parents or guardians of elementary students in Cheonan during the period from 2007 to 2008. We analyzed 15,981 questionnaires. Autism Spectrum Screening Questionnaire consists of questions on social interaction, behavior, and motor and negative symptoms. Each question was given a score between 0 and 2 and if the total score was 15 or higher the child was considered to have ASD.

Results: The mother's drinking during pregnancy increased the risk of ASD in children by 1.66 times compared with children whose mother did not drink, with a significant dose-response relationship (P-trend $<$ 0.0001). The risk of ASD was 1.66 times higher in children whose mothers were exposed to ETS during pregnancy than those mothers not exposed to ETS. The odds ratio (OR) of ASD of children whose mother was exposed to ETS during pregnancy was 1.51 for 1–2 times ETS exposures a day, 2.86 for 3–4 times ETS exposures, and 2.80 for 5 or more times ETS exposures compared to children whose mother was not exposed to ETS during pregnancy, showing an obvious dose-response relationship between exposure to ETS and the risk of ASD (P-trend $<$ 0.0001).

Compared with children whose mother did not drink and was not exposed to ETS during pregnancy, the risk of ASD was significantly higher in those whose mother exposed to both drinking and ETS (OR = 1.80; 95% CI: 1.39, 2.33) (P-interaction $<$ 0.0001).

Conclusion: We found that mother's drinking during pregnancy and parents' ETS associated with ASD in their children.

PP-31-071

Exposure Assessment of Preservatives in Children's Cosmetics

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Background/Aims: The preservatives used in children's cosmetics such as lotion, shampoo, and bath wash are made up of some of hazardous chemicals and may be released directly onto skin. Especially, the sensitive groups such as infant and children have taken more risk than adult because of their rapid growth rate, immature body and cell tissues, and weak immune system. Therefore, the dermal exposure assessment and risk management have to be established urgently to protect children health from the exposure by hazardous chemicals contained in children's products.

Methods: . We conducted dermal exposure assessment of 30 children articles including lotion, shampoo, and bath wash. These products are likely to significantly contact by hands and other body parts. We followed 8 preservatives which might be contained in these children's products. They included 2 alcohols (benzyl alcohol and phenoxyethanol) and 6 parabens (methyl paraben, ethyl paraben, isopropyl paraben, propyl paraben, isobutyl paraben and butyl paraben). First, all component tests of these chemicals in products were evaluated. As for exposure factors, we conducted a survey about infant formula intake, children's weight, activity time and product skin contact time, targeting 550 children aged from 0 to 5 via online questionnaires.

Results: As a result, among 30 children's products, 22 products contained some of 8 chemicals we conducted. Methyl paraben was found in 20 products and phenoxyethanol was found in 14 products, respectively, including body lotion, shampoo, and bath wash. As for phenoxyethanol, different products were found to have high exposure amount with posting 4.22–622.46 μg/kg/d.

Conclusion: These results of dermal exposure assessment will support the scientific method for risk assessment of children's products. It also will be used to manage safety of hazardous substances in children's products in the focus on protection of children's health.

PP-31-072

Dermal Exposure Assessment of Heavy Metals in Children's Products

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Background/Aims: Many children's products are handled with the hands, but some may also be contacted by skin of other body parts, such as neck and ankle contact with jewelries and the bottom part contact with a diaper. When children contact these products such as school supplies, jewelries, and diaper onto their skin, some of heavy metals may enter their bodies. Some of the substances, which are not always chemically bound to the products, may also be released directly onto skin. Therefore, the purpose of this study is to evaluate the dermal exposure assessment and risk management for hazardous chemicals associated with their articles. Because children are more vulnerable to the effects of toxic chemicals, even small amounts of a chemical can impact a child's ability to reach his or her full potential.

Methods: First, all migration possibilities of heavy metals in products were evaluated through preliminary component tests for 80 products including school supplies such as sticker book and crayons, jewelries, and diapers. Among articles having migration possibility, the amount of migrated heavy metals using artificial sweat and urine were quantified.

Results: As a result, among 9 heavy metals, migration of 8 types (Pb, Cr, Ni, Cu, Zn, As, Cd, and Sb) were confirmed. Cu and Zn were found in various products including school supplies and jewelries. As for Ni and Cd, jewelries were found to have high exposure amount with posting 0.40–731.3 μg/kg/d and 3.56–6.98 μg/kg/d, respectively.

Conclusion: The results of investigation found that the exposure of children with 5 different age groups (0–5 years) to Ni and Cd in jewelries were higher than the reference toxicity. To be exposed to Ni and Cd from products raise health problems such as high blood pressure, kidney damage, anemia, and neurobehavioral/learning disabilities.

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PP-31-073

Perinatal Exposure to Environmental Phthalate and the Cognitive Development of 6-Month-Old Infants (MOCEH Study)

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Background/Aims: The relationship between the maternal urinary concentrations of phthalate metabolites during pregnancy and the children's intellectual development was explored.

Methods: Mono-2-ethylhexyl phthalate (MEHHP) and mono (2-ethyl-5-oxohexyl) phthalate (MEOHP), both metabolites of di (2-ethylhexyl) phthalate (DEHP), and mono-n-butyl phthalate (MBP), a metabolite of dibutyl phthalate (DBP), were measured in urine samples of 236 mothers at first trimester and 470 mothers at mid trimester of pregnancy. The cognitive developmental status of the 6-month-old infants was assessed using Korean Bayley scales of Infant development-second edition.

Results: The mean concentrations of MEHHP, MEOHP, and MBP were 12.6 μg/L (SD = 13.8, range: 0.25–97.9), 13.3 μg/L (SD = 17.8, range: 0.28–193.9), and 35.3 μg/L (SD = 66.1, range: 0.22–911.9), respectively, at first trimester and 15.4 μg/L (SD = 23.0, range: 0.25–262.7), 18.9 μg/L (SD = 29.7, range: 0.28–303.6), and 35.5 μg/L (SD = 56.9, range: 0.22–528.1), respectively, at mid trimester. After adjusting for demographic and developmental covariates, the cognitive quotient and motor quotient were negatively associated with DEHP metabolites, but not with DBP metabolites concentrations of mothers at first trimester. We also found a tendency for negative relationship between the cognitive quotient and motor quotient and DEHP metabolites, but not with DBP metabolites concentrations of mothers at mid trimester. After controlling for maternal IQ, the tendency for inverse relationship between the DEHP metabolites at mid trimester and the cognitive quotient and motor quotient was still observed.

Conclusion: This study observed a tendency for an inverse relationship between phthalate metabolites in urine of mothers during pregnancy and the infant developmental quotient at 6 month of the offspring.

PP-31-074

The National Children's Study: Effectiveness of Household-based Recruitment

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Background/Aims: The National Children's Study (NCS) is a nationwide United States birth cohort study. The initial design proposed household-based multi-stage cluster sampling procedures to enroll 100,000 births with a target of 1000 in each of 105 randomly selected locations. In the second sampling stage 7–20 small neighborhoods (segments) were randomly selected in each location. All women in the segments who become pregnant during a 4-year period are eligible for enrollment. In fall 2005, Orange County, California was 1 of 7 locations chosen to evaluate a draft NCS protocol, including the community-based recruitment and data collection methods.

Methods: In April 2009, the Orange County location started door-to-door household recruitment, pregnancy screening of age-eligible women, enrollment of pregnant women, and data collection from the first trimester of pregnancy through the 6 month child visit in 15 segments that combined have 10,500 dwelling units. The segments are highly diverse in physical characteristics, sociodemographics, and race-ethnicity, which has required use of multiple strategies for community engagement.

Results: As of April 2010, household enumeration was completed for 10,229 (95.6%) of available dwelling units. Despite substantial community outreach, only 30% of respondents had heard of the NCS prior to the household visit. The enumeration identified 5171 women between 18 and 49 years of age, and pregnancy screening interviews were completed on 5093 (98.5%) of them. In this very early stage, 130 eligible pregnant women were identified, 91 (70%) enrolled in the study, and 27 births have occurred. There have been fewer births so far than was anticipated with the sampling design.

Conclusion: Experiences of the pilot study in Orange County indicate that community based door-to-door recruitment and enrollment is feasible, but it took substantial effort and the number of births is less than anticipated. The NCS is currently pilot testing alternative recruitment schemes to evaluate how recruitment yield and efficiency can be enhanced.

PP-31-075

Environmental Exposure and Safety Study in Children's Activity Space

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Background/Aims: Children have increased vulnerability to hazards in the environment. There are many differences between children and adults that are likely to result in greater toxicity in children from similar external environmental exposures. Their immune, nervous, and respiratory systems are not complete, and the rapidly growing tissues of their systems are more susceptible to environmental assaults. In addition, children's behavior (eg, hand-to-mouth activity) and the way that children interact with their environment may have a profound effect on the magnitude of their exposures to contaminants and put children at a higher risk. In some cases, childhood exposure to toxins can cause serious health damage to an individual later on in life.

There can be many kinds of chemicals of concern in children's activity space. The materials used in children's products and space like plastics, paints, and fabrics are made up of chemicals, and these chemicals can cause harm to the children's health.

Methods: The purpose of this study is to provide a conceptual framework for a more complete assessment of children's exposure to hazardous chemicals which existed in their activity space, and the resulting potential health risks.

Results: This framework outlines the phases for assessing the risks of exposure to chemicals in children's space during childhood using a phased approach that includes problem formulation, hazard identification, exposure analysis, and risk characterization.

Conclusion: However, further studies are needed for more detailed quantitative estimates of children's exposures and for evaluating cumulative risks of the chemicals contained in the children's activity space.

PP-31-076

The Prevalence of Childhood Depressive Disorder in South Korea

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Background/Aims: Childhood depressive disorder is the most common childhood-onset psychiatric disorder, and one of the most prevalent chronic health conditions affecting school aged children. The prevalence of childhood depressive disorder is estimated to be approximately 2%–8% in American or European children. It is not yet clear why the prevalence of depression increase during adolescence. The objective of this study was

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to examine the prevalence and epidemiological characteristics of childhood depressive disorder in Korea.

Methods: This study conducted a survey of elementary students in the Cheonan area for 2007. Twelve thousand twenty-three children who replied to questions on Kovacs Depression Inventory and Epidemiological Data, including father and mother smoking/drinking history, vaccination history, ADHD, and autistic spectrum disorder history, etc were analyzed.

Results: Mean age was 9.21 ± 1.81 years for control group (5810 male, 5844 female) and 9.91 ± 1.83 years for depression group (CDI sore >22; 159 male, 210 female). The 2 groups were similar regarding age, height, weight, and economic status but different to sex and grade. The scores ASSQ and Dupaul's ADHD Scales in the depressive group was significantly higher than that in the control group (χ^2 = 386.01, P = 0.00, χ^2 = 166.58, P = 0.00).

Depressive group were correlated with indirect smoking history (χ^2 = 32.36, P = 0.00), alcohol drinking history (χ^2 = 7.57, P = 0.01), vaccination history (χ^2 = 27.60, P = 0.00), not associated father and mother smoking history.

Conclusion: Increased rates of childhood depressive disorder, as reported by primary caretakers, might reflect the increasing negative impact of environmental risk factors on neurobehavioral health. The longitudinal study of the prevalence of childhood depressive disorder must be considered for further.

PP-31-077

A Study on Correlation of Home Environment and Asthma and Allergy Among Preschool Children in Seoul, Korea

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Background/Aims: Allergic disease has become an issue due to rapidly increasing prevalence in children and environmental factors are known to be possible causes of the disease. The aim of this study is to explore the associations between indoor environmental factors and asthma and allergy symptoms among pre-school children.

Methods: This study is based on self-administered questionnaires to survey the home environment and the children's health. The standardized International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire used.

Results: A total of 2145 surveys have been distributed and 1102 of them have been returned (response rate 51.4%) and 1067 of them were valid. The prevalence of doctor-diagnosed rhinitis was 18.4% and eczema was 23.6%. More than 70% of children were living in multi-family buildings or town house and living in multi-family house increased the risk of doctor-diagnosed rhinitis and cough at night. There was a significantly increased risk of all symptoms as the size of residence is smaller. More than 50% of homes used PVC material and it tended to be associated with all of the investigated symptoms. Of the parents, 53.9% reported visible mold and 39.4% reported damp stains. Discolored wood floors, water leakage/flooding and floor moisture had strong association with cough at night, doctor-diagnosed asthma and Rhinitis. The risk was higher for children living in homes with condensation more than 25 cm. At least one of the family members smoked in 66.5% of the families. Smoking habit and keeping pets are significantly associated with all symptoms. Attending day-care center earlier increased the risk of doctor-diagnosed Asthma.

Conclusion: The present survey found that Type of dwelling, size of residence, flooring material, dampness, smoking habit, attending day care were associated with an increased risk of allergic symptoms.

PP-31-078

A Comparison of Sensitization Rates of Inhalant Allergen Between Tangerine Farm and Non-Tangerine Farm Communities

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Background/Aims: According to the surveys, Jeju Province, despite being a clean area, has a significantly higher rate of receiving medical treatments of atopic diseases called environmental diseases such as atopic dermatitis, allergic rhinitis. This study tries to provide a basic data for finding some factors of allergic development, by comparing the relations of tangerine farming in Jeju Province.

Methods: For this purpose, the total students of 2 elementary schools in a tangerine farming community and one in non-tangerine farming were sampled. Under their parents' agreement, skin prick tests were conducted on the 1284 children (82.3%) of the total 1550 students. The skin prick test applies 16 kinds of inhalant allergen with 22G needles. The skin prick tests were conducted on 19 May and 5 June, 2009. Diagnostic allergen extracts of citrus red mite were personally manufactured and applied. The size of wheal due to histamine (A/H ratio ≥ 1) was evaluated as positive. The wheals that were less than 2 mm in diameter due to histamine and the ones observed in the negative contrast group were excluded from validity study.

Results: The valid subjects among the 1284 children in total were 1041 (81.1%) children, whose average ages were 9.6 ± 1.6 and the males were 50.2%. The sensitization rate for more than 1 allergen was 41.9%. It can be ordered into *D. pteronyssinus*, *D. farinae*, cedar, Mould 1, *Tyrophagus*, Grass, and citrus red mite. The sensitization rates tended to be significantly on increase in proportion with their ages. The significant antigens of sensitization rate in the tangerine farming community were ordered into citrus red mite, cedar, *Tyrophagus*, cockroaches, *D. farinae*, Animal hair 1, and Trees 2. As for the non-tangerine farming community, only Mould 1 showed significant sensitization rates. The comparison of more than 1 sensitization rates of allergen showed higher sensitization rate (P = 0.004) in the tangerine farming community (47.5%) than in the non-tangerine farming community (38.4%). Despite the correction of genders and ages, the sensitization rate of allergen showed significant differences.

Conclusion: More than one sensitization rate of the 16 inhalant allergens showed 41.9%. The tangerine farming community shows higher sensitization rate than the non-tangerine farming community. Above all, the tangerine farming community shows the sensitization rate of the allergens of citrus red mites and cedars related to tangerine farming. These allergens are assumed to be the main allergens developing atopic diseases. Therefore, this suggests that the control methods should be found by studying the mechanism of sensitization rates of allergens.

PP-31-079

Prenatal Exposure to PCBs and OCPs and Neurodevelopment of Newborn: Shanghai Study

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Background/Aims: Research found that prenatal exposure to polychlorinated biphenyls (PCBs) and organochlorine pesticide (OCPs) can affect infant growth and neurodevelopment. But we have not known PCBs and OCPs prenatal exposure levels in Shanghai and whether or not they affect infant health at these levels.

This study is to investigate the prenatal exposure levels of PCBs and OCPs to identify the exposing high-risk factors in Shanghai, and to evaluate the effect of the PCBs and OCPs prenatal exposure on the growth and neurodevelopment of newborn infants.

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Methods: A total of 200 mother–infant pairs were enrolled between October 2008 and September 2009 in Shanghai. General information and risk factors were obtained by questionnaire. Birth weight, length, and head circumference were obtained from medical records. Neonatal neurodevelopment was determined by neonatal behavioral neurological assessment. Cord blood samples were collected during delivery, and PCB and OCP levels in cord serum were determined by gas chromatography-electron capture detector.

Results: Among the 21 investigated PCBs and 20 investigated OCPs, p,p'-DDE, HCB, β-HCH are predominant pollutants found in cord serum. The detection rates were 91.4%, 87.8%, 76.6% and the median (range) were about 0.46 (0.34–23.01) μg/L, 0.66 (0.12–2.31) μg/L, 0.42 (0.2–6.81) μg/L, respectively. p,p'-DDE was positively correlated with mothers' age, occupation, education level, and egg and meat consumption frequency. β-HCH was positively correlated with mother's occupation and shrimp consumption frequency. The association between HCB and these factors were not found.

We did not find any association between p,p'-DDE, HCB, β-HCH levels and infant birth weight, length, and head circumference. The association between p,p'-DDE, HCB, β-HCH and the results of neonatal behavioral neurological assessment were also not found. But we found HCB was negative when correlated with hand grip and β-HCH was negative when correlated with hand stretch. The detection rates of PCBs ranged from 0% to 38%; related results are not given because of low detection rate.

Conclusion: In this research, we found that the predominant contaminant were p,p'-DDE, HCB, β-HCH, and food maybe their major resource. We did not find effects on infant health. This research provided useful information about related study and further research.

PP-31-203

Vitamin D Deficiency and Indicators of Increased Adiposity in School-age Children: A Prospective Study

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Background/Aims: Cross-sectional studies indicate that vitamin D serostatus is inversely associated with adiposity. It is unknown whether vitamin D deficiency is a risk factor for the development of adiposity in children. We investigated the associations between vitamin D serostatus and changes in body mass index, skinfold ratio (subscapular/triceps), waist circumference, and height in a longitudinal study of children from Bogotá, Colombia.

Methods: We quantified plasma 25 (OH) vitamin D (25 (OH)D) in baseline samples of a randomly selected group of 479 children aged 5–12 years and classified vitamin D status as deficient (25 (OH)D $<$50 nmol/L), insufficient (25 (OH)D $\geq$50 and $<$75 nmol/L), or sufficient (25 (OH)D $\geq$75 nmol/L). We measured anthropometry annually for a median 30 months. We estimated average change in each anthropometric indicator according to baseline vitamin D status using multivariate mixed linear regression models.

Results: Vitamin D-deficient children had an adjusted 0.1 kg/m^2/yr greater change in body mass index compared with vitamin D-sufficient children (P for trend = 0.05). Similarly, vitamin D-deficient children had a 0.03/yr (95% CI: 0.01, 0.05) greater change in subscapular-to-triceps skinfold ratio and a 0.9 cm/yr (95% CI: 0.1, 1.6) greater change in waist circumference compared with vitamin D-sufficient children. Finally, vitamin D serostatus was positively associated with attained height in girls; vitamin D-deficient girls grew an estimated 0.6 cm/yr less than their vitamin D-sufficient counterparts (P = 0.04).

Conclusion: Vitamin D serostatus was inversely associated with the development of adiposity in school-age children and positively associated with linear growth in girls.

DEVELOPMENTAL ORIGINS OF DISEASE AND FETAL PROGRAMMING

PP-31-092

Prenatal and Postnatal Exposure to Phthalates and the Relation to Steroid Hormone and Gender Role Behavior in Children

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Background/Aims: Phthalates exposure was found associated with decreased anogenital index in male newborns and reduced masculine play boys. It is hypothesized that sex hormone might be altered and gender role behavior changed in relation to phthalates exposure.

Methods: We investigate the relation of steroid hormones and pre-school activities inventory to phthalate metabolites in pregnant women and their children in a perspective cohort during 2001–2009 in central Taiwan. In all, 11 phthalate metabolites representing the exposure to 5 commonly used phthalates (Di(2-ethylhexyl)phthalate [DEHP], DiBP, DnBP, BP, and DiNP) were measured in urine, serum, and human milk by fully automated LC-LC/MS-MS-system. Steroid hormones were analyzed in maternal and children serum using radioimmunoassay.

Results: DEHP metabolite levels in pregnant women urine were significantly correlated with their corresponding cord blood. Phthalate exposure was associated with decreased testosterone (TT) concentrations at the years of 0 (ie, cord cx-MiNP and cord TT: spearman correlation $r = -0.49$, $P < 0.05$, respectively). Postnatal exposure to DEHP was associated with decreased TT and pre-school activities inventory scores in girls at the age of 5 years, indicating stereotyped feminine toys and activities, with adjustment for gender, education of the major caretaker, and elder brother or sisters.

Conclusion: It is firstly reported that TT levels decreased with increasing phthalates exposure consistently in the young children at the ages of 0, 2, and 5 years. Transplacental exposure of phthalates and effect of steroid hormones are established. The feminine role might associate partly with the decreased TT. Postnatal exposure to phthalates is also important for the changes in hormone and behavior.

PP-31-094

Prenatal, Perinatal, and Early Postnatal Risk Factors of Childhood Asthma

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Background/Aims: The aim of this study is to investigate the impact of prenatal, perinatal, and early postnatal risk factors on asthma and their links to early or late-onset asthma in children.

Methods: We conducted a 1:2 matched case-control study from previous Taiwan Children Health Study population, which was a nationwide study recruiting 12 to 14 year-old school children in 14 Taiwanese communities. A total of 579 mothers of participants within 5 years of age and the in-utero period were telephone interviewed for environmental exposures,. We used conditional logistic regression for statistical analysis.

Results: Childhood asthma was associated with maternal medication tablet use during pregnancy (OR = 3.73; 95% CI: 2.2–6.33), forceps and

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vacuum use during delivery (OR = 4.10; 95% CI: 1.39–12,1) (OR = 4.08; 95% CI: 1.84–9.03), recurrent respiratory tract infections within first year of age (OR = 2.67; 95% CI: 1.78–4.02), hospitalization within first year of age (OR = 2.99; 95% CI: 1.58–5.67), daycare attendance before 3 years of age (OR = 2.47; 95% CI: 1.33–4.57), and main caregiver care other children in first year of age (OR = 1.51; 95% CI: 1.02–2.23). Exposures of the above factors showed dose-responsiveness on the risk of asthma (P for trend < 0.05). Exclusive breastfeeding was a protective factor for asthma (OR = 0.49; 95% CI: 0.31–0.79). Most of the effects of the above factors revealed greater impact on early-onset asthma, except for forceps and vacuum use, and daycare attendance.

Conclusion: Exposures to maternal gestational medication use, forceps and vacuum use during delivery, recurrent respiratory infections, daycare attendance were associated with higher risks of childhood asthma. Exclusive breastfeeding was a protective factor for asthma. Policies should be made to prevent risks and promote exclusive breastfeeding for children.

HEAVY METALS AND METALLOIDS

PP-31-144

Assessment of Prenatal Mercury Exposure in Mother-neonate Pairs in an Urban Immigrant Community

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Background/Aims: Prenatal mercury exposure can interfere with essential brain developmental processes, and can cause developmental and language deficits. The most common route of prenatal exposure is through maternal ingestion of contaminated fish, which contains methylmercury, and contaminated products (eg, skin-lightening creams) that contain inorganic mercury. Additional environmental risk factors, unique to urban immigrant communities, include spiritual use of elemental mercury, foreign birth of the mother, and coastal proximity. This study assessed mercury levels in the urine of pregnant women and in cord blood collected at delivery, and examined sources of exposure in a predominantly Caribbean, urban immigrant population in Brooklyn, NY.

Methods: A questionnaire designed in collaboration with health professionals from the Caribbean community assessed possible environmental exposures to mercury, including fish consumption, ritualistic practices, occupational exposures, use of dental amalgams, and use of mercury-containing skin products and household products. Of the 190 participants, 189 provided urine samples and 78 provided cord blood samples.

Results: The geometric mean (95% CI) for total mercury in cord blood was 2.18 μg/L (1.76–2.69), compared to 0.326 μg/L (0.285–0.372) total blood mercury reported in CDC's Fourth National Report on Human Exposure to Environmental Chemicals in the age group 1–5 years. The 95th percentile levels for our study and CDC were 9.15 μg/L and 1.80 μg/L, respectively. Predictors of elevated cord blood mercury levels included higher gestational fish consumption and foreign birth of the mother. There were no reports of elemental mercury use in ritualistic practices or use of skin-lightening creams.

Conclusion: This study highlights data gaps in the assessment of environmental risk factors related to mercury exposure in urban immigrant communities. Findings may help target interventions with respect to fish consumption habits during pregnancy and appropriate handling and disposal of mercury sources in the home.

PP-31-146

Exposure to Selenium and Risk of Cutaneous Melanoma

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Background/Aims: Selenium (Se) is a metalloid of strong toxicological and nutritional interest in human health, and both beneficial and adverse effects on the risk of human cancer have been suggested on the basis of epidemiologic and laboratory studies. A recent trial has shown no beneficial effects of Se on cancer risk, and 2 observational cohort studies indicated an excess incidence of melanoma among subjects with the highest Se exposure. We investigated this possible association through a population-based case-control study in an Italian community.

Methods: In all, 59 patients with newly diagnosed cutaneous melanoma and 59 population controls residing in the city of Modena, northern Italy, reported details about their life-style and dietary habits, and yielded a blood sample. We assessed serum Se concentrations through atomic absorption spectrometry, and we calculated the relative risk of melanoma with its 95% confidence interval (CI) associated with serum Se concentrations through conditional and unconditional logistic regression models, adjusting for potential confounders.

Results: Relative risk of melanoma was increased in the middle tertile (2.2, 95% CI: 0.7–6.9) and in the upper tertile (4.4, 95% CI: 1.5–12.6) of serum Se levels, as compared to subjects in the bottom tertile, with P for linear trend of 0.001. These results were substantially confirmed after adjustment for potential confounders, such as family history of melanoma, number of atypical nevi, sun exposure, history of sunburns, and education. Serum Se levels were associated with dietary intake of Se, as evaluated through a semi-quantitative food frequency questionnaire, in patients but not in controls.

Conclusion: In this population, disease risk was strongly associated with a biological indicator of Se exposure, serum Se concentration, though risk estimates were statistically unstable due to the small sample size. Study findings appear to confirm that exposure to environmental Se increases the risk of cutaneous melanoma.

PP-31-147

Trace Metal Composition of Ambient $PM_{2.5}$ and PM_{10} and Their Spatiotemporal Variation Near a Major Highway in an Alpine Valley in Switzerland

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Background/Aims: We have conducted a pediatric asthma panel study in a community located in an Alpine valley in Switzerland to examine highway exhaust exposure and its effects on respiratory health. One of our objectives is to examine the spatial and seasonal distribution of ambient particulate matter (PM) and NOx, and thereby develop spatial models for residential outdoor PM exposure. This paper focuses on the trace metal composition and their spatiotemporal distribution in the Alpine valley in Switzerland.

Methods: Two fixed (one near highway and the other background) and 4 other mobile locations were monitored for daily PM_{10}, particle number concentrations, and NOx in Erstfeld, Switzerland during November 2007–June 2009. The mobile locations measured for 1 month each in the 4 seasons. In addition, 2-week integrated measurements of PM_{10}, $PM_{2.5}$, and NO_2 were also obtained outside 9 children's homes in 3 different seasons. PM filters were analyzed for elemental and organic carbon using TOR-IMPROVE protocol and 48 trace metals using XRF.

Results: Mean daily total metal levels ($\pm$ Standard Deviation) were 3.2 $\pm$ 2.7 μg/m^3 for a total of 547 daily measurements, which were about 21% of the average PM_{10} levels. The impact of local biomass combustion (with K as tracer) is consistently higher in winter, regardless of sampling

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locations. The dominant contribution of highway exhaust and break wear (Cu, Zn, Sb, Ba) is observed at the nearest location (55 m away) from the highway. Contrary to PM mass, which is significantly elevated in winter, crustal and resuspended road dust components (Al, Si, Ca) are observed higher in summer both in home outdoor PM_{10} and $PM_{2.5}$ samples. Significant impact of road salt (Na, Cl) use in winter is also noticed in PM_{10} (but not in $PM_{2.5}$) samples.

Conclusion: These first results indicate significant contribution of highway traffic and local biomass burning on the PM exposure in the community.

PP-31-148

Renal Effects of Blood Mercury and Lead Among Chinese Herbalists

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Background/Aims: Traditional Chinese medicine has been reported containing some heavy metals, especially arsenic, cadmium, mercury, and lead. Chinese herbalists may consume more Chinese medicine, and they are also potentially exposed to heavy metals while gathering plants, preparing or applying Traditional Chinese medicine. The objective of this study was to explore the renal effects of nephrotoxic metals in Chinese herbalists.

Methods: A total of 138 subjects who were members of the occupational union of Chinese herbalist recruited between May 2007 and June 2007 in Taiwan. Heavy metals in blood samples were analyzed by Agilent 7500C inductively coupled plasma-mass spectrometry. Renal function assessed by using simplified Modification of Diet in Renal Disease Study equation to estimated glomerular filtration rate (eGFR). Subjects with eGFR level less than 60 (mL/min/1.73 m^2) were regarded as renal dysfunction.

Results: Heavy metal concentration of arsenic, cadmium, mercury, and lead in blood were 5.01 ± 4.8, 2.04 ± 2.3, 19.92 ± 14.8 μg/L, and 51.06 ± 54.0 μg/L, respectively. There were 22 (15.9%) subjects with eGFR less than 60 (mL/min/1.73 m^2). After adjusting for work years, gender, BMI, systolic pressure, diabetes, smoking, alcohol consumption, and uric acid, in single-metal analysis, there were negative effects on eGFR level in arsenic (per log10 unit: β ± standard error [SE] = −1.21 ± 2.54, P = 0.634) and lead (per log10 unit: β ± SE = −4.33 ± 2.71, P = 0.112), respectively. In multimetal analysis, there were significant negative effects on eGFR level in mercury (per log10 unit: β ± SE = −12.90 ± 5.80, P = 0.028) and lead (per log10 unit: β ± SE = −9.42 ± 3.68, P = 0.011) with a significant interaction (P = 0.007) between mercury and lead.

Conclusion: Mercury and lead in blood had significant negative effects on renal function with an interaction brought to light. The elevated mercury and lead levels in blood were found among these Chinese herbalists, which reinforce the need to control the exposure of mercury and lead from Chinese herbal medicine.

PP-31-150

Biodurability of Inhaled Tungsten Oxide Fibers and Particles

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Background/Aims: To manufacture wire for light bulb filaments, tungsten oxide (WOx) powder is reduced to tungsten metal, during which fiber-containing aerosols may be generated. While fiber dimensions determine, in part, the extent which they are inhaled, retained, and mechanically cleared by the lung, their chemistry influences physiological durability. The purpose of this study was to measure the dissolution of fiber- and isometric-shaped tungsten compounds in lung fluids.

Methods: Three common industrial powders that contained fibers (WO2.81, WO2.66, and WO2.51) and 3 that contained isometric-shaped particles (WO_3.00, WO2.98, and W metal) were characterized by microscopy. Dissolution behavior of all powders was evaluated using a static dissolution technique in 2 different artificial fluids: airway epithelial lining fluid (pH = 7.3) and alveolar macrophage phagolysosomal fluid (pH = 4.5). Fiber data were modeled assuming constant dissolution velocity and isometric particle data modeled assuming surface-area-limited dissolution.

Results: Fibers were respirable with high probability of deposition in the nonciliated alveolar region of the lung. The WO2.81 and WO2.51 powders were 80% fibers/20% particles by mass, whereas the WO2.66 powder was 2% fibers/98% particles by mass. At pH 4.5, the rank order of dissolution in units of g/cm^2·day was as follows: WO2.66 ($4.3 \pm 0.4 \times 10^{-7}$) > W ($3.7 \pm 1.9 \times 10^{-7}$) ≈WO2.51 ($2.4 \pm 0.1 \times 10^{-7}$) > WO2.98 ($1.0 \pm 0.1 \times 10^{-8}$) > WO2.81 ($3.3 \pm 0.9 \times 10^{-8}$) > WO3.00 ($9.3 \pm 5.5 \times 10^{-9}$). At pH 7.3, the order was: WO3.00 ($5.7 \pm 1.8 \times 10^{-6}$) > W ($3.0 \pm 0.5 \times 10^{-6}$) > WO2.98 ($1.0 \pm 0.1 \times 10^{-6}$) ≈ WO2.81 ($1.0 \pm 0.1 \times 10^{-6}$) > WO2.66 ($6.7 \pm 0.5 \times 10^{-7}$) > WO2.51 ($3.0 \pm 0.2 \times 10^{-7}$).

Conclusion: All tungsten compounds were poorly soluble and each tended to dissolve slower in acidic phagolysomal fluid than in neutral airway epithelial lining fluid. Fiber-containing WO2.81 and WO2.51 materials were respirable size and generally less soluble than isometric-shaped tungsten materials and therefore, may persist longer in the alveolar region of the lung.

PP-31-151

Mercury Concentration of Whole Blood and Red Blood Cell in Taiwan Residents

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Background/Aims: People are exposed to different forms of mercury (Hg), and about 80% of methylmercury (MeHg) in blood is associated with red blood cells (RBC), where it is largely bound to hemoglobin. We aimed at measuring the Hg concentration in whole blood (WB) and RBC and evaluating their correlation in Taiwan residents.

Methods: We recruited 43 volunteers (18 male and 23 female) aged between 19 and 48 years who were not exposed to Hg. Samples of blood (5 mL) were collected and 3 mL RBC was obtained at the same time. The amount of total Hg in WB and RBC is determined by using cold vapor atomic absorption spectroscopy. The WB and RBC samples were treated by microwave-assisted digestion to reach complete solubilization before determination.

Results: We found 95% of Hg kept in RBC, the concentration of Hg in WB and RBC was 5.91 ± 2.81 and 11.22 ± 5.68 ng/g, respectively. A high correlation of Hg concentration between WB and RBC was observed (r = 0.93, P < 0.001), this correlation was higher in males (r = 0.95) than that in females (r = 0.90). We divided volunteers into 2 groups by median of age; both WB and RBC Hg concentrations were found almost the same in these 2 metrics. The Hg concentration of WB observed in males was higher than in females (6.14 vs. 5.72 ng/g, P = 0.34), however, in RBC, the results showed adverse direction (10.47 vs. 11.80, P = 0.28).

Conclusion: We found the WB and RBC Hg concentrations in Taiwan residents were 5.91 ± 2.81 and 11.22 ± 5.68 ng/g, respectively, this level was higher as compared with the residents of United States and European countries.

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PP-31-153

Hexavalent Chromium-induced ROS Formation, Subsequent Akt, NF-κB, and MAPK Activation, and TNF-α, and IL-1α Production in Keratinocytes, Which Might Facilitate the Progression of Chromium Hypersensitivity

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Background/Aims: Chromium (Cr) hypersensitivity is an important issue in occupational skin disease. When Cr(VI) enters the cell, it can be reduced to Cr(III), resulting in the formation of reactive oxygen species (ROS). By the effects of ROS, Cr(VI) could activate the Akt, NF-κB, and MAPK pathways. Cr(VI) could also stimulate the release of cytokines, such as TNF-α and IL-1α. The release of TNF-α and IL-1 is a central event in the progression of allergic contact dermatitis.

Aims: We hypothesized that keratinocytes might be stimulated by Cr(VI), resulting in the formation of ROS, which activates the Akt, NF-κB, and MAPK pathways, increasing TNF-α and IL-1α production.

Methods: In vitro, we used HaCaT cells exposed to Cr(VI) and monitored ROS formation and the activation of the Akt, NF-κB, and MAPK pathways, as well as the expression of TNF-α mRNA and the release of IL-1α. In vivo, we administered a Cr(VI) dermal injection to albino guinea pigs to observe the activation of the Akt, NF-κB, and MAPK pathways.

Results: We found that, in HaCaT cells, Cr(VI) could increase ROS formation, activate the Akt, NF-kβ, and MAPK pathways, and increase the expression of TNF-α mRNA and the release of IL-1α. We also found that, in albino guinea pigs, a Cr(VI) injection could activate the Akt, NF-kβ, and MAPK pathways.

Conclusion: These observations indicate that Cr(VI) could increase ROS formation, activate the Akt, NF-kβ, and MAPK pathways, and increase the expression of TNF-α mRNA and the release of IL-1α, which might facilitate the progression of chromium hypersensitivity.

PP-31-154

Studies of Heavy Metal Analytical Methods for Human Urine Using Inductively Coupled Plasma-mass Spectroscopy

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Background/Aims: There are growing needs for the human biomonitoring to provide unique exposure informations to help prevent diseases that result from exposure to environmental chemicals. The purposes of human biomonitoring are to determine which chemicals get into people and at what concentrations, to establish reference ranges of exposed chemicals, to track, over time, trends in levels of exposure of the population, and to set priorities for researcher on human health effects. Among them, the quantification of trace metals in body fluids plays a major role in the diagnosis and treatment of a range of disorder. For the last 30 years, these determinations have been dominated by graphite-furnace atomic absorption spectroscopy techniques, which are single-element sequential analysis techniques and, hence are slow. Therefore, the introduction and development of inductively coupled plasma-mass spectroscopy (ICP-MS) are needed in clinical laboratories for multielement determinations. The ICP-MS methods with reduced sample consumption and simplified sample preparation make possible to access to a wider range of analytes at trace levels.

Methods: This study was performed to develop the analytical methods using ICP-MS with HNO_3-dilution pretreatment for toxic trace metals in human urine such as antimony, barium, beryllium, cadmium, cesium, cobalt, lead, molybdenum, platinum, tungsten, thallium, and uranium. The method detection limits, accuracies and precisions of each analytes were determined and the validations were carried out by analyzing CRMs such as NIST SRM and quality control materials such as SERO urine, ClinkChek, and BioRAD.

Results: The ICP-MS methods were also validated by comparing the analytical results with those of graphite-furnace atomic absorption spectroscopy for cadmium in human urine samples ($n = 75$). The analytical results from 2 methods were in good agreement ($P > 0.05$) and showed good correlations ($R = 0.932$ for Cd in urine).

Conclusion: This implied that the ICP-MS methods can be used as an alternative for a commonly used method such as graphite-furnace atomic absorption spectroscopy. Therefore, it is considered that the established ICP-MS methods showed good accuracies and precisions with high detection powers, which can be possibly used in biomonitoring project in near future.

PP-31-155

Mercury Content in Selected Organs of Potato (*Solanum tuberosum*) Plants in the Areas With the Elevated Mercury Soil Content in Slovakia

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Background/Aims: The main aim of the present paper was assessment of the potato (*Solanum tuberosum*), assessing mercury content in the particular organs of the plant in chosen foodstuffs because of increased amounts of mercury in the soils in Slovakia when compared with other countries. Heavy metal can be distributed into a human organism by the food chain.

Methods: We monitored mercury content in potato tubers ($n = 15$) and in the soil. The results were evaluated according to mercury limits of domestic norms. To find the concentration of mercury in some commodities, we used the fireless atomic absorption spectrometry—AMA 254.

Results: Findings were sorted into 3 groups from zero level of mercury up to permissible limit. Two samples belong within the span up to 0.006 mg kg^{-1} Hg. Within span of 0.006 up to 0.013 mg kg^{-1} Hg, there were 4 samples. In the next set of samples, Hg content was from 0.013 up to 0.020 mg kg^{-1}. This group included 6 samples. Three samples analyzed were more than the Hg limit 0.020 mg kg^{-1}.

The measured values of samples were in the interval from 0.015 up to 20.018 mg kg^{-1} Hg.

Analyses included selected organs of potato plants: roots, tubers, and leaves of potato plants (*S. tuberosum*). The lowest concentration was in potato (0.015 mg kg^{-1}) (limit, 0.02 mg kg^{-1}). Higher concentration of Hg was in roots (11.125 mg kg^{-1}). The highest one was measured in tubers (20.018 mg kg^{-1}). In soils samples, Hg content was from 140 up to 480 mg kg^{-1} Hg (limit, 3 mg kg^{-1}).

Conclusion: We have to take into account that the soil chemistry is important factor and the increased amount of mercury poses environmental risks. This is the reason why it is important to continue monitoring of the mercury concentration in medical and cultivated plants.

PP-31-156

The Association of Lead Exposure and Impairment of Brainstem Auditory-evoked Response and Cochlea Function

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Background/Aims: On the basis of some researches, the heavy metals (including lead, mercury, and tin) may be toxic on hearing in human beings and animals. Complex exposures to lead and noise were the 2 common sources of occupational exposures in the factories. The aim of the study was to investigate the effect of occupational lead on the auditory system.

Methods: We measured the auditory brainstem-evoked response and cochlea function with distortion product otoacoustic emissions (DPOAEs) that are preneural responses of the outer hair cells of the inner ear in 12 adult lead-workers and 12 age- and sex- matched persons who were not exposed to lead and noise.

Results: The results showed that the auditory brainstem-evoked response latency of wave I, II, III, and III–V significantly increased in the group of lead-workers (blood lead: 36.13 ± 4.52 μg/dL), as compared with the group without lead exposure (blood lead: 4.09 ± 1.41 μg/dL). The latency of wave I, II, III, V, and interpeak latency I–III were correlated to blood lead levels. Mean DPOAEs of the lead workers were significantly different from the reference group at DP frequencies of 812, 1000, 1281, 1593, 2031, 2562, and 3187 Hz. However, the DPOAEs for the lead workers were within the normal ranges of the reference group only at 4031 Hz. Although there was a tendency for the lead workers to have diminished DPOAEs, no consistent correlation of DPOAEs with lead level was found. The prevalence of normal DPOAEs in the lead workers was up to 79%.

Conclusion: We concluded that lead should be otoneural toxic, especially, in the workers exposed to lead and noise both. The hearing conservation program should enhance more for the worker exposing to both ototoxic agents.

PP-31-157

Blood Cadmium Concentration of Residents Around Abandoned Metal Mines in Korea

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Background/Aims: The purpose of this study is to evaluate the blood cadmium concentration and to analyze related factors of residents around the abandoned metal mines in comparison with a control group in Korea.

Methods: Blood cadmium concentration was analyzed through investigations of age, sex, working history of mines, periods of residence, smoking habits, and dietary water type of subjects living around abandoned metal mines (exposure group) (n = 14,464) as compared with those living in designated control areas (control group) (n = 697).

Results: The blood cadmium concentration (1.25 [1.24–1.27] μg/L) of exposure group was significantly higher than control group (1.17 [1.13–1.22] μg/L). The period of residence and working history of mines in exposure group were significantly higher than control group. The blood cadmium concentration was increased according to increasing age and period of residence in both groups. Blood cadmium concentration of current-smokers in both groups was higher than nonsmokers.

Conclusion: This was the first report about the blood cadmium concentration of the exposure group who lived around all abandoned metal mines in Korea. The exposure group had higher blood cadmium concentration than the control group. We attributed the elevated blood cadmium concentration in the abandoned mine residents to the influence of the abandoned mine sites in Korea.

PP-31-158

The Mechanism of Arsenic-mediated High Cholesterol Diet Exacerbate Insulin-dependent Depressive Mice

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Background/Aims: Arsenic (As) is one of the global environmental toxicants. Epidemiological studies demonstrated that chronic As exposure might cause variable cancers, skin diseases, neurological diseases, and vascular diseases including cardiovascular diseases. Previous studies revealed that depression might lead to developing cardiovascular disease through its association with the metabolic syndrome. Recent studies showed that the initial similarities (obesity, glucose intolerance, hypertension, and hyperlipidemia) might extend them to be associated features of depression. The aim of this study was to explore the association between As and hyperlipidemia in an insulin resistance-mediated depressive animal model.

Methods: The reserpine- and electrical stimulation-induced depression was conducted to BALB/c mice. Arsenic trioxide alone or in combination with the high-cholesterol diet was administrated to evaluate the progression of depression in depressed BALB/c mice. Biochemical parameters, including blood insulin concentration, triglyceride, total cholesterol, high-density lipoprotein, and low-density lipoprotein levels, oral glucose tolerance test, and insulin tolerance test were monitored to evaluate the insulin resistance and lipid metabolism. The effects of depression were evaluated by elevated-plus maze, forced swimming test (FST), and tail suspension test (TST). The 5-hydroxytryptophan (5-HT) and its metabolites were measured from the sacrificed mouse cerebrum homogenate by high performance liquid chromatography to evaluate the depression-related monoamine neurotransmitters.

Results: As exposure had effects on elevated-plus maze but not on FST and TST in depressed mice. However, As in combination with high-cholesterol diet administration for 1 week could profoundly decrease high-density lipoprotein or low-density lipoprotein ratio, potentiate depressive symptoms of FST, TST, and increase insulin resistance-derived depressive mice, while these effects could be exaggerated after 2 weeks treatment.

Conclusion: Long-term inorganic As combined with high cholesterol diet could augment several depression-like symptoms and progressive insulin resistance in insulin-dependent mice.

PP-31-159

Mercury Pollution in La Libertad, a Gold Mining Town in Central Nicaragua. Uncontrolled Mining, Economic Crisis, and Climate Effects—A Dangerous Mixture

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Background/Aims: Mercury is a global pollutant with serious implications at the local and regional level, and is widely used through gold mining communities, especially in developing countries, as Nicaragua where the gold mining activity represents one of the major income sources.
Methods: Mercury pollution emitted by small scale mining activities was evaluated in the mining town "La Libertad" in Chontales, central Nicaragua. The crushing/amalgamation centers "Rastras" where most mercury is released were georeferenced and monitored during 2008 and 2009. Furthermore, the concentration of mercury was analyzed using atomic absorption spectrophotometry in the environment (water and soil) and in blood samples from 124 miners and non-miners grouped in miners and non-miners families from the same town.
Results: The crushing/amalgamation centers as an indicator of the mining activity were located all around the town and their numbers were almost doubled in 2009. High concentrations of total mercury were found in water samples (range concentration: 1.56–235.9 μg/L) where water level in creeks and rivers were reduced by drought and season. Concentrations of mercury in the total sample exceeded 15.36 μg/L of total mercury, which might represents a risk for health. Comparing total mercury in blood samples from miners and non-miners families, there was no significant difference between median groups (5.31 vs. 5.145 μg/L; $R > 0.005$) detonating environmental exposure more important than working exposure in agreement with the short distance between crushing/amalgamation centers and houses.
Conclusion: Mercury used in gold mining represents a risk for general population in the mining town La Libertad.

PP-31-160

Environmental and Occupational Lead Effect on Hearing

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Background/Aims: The study of lead effect upon the hearing ability of women, children, and workers from lead smelter industry polluted town evidenced a hearing loss among investigated groups.
Methods: The women and workers have 20–55 years but children have 7–12 years, they never moved off the town. The lead concentration in the environment exceeded by 50–100 times the normal values (0,0007 mg/m javascript:Add4 ('%E2%82%83′)/24 hours), in contrast with the working places where exceeded by 40–80 times the maximal admissible value (0,1 mg/mjavascript:Add4 ('%E2%82%83′)). The exposed groups comprised 77 women, 152 children, and 152 workers (no noise polluted workplace). The reference groups was constitute from 75 women, 150 children and 70 workers with same age as exposed ones, were selected from no polluted town (having an identical density of population and motor traffic or workplace), respectively. All groups were tested by air and bone conducted audiometer.
Results: The biochemical tests performed in the exposed women evidenced a blood lead level between 15 and 40 μg/dL, in contrast with higher levels of blood lead among children and workers, between 20 and 70 μg/dL. The blood lead levels in all persons from reference groups were under 15 μg/dL. The median audiometry difference between exposed and nonexposed women show a 10 and 9 dB for 6 and 8 kHz. The similar values between exposed and nonexposed children was almost 5 dB higher than the women hearing values. No statistically significant difference between hearing loss of workers and children for high frequencies (6 and 8 kHz)
Conclusion: A lower exposure level of lead in children have similar effect with higher exposure level in workers (same exposure duration in years) probably because lead is easily absorbed by children organism.

PP-31-161

The Effect of Body Lead Burden on Neurobehavioral Function in Retired Lead Workers

Nam-Soo Kim and Byung-Kook Lee *Soonchunhyang University, Choongnam, Republic of Korea.*

Background/Aims: To evaluate the effect of lead biomarkers including bone lead on neurobehavioral test in retired lead workers
Methods: One hundred thirty-one retired lead workers without any occupational exposure to organic solvent, mercury, and arsenic were agreed to participate in this study. For the control subjects, 56 nonoccupationally lead exposed subjects were recruited from same area of retired lead workers with consideration of demographic characteristics.
Results: The mean levels of blood and bone lead of retired lead workers were significantly higher than control group and there were significant correlation among other lead biomarkers. Compared with controls without occupational lead exposure, lead exposed subjects had worse performance on 10 tests out of 12 neurobehavioral tests, but only 2 tests (Purdue pegboard nondominant and both hand) showed statistical significance of differences. In multiple linear regression analysis of neurobehavioral tests with lead biomarkers and demographic and lifestyle variables, age was associated negatively with 11 neurobehavioral tests, whereas log-transformed ZPP was associated with Purdue pegboard (both hand) and Santa Ana manual dexterity (non dominant hand). On the other hand, tibia lead was associated Pursuit aiming test (correct) and Purdue pegboard (dominant hand) and calcaneal lead was associated with Purdue pegboard (dominant hand).
Conclusion: This study confirmed that among all relevant variables age was most significantly associated with the poor performance of neurobehavioral tests. The blood lead did not have any significant association with neurobehavioral tests, but tibia and calcaneal bone lead and blood ZPP showed significant association with a few tests even after more than mean 9 years from their retirements.

PP-31-162

Effect of Increased Blood and Tibia Lead on the Change of Bone Mineral Density in Retired Male Lead Workers

Nam-Soo Kim and Byung-Kook Lee *Soonchunhyang University, Choongnam, Republic of Korea.*

Background/Aims: To investigate the effect of increased blood and tibia lead on the change of bone mineral density in retired male lead workers.
Methods: One hundred nine retired male lead workers who worked in 4 different lead industries and 51 nonoccupationally lead exposed male subjects were recruited from March 2004 to October 2004. Bone mineral density (BMD) was measured by broadband ultrasound attenuation (BUA) at left calcaneous bone area with broadband ultrasound attenuation method of QUS-2 (Metra Biosystems Inc, USA). Tibia bone lead was measured for skeletal bone lead with K-xray fluorescence (K-XRF) and blood lead was analyzed with flameless atomic spectrophotometer. Hemoglobin, hematocrit, serum calcium and iron were also analyzed. In addition, information for smoking and drinking status and basic personal data such as age and lead exposure were also collected using questionnaire inquiry.
Results: Blood lead was correlated with tibia lead ($r = 0.711$) and these 2 variables were negatively correlated with BUA in bivariate analysis. BUA and tibia lead showed significant main effects on the change of blood lead after adjusting covariates. The effect modification by the level of BMD (low: lower than the median of BUA and high: higher than the median of BUA) was observed between the association of tibia lead and blood lead after adjustment of covariates. The subjects who had higher BMD seemed to have lower blood lead by the increase of tibia lead than those of lower BMD. In the multiple regression analysis of blood lead and

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tibia lead on BUA after adjustment of covariates, only blood lead showed statistically significant effect on BUA.

Conclusion: This study confirmed that BMD and blood lead were significantly associated. To verify the causal association of BMD on blood lead and vice versa, further longitudinal studies are needed.

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PP-31-163

Blood Lead Concentration of Firefighters and Its Association With Blood Pressure in Korea

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Background/Aims: Firefighters are frequently exposed to significant concentrations of hazardous materials including heavy metals such as lead. We investigated the blood lead concentration of firefighters in a large city of Korea to evaluate the possible exposure to lead during their mission of firefighting. We also further analyzed the association of blood lead with blood pressure and biomarkers of renal and liver function

Methods: Seven hundred fifty-eight male firefighters in 5 fire departments of a large city participated in this study during their annual health examination in 2009. We measured the blood lead concentration and biochemical indices such as SGOT, SGPT, gamma GT for liver function and BUN and serum creatinine for renal function test. We also collected the demographic information and drinking status.

Results: The geometric means of the blood lead of 758 firefighters was 2.81 μg/dL (95% confidence interval: 2.76–2.86). In crude comparison, there were significant differences of blood lead among age group, job duration, and job title, but the differences were disappeared after adjustment of relevant study variables. Drinking was the only variable to increase the blood lead concentration in both crude and adjusted comparison. In multiple regression analysis after adjustment of relevant covariate, log-transformed blood lead was statistically associated with diastolic and systolic blood pressure. Among liver and renal function biomarkers, gamma GT was statistically positively associated with blood lead.

Conclusion: The mean blood lead concentration of firefighters was not differed from that of representative Korean adult male population (2.77 μg/dL, 2008 KNHANES). This study confirmed the positive association of blood lead concentration with diastolic and systolic blood pressure even in relatively low blood lead concentration.

PP-31-164

High Blood Lead Levels in E-waste Recyclers

Ashish Mittal *OHS-MCS, New Delhi, India.*

Background/Aims: There is a huge informal sector of electronic and electrical waste recycling in India. Domestic as well as imported e-waste from developed countries is being recycled to extract valuable heavy metals like lead, cadmium, chromium, mercury, aluminium, and gold. During the process, the workers are exposed to toxic fumes of various heavy metals through inhalation and contact form skin surface in the poor working conditions.

Methods: Blood samples of 20 workers (13 male, 5 female, and 2 children) were taken randomly from 64 workers who are involved in the process of desoldering of components and burning of printed circuit boards to recover the metals. Blood samples were analyzed for blood lead levels, hemogram, and renal function tests. Interview about health symptoms were conducted and analyzed.

Results: All the 20 samples analyzed for blood lead levels were found to be high of prescribed levels of 10 μg/dL of CDC. The lowest BLL was 18.3 and highest was 40.4 μg/dL, with an average level of blood lead 30.13 μg/dL in these 20 workers. The minimum age of workers being 14 years and maximum 45 years (mean age 30 years), no evidence of hematotoxicity or renal toxicity or neurotoxicity could be found with 1–3 years of exposure to recycling of e-waste. None of the workers uses any personal protective equipment.

Conclusion: The high blood lead levels, especially in the children will have long-term health effects on these workers. Further exposures need to be immediately ceased to prevent long-term health impacts of high blood lead levels. Long-term follow-up for evaluation of toxicity from other metals must be done. Improvement of working condition, prohibiting child labor and technological interventions for the recovery of toxic heavy metals are required immediately.

PP-31-165

Benchmark Dose of Urinary cadmium For Renal Effects by Hybrid Approach in a Cadmium Nonpolluted Area in Japan

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Background/Aims: To apply an updated hybrid approach to estimate benchmark doses (BMD) and their 95% lower confidence limits (BMDL) for cadmium-induced renal effects in humans. Using this method, the BMD and BMDL were estimated based on a continuous exposure and a continuous effect marker, thereby avoiding categorization of the subjects which was inevitable in previously used approach.

Methods: The target subjects were 547 men and 723 women aged 50 years or older in a cadmium non-polluted area in Japan. We measured urinary cadmium (U-Cd) as a marker of long-term exposure, urinary protein, β2-microglobulin (β2-MG), and N-acetyl-β-D-glucosaminidase (NAG) as renal effect markers. BMD and BMDL corresponding to an additional risk (BMR) of 5% were calculated and with the background risk at zero exposure set at 5%.

Results: The BMDL of U-Cd for renal effect markers were 2.1 (urinary protein), 2.6 (β2-MG), and 4.1 (NAG) μg/g creatinine in men and 1.5 (urinary protein), 1.4 (β2-MG), and 3.1 (NAG) μg/g creatinine in women.

Conclusion: The BMDLs in the present study may contribute further to the discussion for the health risk assessment of cadmium exposure, compared to BMDLs by previously used approach.

PP-31-166

A New Estimation of Benchmark Dose of Urinary Cadmium For Renal Effects by Hybrid Approach in Nonpolluted and Polluted Areas in Japan

Yasushi Suwazono,[1] Kazuhiro Nogawa,[1] Mirei Uetani,[1] Teruhiko Kido,[2] and Hideaki Nakagawa[3] *[1]Department of Occupational and Environmental Medicine, Graduate School of Medicine, Chiba University, Chiba, Japan; [2]Department of Community Health Nursing, Kanazawa University School of Health Sciences, Ishikawa, Japan; and [3]Department of Epidemiology and Public Health, Kanazawa Medical University, Ishikawa, Japan*

Background/Aims: We applied an updated hybrid approach to estimate benchmark doses (BMD) and their 95% lower confidence limits (BMDL) for cadmium-induced renal effects in humans. Using this method, the BMD and BMDL were estimated based on a continuous exposure and a continuous effect marker, thereby avoiding categorization of the subjects which was inevitable in previously used approach.

Methods: Total number of subjects was 3103 (1397 men and 1706 women) for a Cd-polluted area and 1509 (650 men and 859 women) for non-polluted areas. We measured urinary cadmium (U-Cd) as a marker of long-term exposure, β2-microglobulin (β2-MG) as s renal effect marker.

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BMD and BMDL corresponding to an additional risk (BMR) of 5% were calculated and with the background risk at zero exposure set at 5%.
Results: The BMDL/BMD of U-Cd for β2-MG was 3.5/4.0 μg/g creatinine in men and 3.7/4.0 μg/g creatinine in women.
Conclusion: The BMDLs in the present study may contribute further to the discussion for the health risk assessment of cadmium exposure, compared with the BMDLs in the previously used approach.

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WASTE AND ITS MANAGEMENT

PP-31-188

Municipal Solid Waste Incineration and Risk of Soft-tissue Sarcoma: A Case-control Study

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Background/Aims: Soft-tissue sarcoma is a rare neoplasia of the connective tissue with unknown etiology. Heavy metals and dioxins, which are also emitted by municipal solid waste incinerators, are among the environmental factors suspected to play a role in its etiology. We assessed the possible relation between long-term exposure to emissions of a municipal solid waste incinerator and risk of soft-tissue sarcoma in the Italian municipality of Reggio Emilia, through a population-based case-control study.
Methods: We identified 50 cases of newly diagnosed sarcomas from 2001 to 2008, and we randomly selected 4 population controls for each case, matched for sex and age, of whom we geocoded residential history. We also identified 2 areas of the municipal territory with intermediate and high exposures to emissions of the solid waste incinerator. All this information was added to a Geographical Information System database, to assess exposure status of study subjects, and to calculate the associated relative risk (RR) of soft-tissue sarcoma in a conditional logistic regression model.
Results: Three cases of soft-tissue sarcoma occurred among previously exposed subjects. Residence in 1 of the 2 exposed areas was associated with a RR of 0.52 (95% confidence interval [CI]: 0.12–2.37) at disease diagnosis and with a RR of 1.10 (95% CI: 0.28–4.35) 20 years before, after adjusting for educational attainment. When we limited the analysis to highly exposed subjects, we found a RR relative risk of 1.93 (95% CI: 0.32–11.71) at diagnosis and of 3.70 (95% CI: 0.72–18.97) 20 years before. No dose-response relation between exposure status and disease risk was detected.
Conclusion: Overall, the risk of soft-tissue sarcoma was increased among subjects with high exposure to incinerator emissions, but risk estimates were statistically very unstable and no evidence of dose-response relation emerged. Larger studies are required to confirm a relation between emissions from waste incineration and incidence of soft-tissue sarcoma.

PP-31-189

The Health Impact of the August 2006 Toxic Sludge Spills in Abidjan (Ivory Coast): An Analysis

Denis Bard,[1] Pascal Roux,[2] Daouda Coulibaly,[3] Daniel Ekra Kouadio,[3] and Guillaume Yao Loukou[4] *[1]EHESP School of Public Health, Rennes, France; [2]Signaux Forts, Paris, France; [3]National Institute for Public Hygiene, Abidjan, Cote d'Ivoire; and [4]University of Abidjan, Abidjan, Cote d'Ivoire.*

Background/Aims: In August 2006, about 400 metric tons of oily sludge from Europe offloaded from the cargo ship Probo Koala was dumped in several locations of the Abidjan metropolitan area. In the following hours and days, increasing numbers of people complained first about very strong irritating odors, prompting large amount of the population to flee their homes. Three days after the first dumping, individual complaints of discomfort, associated with a host of nonspecific symptoms (eg, vomiting, nose bleed, diarrhea), were so frequent that the Ivorian Ministry of Health decided to offer free care to the affected people. The number of people seeking care rose rapidly from 10 days after the first dumping, reaching up to 500 daily in the reference hospitals.
Methods: We gathered a comprehensive set of official and unofficial literature on the circumstances of the episode, as well as the results of various field epidemiology results and those of an air dispersion modeling study.
Results: Altogether, 10–17 deaths, 64–101 hospitalizations, and 104,000 consultations were attributed to the toxic sludge to the end of 2006. Many uncertainties remain as to the sludge chemical composition as well as the extent of population exposure. Mercaptans are the best-characterized component, while the importance of exposure to H_2S and other chemicals is not clear. In addition, reported symptoms and diagnoses and time to onset in people seeking care are not fully in accordance with the known acute toxic effects of both mercaptans and H_2S. It has to be stressed that little is known on the subchronic and chronic effects of those compounds, and almost nothing on effects in children and infants.
Conclusion: On this basis, we discuss what could be the actual health impact of the dumping and its possible long-term consequences.

PP-31-190

Environmental Impact Analysis for the Alternative Waste Management Scenarios in Hanoi, Vietnam

Suk-Hui Lee[1] and Ki-in Choi,[2] *[1]KOEM, Seoul, Republic of Korea; and [2]KICET, Seoul, Republic of Korea.*

Background/Aims: In this study, we designed 4 alternative scenarios for the landfill stream of Hanoi's MSW, and estimated not only the greenhouse gas reduction potential in each scenario but also the change in environmental burden. This includes landfill gas recovery, dominant CDM activity in waste disposal, recycling of organic waste considering that Hanoi promotes the practice of source separation, and incineration of waste before landfilling. To strengthen sustainability assessment of CDM, we employed the life cycle assessment (LCA) method, usually used to decide more sustainable or environmentally friendly options in waste management
Methods: To estimate the environmental burden in each scenario, we used the IPCC Guidelines and several LCI databases. Greenhouse gases (CO_2, CH_4, and N_2O) emitted during each process were calculated from the IPCC Guidelines, which excludes biogenic CO_2 because the carbon in biomass is supplied from atmospheric CO_2. Other emissions were taken from stoichiometric calculations or the IWM model, which provides typical emissions from each type of waste, eg, organics, paper, plastics, metals, glass, and so on, during biological and thermal treatment processes as well as final disposal.
Results: The incineration scenario showed relatively large energy consumption compared with commercial incinerators. This is because we considered energy recovery using electricity only. Ozone layer depletion and abiotic depletion are closely linked to energy consumption; hence, most scenarios, excluding Scenario 3, showed a net savings in both categories thanks to the electricity generation. Even though displacement by produced compost led to some impact reduction in both categories, composting of organic waste showed a greater impact compared with the base scenario. Fresh water aquatic ecotoxicity was also affected by the energy, especially the electricity parameter. Scenarios 1, 2, and 4 containing electricity generation activity showed significant avoidance of impact; incineration in particular showed the highest avoidance effect.
Conclusion: In most of the scenarios, the energy recovery from waste contributed greatly to reducing environmental impacts. Landfill gas

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recovery showed the least impact on ozone layer depletion, abiotic depletion, and net energy consumption by displacement of grid electricity, and anaerobic digestion of organic waste showed the least impact on human toxicity, acidification, eutrophication, and global warming. Moreover, anaerobic digestion is expected to provide the highest CER potential among the scenarios by decreasing the amount of organic waste in landfill and by generating electricity using biogas. On the other hand, incineration of waste before landfilling and composting of organic waste could lead to a greater impact on acidification and eutrophication due to gaseous emissions and high energy consumption.

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PP-31-191

Identification of Major Glycerols and Other Polar Compounds in Waste Vegetable Oil

Ki-in Choi *KICET, Seoul, Republic of Korea.*

Background/Aims: Trap grease is waste grease traped in sewage interceptor at restaurant, hotel, food processing company, or building with eating place. BDF production from trap grease can give considerable merits not only in terms of inexpensive BDF feedstock supply, but also waste recycling itself. While trap grease has been frequently mentioned as an alternative feedstock to bring down the cost of BDF, its relatively low quality is a major obstacle as BDF feedstock. To evaluate its applicability as a BDF feedstock, it is fundamental to know the content and composition of lipids, as well as to identify the potential contaminants in trap grease. In this work, we monitored major lipid components of several trap greases from restaurants, as well as polyaromatic hydrocarbons, pesticides, and polar compounds.

Methods: Two parts of samples were taken for the analysis of FA, FAME and glycerides; watery one at the bottom of the collected sample, and less watery one on the top. Each sample was extracted with tetrahydrofuran, and then settled over a day. After diluted, an upper solvent layer was analyzed by GC-MSD and HPLC-MS.

Results: Tra could be summarized as high FA, but low glycerides in all samples. The former contributed over 90% of total lipid compositions, but the latter was less than 10%. Oleic and linoleic acids were dominant in total FA, but FAMEs were not detected in all samples. The amounts of both OOO and PPP were less than 1% of the total. Aldehydes, ketones, and most of the pesticides were not detected in all samples except for fenitrothion.

Conclusion: Proceeding from the results in this study, trap grease from the restaurants seems to be available as a BDF feedstock because of high FAs contents but low contamination. Like other alternative feedstock, however, trap grease lies quite uncovered from non-point contaminant sources.

WATER POLLUTION - EXPOSURE TO METALS, EMERGING AND REMERGING DISEASES

PP-31-192

The Genotoxicity of the Organics in Effluent From Different Treating Processes of 6 Water Works in Shenzhen

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Background/Aims: To detect and assess the genotoxicity of the organic extracts in effluent of 6 water works in Shenzhen.

Methods: The Salmonella mutagenicity test was used to detect the mutagenicity of water samples collected from 6 water works (A, B, C, D, E, and F) on May and June, 2008, Shenzhen.

Results: Except for the water sample from active carbon pool of B water works, all other showed positive result for Ames test, and the type of mutagenicity was mainly code-shifting. The intensities of mutagenicity of every water samples during the treatment were as follows: A: output water > precipitated-filtrated water > source water > second chlorinated water > tap water > prechlorinated water; B: source water > second chlorinated water > precipitated-filtrated water > tap water > output water > active carbon filtrated water; C: prechlorinated water > output water > precipitated-filtrated water > source water > tap water > second chlorinated water; D: tap water > precipitated, filtrated water > prechlorinated water > output water > source water; E: output water > prechlorinated water > tap water > precipitated-filtrated water > second chlorinated water > source water; F: second chlorinated water > precipitated-filtrated water > source water > output water > tap water. The comparisons of mutagenicity of output water among 6 water works: TA98 (−S9): E > D > C > A > F > B; TA98(+S9):E > C > F > D (A, B were negative); TA100 (−S9): E > F > C > A (D, B were negative); TA100 (+S9): only E was positive.

Conclusion: The mutagenicity of Dongjiang river decreased after the treatment of B and F water works, increased after the treatment of A and C; the mutagenicity of Dongjiang river plus reservoir water source increased after the treatment of D and E. The treatment techniques of pre-O_3-O_3-bioactive carbon filtration had positive effect in reducing the mutagenicity of output water. During the treatment techniques, cancelling of the prechlorination or using the dioxochloride replaced for chlorine as the disinfectant might have positive effect toward optimizing the quality of output water.

PP-31-193

Nitrate From Drinking Water and Prevalence of Abnormal Thyroid Conditions Among the Old Order Amish in Pennsylvania

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Background/Aims: Nitrate is a widespread contaminant of drinking water, especially in agricultural areas. At high concentrations, ingested nitrate interferes with iodide uptake by the thyroid; thus, potentially impacting thyroid function.

Methods: We conducted a cross-sectional study of drinking water nitrate concentrations and thyroid conditions among 2543 old order Amish residing in Lancaster, Chester, Lebanon Counties, Pennsylvania. Thyroid stimulating hormone (TSH) levels, an indicator of thyroid function, were measured from 1995 to 2008 and were used to define the following outcomes: clinical hyperthyroidism (n = 10), clinical hypothyroidism (n = 56), subclinical hyperthyroidism (n = 25), and subclinical hypothyroidism (n = 228). We obtained nitrate concentrations for private wells in these counties that were previously measured (1976–2006) by the US Geological Survey. We estimated nitrate concentrations at study participants' residences using a standard linear mixed effects model that included hydrogeological covariates (aquifer type and land use) and kriging of the wells' residuals. The residual value for each study participant included a weighted average of the 20 neighboring wells. Generalized linear regression was used to assess the relationship between nitrate exposure estimates and thyroid disease status.

Results: Nitrate levels estimated by the model ranged from 0.35 mg/L to 16.4 mg/L N-NO_3, with a median value of 6.5 mg/L, which we used to define high and low nitrate exposure. Among women, high drinking water nitrate exposure was significantly associated with subclinical hypothyroidism (Odds Ratio = 1.60; 95% Confidence Interval:

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1.11–2.32). Nitrate was not associated with subclinical hypothyroidism in men (Odds Ratio = 0.98; 95% Confidence Interval: 0.63–1.52) or with clinical thyroid disease in men or women.

Conclusion: Although these data do not provide strong support for an association between nitrate in drinking water and thyroid disease, our results suggest that further exploration of this hypothesis in studies that incorporate measures of both dietary and drinking water nitrate intake are warranted.

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PP-31-194

Water Quality of Mine Void Pit Lakes Used for Recreation

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Background/Aims: Australia has an increasing number of open cut mines with over 1800 in Western Australia. When mining ceases, a large open void may remain and become filled with water to form a pit lake. These lakes are known to become acidic or hyper saline. Coal has been mined in the Collie area in the South West of Western Australia since 1898. Pit lakes have been present in the area for approximately 50 years since mining began.

Methods: There are 3 main lakes used by the regional public for recreational purposes, including swimming, fishing, and boating and water quality varies between them. We collected water quality data for the lakes.

Results: Lake pH is typically low (3.8–6.8) due to acid mine drainage from sulphide rich materials such as pyrite. Water temperature ranges from 12.5°C to 28.9°C. Concentrations of Hg were above Australian Drinking Water Guidelines (mean, 171 μg/L; range, 100–240 μg/L) at Black Diamond. The detection limits for other pollutants were above the Australian Drinking Water Guidelines making interpretation difficult. At the other 2 lakes, Lake Kepwari and Stockton Lake respectively concentrations of Al (means 3577 and 529 μg/L), Ni (means 90 and 25 μg/L); Pb (means 33 and 59 μg/L); and As (means 38 and 19 μg/L) were also above drinking water and some recreational water quality guidelines. Sampling of lake aquatic biota indicates a regular summer presence of mosquito larvae (*Culex* sp. with the likely presence of other genera) and biting midges, which may be transmitters of vector-borne diseases. Further testing is required to determine which species is present.

Conclusion: A preliminary risk assessment based on the results of recreational use of the lakes, and water quality parameters suggests a potential for health impacts in users depending on the frequency and type of lake-based activities.

PP-31-195

Recreational Use of Acid Mine Pit Lakes

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Background/Aims: In recent years, both the mining industry and regulators have begun to recognize the importance of the environmental and social impacts of pit lakes formed through open cut mining. In the mining town of Collie, in south-western Australia, there are 15 pit lakes of which 3 are commonly used for recreational purposes including swimming, fishing, and boating.

Methods: A cross-sectional survey of community use of the lakes was undertaken. Questionnaires were mailed to 1200 randomly selected addresses in the Collie shire with an additional 170 questionnaires distributed to specific interest groups. Participants were asked about their uses of the lakes, frequency and duration of use, and any health symptoms experienced after use.

Results: A total of 250 questionnaires were returned, 176 (15%) from the random mail out and 74 (43%) from the targeted mail out. More males responded than females and 63% were aged over 50 years. Three pit lakes were used for recreational purposes by 62% of respondents. Black Diamond Lake had the highest number of visitors (126 respondents) and was also the most frequently visited lake (10 visitor d/yr). Attendance at the lakes was seasonal with most visits occurring in the summer months. Swimming was the most common activity (2.5–2.9 hour per week) and time spent on other water-based activities ranged from 2.9 to 5.1 hour per week. In all, 52% of respondents using the lakes were concerned about lake water quality and 28% reported health effects with 22% experiencing sore eyes from a particular lake (Black Diamond). Of those who used the lakes, 24% used one or more lakes for fishing (marron) and 82% ate the seafood they caught.

Conclusion: These data and chemical and biological characteristics are being used in a preliminary assessment of the risks of recreational use of the pit lakes.

PP-31-196

The Relationship Between Intestinal Infectious Diseases of the Population and the Drinking Water Pollution in 2004–2008 in Fangshan District of Beijing, China

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Background/Aims: The prevalence of intestinal infectious diseases of the rural population in China has been relatively higher than the developed countries for many years. However, the reason for it has not been clear.

Objective: To explore the epidemic features of the intestinal infectious diseases of the exposed population and the association with the drinking water pollution in the suburb of Beijing for 5 years.

Methods: The data of the prevalence of intestinal infectious diseases and regular monitoring for drinking water quality were collected in 2004–2008 in Fangshan district. The descriptive analysis and Pearson correlation were conducted by SPSS statistical software for the spatial and temporal distribution of the diseases and drinking water quality in the different township.

Results: The prevalences of the intestinal infection in the exposed population were 140.10/100,000 in 2004, 344.12 in 2005, and 346.05 in 2006, respectively; however, it decreased to 266.28/100,000 in 2007 and 265.73/100,000 in 2008 than that in 2006, respectively. The distribution of the drinking water quality was associated with the prevalence of intestinal infectious disease in the different township in Fangshan district.

Conclusion: The prevalence of the intestinal infectious diseases may be associated with the drinking water quality of the exposed population in rural area of Beijing.

PP-31-197

Increased Oxidative DNA Damage in Workers Exposed to External Environmental Di(2-ethylhexyl) Phthalate (DEHP) in a Waste Plastic Recycle Area in China

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Background/Aims: Di(2-ethylhexyl)phthalate (DEHP) is a general-purpose plasticizer for polyvinyl chloride and has become a ubiquitous

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environmental contaminant. It is suspected to be an endocrine disrupting/modulating substance in humans. China has already been the second county of plastic production and consumption in the whole world. As the universal application and high-out rates of plastics in our daily life, plastics recycling and processing industry have emerged. A large number of abandoned plastic products have been collected and transport to waste plastic recycle areas. According to statistics, the number of plastics recycling businesses in China is up to 10,000 or so, developing a number of large-scale plastics recycling markets and processing areas. The amount of recycling waste plastics of an annual is about more than 600 million tons. However, with the lack of effective market regulation, backward technology and poorly equipped of plastics recycling businesses, the aggravation environment problems and people's health in these areas have become a social issue of common concern, especially burning and depositing plastic waste. The aims of the study were to perform the monitoring of levels ofDEHP in the water samples and 5 PAEs in the soil samples, which were collected from the exposure region and the control region; to measure the levels of oxidative stress and the extent of deoxyribonucleic acid DNA oxidative damage by the biomarkers including levels of malondialdehyde (MDA), super oxide dismutase (SOD), and glutathione peroxides in sera samples and 8-OHdG in the urine samples from the workers who engaged plastic recycle and plastic reclaim, and to analyze the risk factors relating to these biomarkers.

Methods: The exposure region was a plastic recycling centers in the Southern city where has had over 20 years in plastics recycle and the control region was 50 km far away from exposure region where it is without known sources of pollution related. The 157 workers in exposure region and 157 residents in control region were selected based on gender and age matched, and the basic information was collected by uniform questionnaire. DEHP levels of collected water samples from the sites (including the river, wells, ponds, tap water, and industrial effluent) in the exposure region and the control region were detected using the solid-phase extraction and gas chromatography method. The column chromatography and gas chromatography techniques were applied to determine the concentrations of DEHP and other PAEs in soil samples. The chemical colorimetric was used to determine serum MDA, glutathione peroxides, and SOD in exposure and control population, which is served as an oxidative stress index of DNA damage. The electrochemical-high performance liquid chromatography was applied to test the level of urinary 8-OHdG, which is served as an index of the extent of DNA oxidative damage. The demography data and related medical index in exposure and control were analyzed by using significance test. Logistic regression was performed to analyze the DNA damage.

Results: The average DEHP level in the river water samples from the polluted section (mean: 2.05 μg/L) was 6.4 fold compared with that from the control section (0.32 μg/L). Average DEHP level in the pond (135.68 μg/L) and the well (14.20 μg/L) water samples from the exposure region were 18 fold and 215 fold compared with those (0.79 μg/L and 0.37 μg/L) in the control region, respectively. The DEHP level in industrial effluent sample ranged from 0.36 μg/L to 161.86 μg/L. The dibutyl phthalate (DBP) (0.94–24.09 mg/kg) and DEHP (0.85–37.23 mg/kg) were indentified in all soil samples from exposure and control regions. In 5 PAEs determined, the DEHP and DBP concentration is the highest one, following by diethyl phthalate, di-n-octyl phthalate (DnOP), and dimethyl phthalate. The average of 5 PAEs in soil of exposure region was 1–19 times of that in control region. The contents of DBP (mean: 9.46 mg/kg) and DEHP (mean: 13.07 mg/kg) in exposure region soil were the 19 and 16 times of that in control region. The detection rate of DBP (range, 0.94–24.09 mg/kg) and DEHP (range, 0.85–37.23 mg/kg) in the exposed soil are 100%. The medians of serum SOD in exposed population and control population were 111.80 U/mL (range, 31.71–167.69 U/mL) and 124.16 U/mL (range, 78.88–181.46 U/mL) respectively, with a significant difference between the 2 groups ($P < 0.01$).

Conclusion: The study results showed that DEHP exposure concentrations in water and soil samples in plastic recycling centers where occupational workers lived were higher than that where the control residents live. The demological study results showed that the occupational exposure was the main factor, which affects the levels of serum SOD, MDA, GAH-Px, and urine 8-OHdG. Although Urine 8-OHdG levels may be affected by other pollutants from plastic recycling center, the exposure population has shown the oxidative DNA damage.

PP-31-198

Numerical Simulations of Chlorpyrifos Transport Through the Unsaturated Zone in Agricultural Area, Ubon Rachatani Province, Northeastern, Thailand

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Background/Aims: One of the agricultural areas, Tambon Hua Ruea, Ubon Ratchatani Province, has intensively used pesticides and fertilizers in agricultural activities, particularly for planting chilli and rice. According to field survey, chlorpyrifos has been long used in such agricultural area. Therefore, people and animals in vicinity areas may be then adversely affected by touching or drinking those polluted soil and groundwater.

The transport of chlorpyrifos through unsaturated soil were evaluated as well as the groundwater vulnerability to contamination, water resource management, and monitoring well plan.

Methods:

1. Twelve undisturbed soil samples were collected around 0–30 cm deep below ground surface in the vicinity of chilli fields. To describe the water characteristic curve ohese unsaturated agricultural soils, the relationship between water contents (θ) and suction pressures head (Ψ) of such soils has been investigated using pressure plate apparatus according to ASTM D 6836.
2. The adsorption properties of chlorpyrifos carried out in batch experiment showed that the Freundlich equation described the observed points well.
3. Finally, with HYDRUS-1D modeling, unsaturated soil properties and adsorption parameters incorporated with metrological data, precipitation, and evapotranspiration, could be used to predict water flow and chlorpyrifos transport through the subsurface environment.

Results:

1. Van Genuchten could explain the soil water characteristic behavior quite better than Brooks and Corey.
2. The simulated results found that chlorpyrifos could not pass through 1 m deep below ground surface. Moreover, the infiltrated water caused water content in soil to increase with depth; consequently, front of chlorpyrifos concentrations moved faster than those in lower water content.

Conclusion: The transport of chlorpyrifos through unsaturated soil in this area probably contaminated to shallow groundwater in vicinity areas. Unsaturated parameters, sorption properties, and meteolorogical data have impacted on chlorpyrifos transport through groundwater systems,

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PP-31-199

Birth and Onset of Recently Diagnosed Minamata Disease Patients

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Background/Aims: The Chisso Company discharged mercury in Minamata from 1932 to 1968. The latent onset of chronic Minamata disease and lack of toxicological information for residents, with social discriminations has disturbed the clinical access of the contaminated residents.

Methods: One hundred ninety-seven exposed residents who have been examined from November 2004 to April 2005 were subjects of this study, and 189 residents had four-limb dominant or generalized somatosensory disturbance and diagnosed as Minamata disease. After 7 subjects without onset information were excluded, 182 were analyzed. We studied the onset of the Minamata disease symptoms. The onset time and symptoms were reported by residents. When the onset year was ambiguous, we adopted the average years as follows: if the reported year is 1960s, we judged the year as 1965 (1960+5).

Results: The onset symptoms were not restricted to one per one subject. The most prevalent onset symptoms were numbness of limbs (49%), and cramps (47%) and motion difficulty (14%) followed. The average birth year was 1941 ± 11, and the average onset year was 1972 ± 14. Younger and late onset people had slighter symptoms. Onsets were before 1956 in 22 subjects (12%), and after 1968 in 100 subjects (55%). There were tendencies showing that symptoms became milder as subjects became younger, but there was no tendency between birth year and onset year on the whole.

Conclusion: Some people might have been affected and have not noticed their abnormalities and others might have experienced health disturbances due to aging and ongoing contamination. We suppose that symptoms and signs of methylmercury contamination should be considered with (1) toxicities, (2) plasticity, and (3) aging effect of or to the central nervous system. Combination and interaction of these 3 effects can explain the worsening of health state after several years after exposure, and (4) ongoing toxic effect cannot also be excluded, especially for previously contaminated residents.

PP-31-200

Health Hazard Still Emerged Even After 1968, When Chisso Company Stopped Mercury Drainage

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Background/Aims: The Chisso Company discharged huge amount of mercury during the 36 years between 1932 and 1968. Residents have avoided receiving medical examination for fear of social discrimination against Minamata disease, and research of the pollution effects on younger people has not been performed.

After the judgment of Japanese Supreme Court in 2004, younger residents began to receive examination on Minamata disease. We examined such people and evaluated the health states of younger people.

Methods: From June 2005 to April 2008, we examined thousands of residents in the polluted area. Among them, 40 subjects (23 males and 17 females) were born after 18 April 1968, when Chisso stopped the drainage. The birth year for them was from 1968 to 1986.

Results: Most of them (92.5%) were aware of the numbness of hand or foot, but those who always felt the numbness were only 15%. The same tendencies were observed in other complaints. Limited peripheral vision was 15% (A: Always) and 55% (A + S: Always + Sometimes). Stumbling on the flat ground was 5% (A) and 52.5% (A + S). Difficulty in smelling was 2.5% (A) and 35% (A + S). Forgetfulness was 17.5% (A) and 90% (A + S). On neurological examination, 92.5% had sensory disturbance. The extent of sensory disturbance was milder than the elderly cases on the whole, but there were also severely impaired residents. Clear truncal ataxia (15%), distinct visual constriction (5%), dysarthria (10%), and hearing impairment (5%) were observed.

Conclusion: These results suggest that the pollution in Minamata has been giving health effects at younger ages. The emergence of huge number of patients after discovery of Minamata disease is caused by failure of policy. Our measuring methods (standard neurological examination) are not sensitive to the health disorders by lower methylmercury contamination. Other psychological and motor function tests should be performed on these younger contaminated people. Chronological safe limit of seafood around Minamata cannot be concluded yet.

PP-31-201

Spread of Health Effects by Methylmercury—Results of Shiranui Seashore Health Survey

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Background/Aims: Health surveys were performed along the Shiranui Seashore and symptoms and signs of inhabitants were studied.

Methods: On 20 and 21 September, 2009, inquiry and neurological examinations of inhabitants were performed. We categorized subjects into 6 according to the present address and residential history in the designated districts where compensation law of public nuisance is applicable, and compared the symptoms and examined signs.

Results: One thousand forty-four residents were examined. The admission of data collection was obtained from 974 subjects. There was family history of Minamata disease in half of the subjects, but subjects who have had an experience of medical examination for Minamata disease in the past were only 112 (11%). The number of people in every classified district was as follows: people who have a career living in an designated place before 1969: 807 (subclassified into Minamata-Ashikita (MA):232, Amakusa-Yatsushiro (AY):166, Izumi-Akune (IA):238, other places (OP):171); people who were born in or moved into the designated place after 1969 (BM): 59; people without a residential career in the designated places (WO): 108. Average age was 62.3 ± 11.8 and was significantly lower in OP subjects (58.8 ± 9.4), and BM (47.3 ± 11.6). The subjective symptoms were as follows: muscle cramps 898 (92%), numbness 896 (92%), stumbling 744 (76%), and difficulty in circumferential vision 591 (61%). Neurological signs by medical doctors were as follows: visual constriction 227 (23%), straight line gait instability 485 (50%), finger to nose test abnormality with closing eyes 302 (31%), superficial sensory disturbance in 4 limbs 775 (80%), systemic superficial sensory disturbance 246 (25%). Incidences of symptoms and signs were characteristic for chronic methylmercury poisoning and incidence pattern in each group was closely resembled including OP and IC groups.

Conclusion: The medical examinees are only a tip of the iceberg, and health hazards by methylmercury are thought to be spread chronically and spatially. Further examinations and provisions are necessary.

PP-31-202

The Effects of Polychlorinated Biphenyls on Lipid Synthesis

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Background/Aims: Polychlorinated biphenyls (PCBs) are a concern because of adverse health effects on people and the environment. Studies have shown significant association between exposure to PCBs and the major diseases of adults, such as cardiovascular disease and diabetes. At least some of these effects of PCBs are secondary to alteration of lipid metabolism, especially of cholesterol and triglycerides.

Methods: We have studied 663 adult Native Americans exposed to PCBs primarily by consumption of contaminated fish. We have previously found a significant correlation between concentrations of several classes of PCB congeners and rates of cardiovascular disease (Goncharov et al, 2008), and have concluded that PCBs alter risk of cardiovascular disease by increasing lipid synthesis. The goal of this study was to determine whether the effects on cholesterol synthesis are similar to or different from those on triglyceride synthesis.

Fasting blood samples were taken and analyzed for 101 PCB congeners, total cholesterol and triglycerides, followed by calculation of total serum lipids. We ran multivariate linear regression to determine the relationship between concentrations of single PCB congeners and levels of cholesterol and/or triglycerides after adjustment for BMI, age, gender, and medication. Multivariate tests were done to determine the relative strength of the relationship for cholesterol as compared to that for triglycerides.

Results: Thirty-five single congeners showed a significant positive association with levels of triglycerides, while only 14 congeners were significantly correlated with levels of cholesterol. These relations were found for estrogenic, dioxin-like, mono, di, and tri+tetra ortho congeners, but the relations were stronger for more highly chlorinated congeners.

Conclusion: These observations indicate that there is a stronger stimulation of triglyceride as compared to cholesterol synthesis by PCBs.

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