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Correlates of change in self-perceived oral health among older adults in Brazil

Findings from the Health, Well-Being and Aging Study

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The assessment of changes in oral health status among members of the population is essential to public health planning. It involves distinct tasks,[1] such as description of the change and identification of differences among people and groups in terms of the nature, direction and magnitude of change; identification of predictors of change; and determination of an explanation of the change.

Traditionally, investigators have assessed change through repeated cross-sectional studies, cohort studies and clinical trials involving the use of clinical indexes. These indicators help determine the progression of disease, but they do not measure improvements in health.[2] Clinical oral health measures depend on the observations of the health professional (normative assessment) and take little account of quality-of-life measures, which reflect how a person perceives his or her oral health status[3] and how that status affects his or her functional and psychosocial well-being.[4]

ABSTRACT

Background. Identifying changes in the oral health status of older populations, and their predictors and explanations, is necessary for public health planning. The authors assessed patterns of change in oral health–related quality of life in a large cohort of older adults in Brazil during a five-year period and evaluated associations between baseline characteristics and those changes.

Methods. The sample consisted of 747 older people enrolled in a Brazilian cohort study called the Health, Well-Being and Aging (Saúde, Bem-estar e Envelhecimento [SABE]) Study. Trained examiners measured participants' self-perceived oral health by using the General Oral Health Assessment Index (GOHAI). The authors calculated changes in the overall GOHAI score and in the scores for each of the GOHAI's three dimensions individually by subtracting the baseline score from the score at follow-up. A positive difference indicated improvement in oral health, a negative difference indicated a decline and a difference of zero indicated no change.

Results. The authors found that 48.56 percent of the participants experienced a decline in oral health and 33.48 percent experienced an improvement. Participants with 16 or more missing teeth and eight or more years of education were more likely to have an improvement in total GOHAI score. Deterioration was more likely to occur among those with two or more diseases. Improvement and decline in GOHAI functional scores were related to the number of missing teeth. The authors found no significant model for the change in the psychosocial score, and self-rated general health was the only variable related to both improvement and decline in pain or discomfort scores.

Conclusions. The authors observed a bidirectional change in self-perceived oral health, with deterioration predominating. The strongest predictor of improvement in the total GOHAI score was the number of missing teeth, whereas the number of diseases was the strongest predictor of deterioration.

Clinical Implications. Dental professionals and policymakers need to know the directions of change in older adults' oral health to establish treatment priorities and evaluate the impact of services directed at this population.

Key Words. Oral health; self-perception; self-assessment; quality of life; General Oral Health Assessment Index; older adults; aging; geriatric dentistry.
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A broad range of subjective instruments exist to measure the self-perceived effect of oral health on quality of life.[5] According to the literature, negative self-perceived oral health is related to a greater number of missing teeth,[3,6] a lower level of education,[7] use of dental prostheses[7,8] and nonuse of dental services.[9] With regard to changes in self-perceived oral health, the evidence reveals that tooth loss,[2] financial hardship[2] and a self-perceived need for dental treatment[10] are related to both an improvement and a decline in oral health, whereas research has not shown that the reason for dental visits is related to such changes.[2] Most of these results are from studies of older people, as there is an increasing interest in this segment of the population, especially owing to the striking inequalities in oral health status and access to dental care among members of this group.[11]

To date, too few investigators have examined changes in oral health–related quality of life across time, and to our knowledge none has conducted research in developing countries. This is a shortcoming, as oral health is considered a determining factor in quality of life and oral health–related quality of life is highly relevant to the evaluation of community oral health programs.[12]

Our aim in the study we describe here was to assess patterns of change in oral health–related quality of life and determine which baseline characteristics were associated with change throughout the observation period among a sample of noninstitutionalized older residents of São Paulo.

METHODS

Sample. Our study is part of a larger epidemiologic survey called the Health, Well-Being and Aging (Saúde, Bem-estar e Envelhecimento [SABE]) Study, which was a multicenter study coordinated by the Pan-American Health Organization, Washington, and conducted in seven countries in Latin America and the Caribbean (Argentina, Barbados, Brazil, Chile, Cuba, Mexico and Uruguay). In Brazil, this study was conducted by the School of Public Health of the University of São Paulo, Brazil, under the coordination of one of the authors (M.L.L.) in the city of São Paulo from 2000 through 2001 and involved a sample of 2,143 people representing 836,204 people 60 years and older, selected through multiple-stage sampling representative of the municipality of São Paulo.[13,14] In 2006, the School of Public Health continued the survey in São Paulo and transformed it into a multiple-cohort study. In this follow-up study, 1,115 of the older people who had participated in the baseline study and still were alive agreed to undergo a new set of interviews that were based on the same procedures as those used in the baseline study. Trained examiners collected data at the participants' homes, a process that involved the use of an interviewer-administered structured questionnaire with questions regarding socioeconomic variables, general health and living conditions as well as a set of anthropometric and physical function measurements.

This study received approval from the Human Research Ethics Committee of the School of Public Health, University of São Paulo. We obtained written informed consent from each participant at the time of his or her interview.

The results of this study are restricted to participants with complete data for the GOHAI at both baseline and follow-up. We excluded from the analysis participants diagnosed with cognitive impairment in any of the study phases. We used the short version of the Mini-Mental State Examination to determine cognitive impairment.[15]

Outcome of interest. We measured self-perceived impact of oral health on quality of life by using the Geriatric Oral Health Assessment Index,[16] which was designed to assess the oral health of older people but also has been used successfully with other groups and therefore was renamed the General Oral Health Assessment Index (GOHAI).[5] This instrument consists of 12 questions aimed at assessment of oral health–related problems in three dimensions:
- physical function (concerns about eating, speech and swallowing);
- psychosocial function (concerns about oral health and self-image, self-consciousness regarding oral health and avoidance of social contact because of oral health problems);
- pain or discomfort.[16]

The respondent answers questions according to a five-point Likert scale.

Via the GOHAI questionnaire, we asked participants how often in the previous 12 months they had experienced each of the problems described: "always," "often," "sometimes," "seldom" or "never." The final score for each participant ranged from 12 to 60 points, with higher scores denoting a better self-rated oral health status or low degree of negative impact on quality of life.

ABBREVIATION KEY. GOHAI: General Oral Health Assessment Index. **SABE:** Saúde, Bem-estar e Envelhecimento (Health, Well-Being and Aging).

We determined changes in GOHAI scores by subtracting the total score at baseline (2000-2001) from the total score at follow-up (2006). As higher scores reflect better oral health, a positive difference indicated an improvement in oral health during the observation interval, a negative difference indicated a decline in oral health and a difference of zero represented no change.

Covariates. The independent variables in our study were as follows:
- sociodemographic data—age, sex, self-perception of income sufficiency and education;
- general health—depression, number of self-reported chronic diseases (diabetes, hypertension, heart disease, chronic obstructive pulmonary disease and arthritis) and smoking status;
- oral health measurements—self-reported number of missing teeth and self-reported use of prostheses.

In the baseline study, respondents provided information about their number of missing teeth according to three categories: zero to four teeth; five to 15 teeth; and 16 or more teeth. As the first category had few participants, we dichotomized this variable as zero to 15 missing teeth and 16 or more missing teeth so that we could keep cell sizes large enough for the data analysis. We collected data regarding all these independent variables during the baseline study.

Statistical analysis. Our statistical analysis involved descriptive and inferential analyses, with a 5 percent significance level and 95 percent confidence interval (CI). We tested associations between categorical variables by using the Rao-Scott modified χ^2 test. When data originates from simple random sampling, the Pearson χ^2 test may be used to test the null hypothesis of independence; however, in studies based on complex survey data, researchers must alter the procedure to account for the survey design. The Rao-Scott test takes into account the design weights from complex sampling procedures.[17]

The dependent variables were changes in the respondents' scores on the total GOHAI and its three dimensions individually. We entered all independent predictors with $P < .20$ in the bivariate analysis into a multinomial logistic regression model. Multinomial logistic regression analysis is an extended variation of binomial logistic regression in which the outcome variable has more than two categories. As the outcome variable has κ categories, multinomial logistic regression involves the comparison of κ − 1 categories, with a reference category

defined by the researcher. The model is adjusted in the same way as in binomial logistic regression, allowing simultaneous comparisons of the effects of independent variables to the dependent variable categories.[18] We included independent variables in sets in the following order: self-reported oral conditions, sociodemographic data and general health. We adjusted the final model for age (continuous variable), depression and self-perception of sufficient income, dichotomizing the latter two as yes or no. We used a statistical software program (Stata 11.0, StataCorp, College Station, Texas) for the analyses and made a correction for the design effect by using the "survey" command to analyze data originating from a complex sample.

RESULTS

At baseline in 2000 and 2001, 1,769 participants were free of cognitive impairment; we had complete GOHAI data for 1,573 of the 1,769. At the five-year follow-up in 2006, 747 (47.49 percent) of these 1,573 participants still were living and had complete GOHAI information. In relation to the baseline study, participants with missing data on the GOHAI (n = 196) were more likely to have 16 or more missing teeth ($P < .01$) and zero to three years of education ($P < .01$). Compared with the group of participants who were unavailable at follow-up, those who remained in the cohort were significantly more likely to be women, were at a less advanced age, had rated their health as "good" and had a lower proportion of two or more chronic diseases. There were no significant differences between the group unavailable at follow-up and the one retained in the cohort in relation to education, perception of having sufficient income to meet basic expenses, smoking habits, depression, number of missing teeth or use of a prosthesis. At baseline, the mean GOHAI score was 53.90 (95 percent CI, 53.35-54.46) among the participants unavailable at follow-up and 54.86 (95 percent CI, 54.25-55.47) among the participants retained, although the 95 percent CIs overlapped.

Regarding the final sample, 61.25 percent were female. The mean age was 67.04 years (median, 68 years); the largest percentage, 44.18 percent, of the respondents were aged 60 to 64 years, followed by those 70 years or older (31.12 percent). The majority had a low level of education; 40.58 percent were illiterate or had less than four years of education, 38.73 percent had four to seven years and 20.69 percent had eight or more years. Only 34.57 percent reported perceiving that they had sufficient income to meet basic expenses. A total of 74.12

percent of the respondents reported missing 16 or more teeth, and 84.01 percent reported using some kind of dental prosthesis (partial or complete dentures).

The changes in total GOHAI score revealed that nearly one-half (48.56 percent) of the participants experienced a decline in oral health during the observational interval, whereas 33.48 percent experienced an improvement. Table 1 displays the distribution of the change in total GOHAI scores according to the independent variables. The results reveal that participants in the three GOHAI score groups (those with a positive difference in scores ["improved"], those with a negative difference in scores ["worse"] and those with no alteration in scores ["no change"]) were similar in terms of sociodemographic data, general health and oral health factors at baseline. In the final model (Table 2), improvement in the total GOHAI score was related to the number of missing teeth and education, whereas a decline in oral health was associated significantly with the number of chronic diseases.

In relation to the pattern of change in scores on the functional dimension of the GOHAI, the groups were more different in terms of oral health and personal characteristics. Men were more likely to have undergone a change ($P < .01$); 43.32 percent experienced a functional decline and 42.79 percent experienced an improvement. Among the women, these figures were 38.07 percent and 34.70 percent, respectively. The groups also differed significantly with regard to the number of missing teeth ($P < .01$) and the use of dentures ($P = .03$). Among those who had lost

TABLE 1

Demographic data and distribution of change in scores on the General Oral Health Assessment Index (GOHAI), according to independent variables.

PARTICIPANT CHARACTERISTIC	PERCENTAGE OF PARTICIPANTS, ACCORDING TO CHANGE IN GOHAI SCORE			P VALUE*
	No Change	Improved	Worse	
Sex				
Male	17.85	32.71	49.44	.93
Female	18.03	33.97	47.99	
Age (Years)				
60 to 64	20.62	34.52	44.86	
65 to 69	18.79	28.94	52.27	.25
70 or older	13.54	35.61	50.86	
Sufficient Income				
No	16.65	32.98	50.37	.19
Yes	20.29	34.33	45.38	
Educational Level				
Zero to three years	15.51	36.15	48.34	
Four to seven years	21.49	27.10	51.41	.07
Eight or more years	16.17	40.19	43.64	
Depression				
Yes	15.73	40.45	43.82	.27
No	18.42	32.07	49.51	
Number of Diseases				
Zero or one	20.30	33.76	45.94	.10
Two or more	13.35	32.93	53.71	
Self-Rated Health Status				
Good	18.17	32.64	49.19	.89
Poor	17.80	34.50	47.70	
Smoking Status				
Yes	11.12	36.31	52.58	.21
No	19.03	33.04	47.93	
Number of Missing Teeth				
Zero to 15	24.87	30.47	44.65	.07
16 or more	15.55	34.53	49.92	
Denture				
Yes	17.30	33.53	49.17	.43
No	21.81	35.40	42.79	

* According to the Rao-Scott modified χ^2 test.

zero to 15 teeth, the majority (57.54 percent) experienced no change in the functional dimension score, followed by those whose scores declined (27.67 percent). Among the participants with 16 or more missing teeth, almost one-half (44.45 percent) experienced a decline and 30.97 percent underwent no change. With regard to dental prostheses, people who wore dentures were more likely to have experienced a decline in physical function (41.03 percent); 35.53 percent of those experienced no change in physical function. In contrast, those without dentures were more likely to have undergone no change (49.58 percent), and 34.30 percent of them experienced

TABLE 2

Final multinomial logistic regression model for participants with changes in General Oral Health Assessment Index (GOHAI) scores.*

PARTICIPANT CHARACTERISTIC, ACCORDING TO CHANGE IN GOHAI SCORE	ADJUSTED ODDS RATIO (95% CONFIDENCE INTERVAL)	P VALUE
Improved		
Missing teeth		
Zero to 15	1	—†
16 or more	1.92 (1.18-3.13)	.01
Educational level		
Zero to three years	0.73 (0.37-1.43)	.35
Four to seven years	0.43 (0.21-0.88)	.02
Eight or more years	1	—
Number of diseases		
Zero or one	1	—
Two or more	1.39 (0.76-2.55)	.28
Worse		
Missing teeth		
Zero to 15	1	—
16 or more	1.62 (0.89-2.92)	.11
Educational level		
Zero to three years	0.85 (0.40-1.79)	.66
Four to seven years	0.75 (0.37-1.54)	.43
Eight or more years	1	—
Number of diseases		
Zero or one	1	—
Two or more	1.76 (1.01-3.06)	< .05

* Model adjusted by age (continuous variable), depression, self-perception of a sufficient income (the latter two dichotomized as yes-or-no questions); n = 744, representing 343,376 people; model P value = .01; "no change" used as reference category.
† Reference category.

factors related to a change in pain or discomfort scores. Improvement was related to self-rated general health and smoking, whereas a decline was associated with self-rated general health.

DISCUSSION

The results of our investigation reveal that nearly one-half—48.56 percent—of the older Brazilian population we studied experienced a decline in oral health–related quality of life during the five-year observation period, and approximately one-third (33.48 percent) of the participants experienced an improvement. Moreover, the number of missing teeth was the best predictor of an improvement in the total GOHAI score as well as of both improvement and decline in the functional dimension. To our knowledge, this

a decline in physical function. We also included smoking status (P = .09) and self-rated health (P = .07) in the multivariate model. Two variables were independently related to functional improvement and one was independently related to a decline (Table 3).

In the psychosocial dimension, we included in the logistic model only smoking status (P < .01) and self-rated health (P = .11). However, the final model was not statistically significant (P = .11).

In the pain or discomfort dimension, there were significant differences among the groups in relation to self-rated health (P < .01) and depression (P = .04). A total of 52.01 percent of the participants whose self-rated health status was "good" underwent no change, whereas 25.90 percent experienced a decline. In contrast, 31.95 percent of those participants with a self-rated health status of "poor" experienced a decline in pain or discomfort scores and 31.25 percent demonstrated an improvement. Table 4 (page 494) displays the final multinomial analysis for

is the first investigation of patterns of change in oral health in a population of older people in a developing country by means of a multi-item oral health quality-of-life measure. Therefore, direct comparison between these results and those in the literature is hindered by differences in population characteristics and outcomes.

In relation to the direction and magnitude of the change, our results differ from those reported by other authors,[2,10,19] in which most of the participants experienced either no change or a decline in self-reported oral health (although Dolan and colleagues[19] found a lower percentage of participants with no change in scores than did investigators in the other two studies). Our findings reveal a greater amount of both improvement and decline in oral health than seen in the studies cited.[2,10,19] These divergences may be related to differences in the methods used to measure change.

A higher number of missing teeth at baseline increased the chance of improvement in oral health during the five-year follow-up period.

However, the analyses of the three GOHAI dimensions separately revealed that this relationship remained significant only for changes in the functional dimension. The apparent incoherence of the patterns of change in the functional dimension score—that people with a greater number of missing teeth experienced both improvement and deterioration in reported oral health—is supported by the literature.[2,10] Slade[2] assessed changes in oral health–related quality of life at baseline and after a two-year follow-up period and investigated its relationship with regard to three risk predictors (tooth loss, problem-based dental visits and financial hardship). According to his results, high-risk groups had both higher rates of deterioration and improvement in oral health than did low-risk groups. Slade[2] stated that the explanation for this lay in the fact that risk factors could have opposite effects in different people. Thus, tooth loss throughout an observation period may reduce the ability to chew and worsen quality of life for some older people, whereas others may experience pain relief after tooth extraction and a consequent improvement in oral health. However, the predominant effect depends on the baseline oral health status in the sample.

Locker[1] suggested that this phenomenon is explained partially by the relationship between tooth loss and pain. Locker found that people who experienced an improvement in oral health also had a reduction in the prevalence of toothache between baseline and follow-up, whereas those who experienced a decline in oral health also reported an increase in pain associated with the use of partial dentures. Atchison and Gift[20] reported that the use of full dentures may represent an improvement in oral health among people who have experienced repeated tooth problems. Thus, improvement in our study may have occurred among people with 16 or more missing teeth at baseline who acquired new den-

TABLE 3

Final multinomial logistic regression model for participants with changes in General Oral Health Assessment Index (GOHAI) functional dimension scores.*

PARTICIPANT CHARACTERISTIC, ACCORDING TO CHANGE IN GOHAI SCORE	ADJUSTED ODDS RATIO (OR) (95% CONFIDENCE INTERVAL)	P VALUE
Improved		
Missing teeth		
Zero to 15	1	—†
16 or more	2.96 (1.87-4.68)	< .01
Sex		
Male	1	—
Female	2.11 (1.19-3.75)	.01
Worse		
Missing teeth		
Zero to 15	1	—
16 or more	2.94 (1.80-4.80)	< .01
Sex		
Male	1	—
Female	0.93 (0.60-1.47)	.78

* Model adjusted by age (continuous variable), depression and self-perception of a sufficient income (the latter two both dichotomized as yes-or-no questions). Age was related to decline infunctional change (OR, 1.04; P = .02) and depression was related to improvement (OR, 2.04; P < .01); n = 744, representing 343,376 people; model P value < .01; "no change" used as reference category.
† Reference category.

tures or started to use prostheses and experienced an improvement in chewing efficiency, whereas those with a high number of missing teeth along with a continued need for prosthodontic treatment would be more likely to experience a decline in oral health. These findings also corroborate those reported in other cross-sectional studies in which having a higher number of teeth was associated with both poor[9,21] and satisfactory[22,23] self-perceived oral health.

The lack of an association between oral health and a change in score in the psychosocial dimension may be explained by the small number of people with 16 or more missing teeth who had no prosthetic replacement, which may have masked some associations. The same may have occurred with regard to a change in score in the pain or discomfort dimension, as there was a high prevalence of tooth loss in the sample and, therefore, a low prevalence of toothache and sensitivity to hot and cold beverages and foods. The fact that smoking was associated with an improvement in oral pain or discomfort in the multinomial model may be because smoking is an important predictor of periodontal disease[24-26] and tooth loss[27,28] and treatment of these conditions is related to relief of pain or discomfort.

Investigators in previous cross-sectional studies reported divergent results regarding

RESEARCH

Final multinomial logistic regression model for participants with changes in General Oral Health Assessment Index (GOHAI) pain or discomfort scores.*

PARTICIPANT CHARACTERISTIC, ACCORDING TO CHANGE IN GOHAI SCORE	ADJUSTED ODDS RATIO (95% CONFIDENCE INTERVAL)	P VALUE
Improved		
Self-rated health		
Good	1	—[†]
Poor	1.82 (1.14-2.91)	.01
Smoking		
No	1	—
Yes	1.60 (1.00-2.56)	< .05
Worse		
Self-rated health		
Good	1	—
Poor	1.76 (1.17-2.65)	.01
Smoking		
No	1	—
Yes	1.52 (0.80-2.88)	.20

* Model adjusted by age (continuous variable), depression and self-perception of a sufficient income (the latter two both dichotomized as yes-or-no questions); n = 743, representing 342,838 people; model P value = .01; "no change" used as reference category.
† Reference category.

associations between self-reported oral health and sociodemographic factors. Researchers have reported associations between self-reported oral health and education,[7] sex[6,22,29] and depression,[29] whereas others found no association between self-reported oral health and education,[29] age or sex.[7,22] However, few researchers in longitudinal studies have investigated these associations, and there remains a gap in knowledge regarding the role of these variables in terms of changes in self-perceived oral health. Slade[2] found that financial hardship was related to both improvement and decline in oral health–related quality of life and had no plausible explanation for this. In our study, different personal characteristics were related to each of the changes in scores analyzed. Education was related independently to improvement in the total GOHAI score. Participants with seven or fewer years of education had a 57 percent lesser chance of demonstrating improvement than did those with eight or more years of education, which corroborates findings described in a previous study.[7] Moreover, having two or more diseases significantly increased the chance of deterioration in overall oral health, which may be explained by the cumulative deterioration of general health caused by chronic disease. Likewise, Locker and Jokovic[10] found general health conditions to be related to a decline in oral health, as the multiple logistic model revealed that people with high levels of stress and those taking three or more prescribed medications were significantly more likely to exhibit a decline in oral health.

Limitations. Our study has limitations that should be addressed. The first is the lack of clinical assessments of oral health, although data from previous studies suggest that self-reports are reliable.[30,31] Secondly, it is important to mention that we did not adjust the final model for baseline GOHAI scores. Thirdly, one should generalize these results with caution, as the participants who completed the observational follow-up were younger, in better general health (as expected in a longitudinal study) and more likely to be women than those unavailable for follow-up. Therefore, one must consider potential biases. However, only two variables in which the two groups differed were associated with changes in self-perceived oral health, and there was no difference between the groups in relation to the dependent variable at baseline. Finally, we considered only baseline characteristics, thereby making inferences for the reasons for changes in self-reported oral health inconclusive.

CONCLUSION

The results of our study demonstrate two primary patterns of change (improvement and deterioration) in the self-perceived oral health of our older Brazilian cohort, with a perception of deterioration predominating. These findings can contribute toward identifying people who are prone to either a positive or negative change across time, as well as toward the establishment of hypotheses regarding changes in oral health–related quality of life among older people. Therefore, further analysis would benefit from including variables related to the progression of oral and general health outcomes and the use of health services to explain the reasons for change. ∎

1. Locker D. Issues in measuring change in self-perceived oral health status. Community Dent Oral Epidemiol 1998;26(1):41-47.

2. Slade GD. Assessing change in quality of life using the Oral Health Impact Profile. Community Dent Oral Epidemiol 1998;26(1):52-61.

3. Sánchez-García S, Heredia-Ponce E, Juárez-Cedillo T, et al. Psychometric properties of the General Oral Health Assessment Index (GOHAI) and dental status of an elderly Mexican population. J Public Health Dent 2010;70(4):300-307.

4. Schierz O, John MT, Reissmann DR, Mehrstedt M, Szentpétery A. Comparison of perceived oral health in patients with temporomandibular disorders and dental anxiety using oral health-related quality of life profiles (published online ahead of print June 4, 2008). Qual Life Res 2008;17(6):857-866. doi:10.1007/s11136-008-9360-3.

5. Slade GD, ed. Measuring Oral Health and Quality of Life. Chapel Hill, N.C.: University of North Carolina, Department of Dental Ecology; 1997:161.

6. Mariño R, Schofield M, Wright C, Calache H, Minichiello V. Self-reported and clinically determined oral health status predictors for quality of life in dentate older migrant adults. Community Dent Oral Epidemiol 2008;36(1):85-94.

7. Tsakos G, Sheiham A, Iliffe S, et al. The impact of educational level on oral health-related quality of life in older people in London. Eur J Oral Sci 2009;117(3):286-292.

8. Steele JG, Sanders AE, Slade GD, et al. How do age and tooth loss affect oral health impacts and quality of life? A study comparing two national samples. Community Dent Oral Epidemiol 2004;32(2):107-114.

9. Martins AM, Barreto SM, Silveira MF, Santa-Rosa TT, Pereira RD. Self-perceived oral health among Brazilian elderly individuals (in Portuguese) (published online ahead of print Sept. 3, 2010). Rev Saude Publica 2010;44(5):912-922. doi:10.1590/S0034-89102010005000028.

10. Locker D, Jokovic A. Three-year changes in self-perceived oral health status in an older Canadian population. J Dent Res 1997;76(6):1292-1297.

11. Petersen PE, Yamamoto T. Improving the oral health of older people: the approach of the WHO Global Oral Health Programme. Community Dent Oral Epidemiol 2005;33(2):81-92.

12. Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century—the approach of the WHO Global Oral Health Programme. Geneva: World Health Organization; 2003:38.

13. Lebrão ML, Oliveira Duarte YA. SABE—Saúde, Bem-estar e Envelhecimento—o projeto SABE no município de São Paulo: uma abordagem inicial. Brasília, Federal District, Brazil: Pan-American Health Organization; 2003:255.

14. Barbosa AR, Souza JM, Lebrão ML, Laurenti R, Marucci Mde F. Functional limitations of Brazilian elderly by age and gender differences: data from SABE Survey (published online ahead of print July 11, 2005). Cad Saúde Pública 2005;21(4):1177-1185. doi:10.1590/S0102-311X2005000400020.

15. Icaza MG, Albala C. Minimental State Examinations (MMSE) del Estúdio de Demencia en Chile: Análisis Estatístico. Washington: Pan-American Health Organization; 1999.

16. Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. J Dent Educ 1990;54(11):680-687.

17. Rao JNK, Scott AJ. On chi-squared tests for multiway contingency tables with cell proportions estimated from survey data. Ann Statistics 1984;12(1):46-60.

18. Afifi AA, Clark VA, May S. Computer-Aided Multivariate Analysis. 4th ed. Boca Raton, Fla.: Chapman & Hall/CRC; 2004:489.

19. Dolan TA, Peek CW, Stuck AE, Beck JC. Three-year changes in global oral health rating by elderly dentate adults. Community Dent Oral Epidemiol 1998;26(1):62-69.

20. Atchison KA, Gift HC. Perceived oral health in a diverse sample. Adv Dent Res 1997;11(2):272-280.

21. Martins AM, Barreto SM, Pordeus IA. Objective and subjective factors related to self-rated oral health among the elderly (in Portuguese). Cad Saúde Pública 2009;25(2):421-435.

22. Swoboda J, Kiyak HA, Persson RE, et al. Predictors of oral health quality of life in older adults. Spec Care Dentist 2006;26(4):137-144.

23. Joaquim AM, Wyatt CC, Aleksejūnienė J, Greghi SL, Peggoraro LF, Kiyak HA. A comparison of the dental health of Brazilian and Canadian independently living elderly (published online ahead of print Nov. 22, 2010). Gerodontology 2010;27(4):258-265. doi:10.1111/j.1741-2358.2009.00340.x.

24. Thomson WM, Broadbent JM, Welch D, Beck JD, Poulton R. Cigarette smoking and periodontal disease among 32-year-olds: a prospective study of a representative birth cohort. J Clin Periodontol 2007;34(10):828-834.

25. Tomar SL, Asma S. Smoking-attributable periodontitis in the United States: findings from NHANES III. National Health and Nutrition Examination Survey. J Periodontol 2000;71(5):743-751.

26. Hyman JJ, Reid BC. Epidemiologic risk factors for periodontal attachment loss among adults in the United States. J Clin Periodontol 2003;30(3):230-237.

27. Astrom AN, Ekback G, Ordell S, et al. Socio-behavioral predictors of changes in dentition status: a prospective analysis of the 1942 Swedish birth cohort (published online ahead of print Nov. 29, 2010). Community Dent Oral Epidemiol 2011;39(4):300-310. doi:10.1111/j.1600-0528.2010.00594.x.

28. Chambrone L, Chambrone D, Lima LA, Chambrone LA. Predictors of tooth loss during long-term periodontal maintenance: a systematic review of observational studies. J Clin Periodontol 2010;37(7):675-684.

29. Mesas AE, de Andrade SM, Cabrera MA. Factors associated with negative self-perception of oral health among elderly people in a Brazilian community (published online ahead of print Jan. 13, 2008). Gerodontology 2008;25(1):49-56. doi:10.1111/j.1741-2358.2007.00196.x.

30. Axelsson G, Helgadóttir S. Comparison of oral health data from self-administered questionnaire and clinical examination. Community Dent Oral Epidemiol 1995;23(6):365-368.

31. Afonso-Souza G, Nadanovsky P, Chor D, Faerstein E, Werneck GL, Lopes CS. Association between routine visits for dental checkup and self-perceived oral health in an adult population in Rio de Janeiro: the Pró-Saúde Study. Community Dent Oral Epidemiol 2007;35(5):393-400.