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SARCOPENIA ACCORDING TO THE EUROPEAN WORKING GROUP ON SARCOPENIA IN OLDER PEOPLE (EWGSOP) VERSUS DYNAPENIA AS A RISK FACTOR FOR DISABILITY IN THE ELDERLY

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Abstract: *Background:* Sarcopenia, defined as low muscle mass (LMM), and dynapenia have been associated with adverse outcomes in elderly. *Objective:* Contrast the association of sarcopenia versus dynapenia with incidence of disability. *Design:* A four-year prospective study (2006-2010). *Setting:* São Paulo, Brazil. *Participants:* 478 individuals aged 60 and older from the Saúde, Bem-Estar e Envelhecimento (SABE) study who were non-disabled at baseline. *Measurements:* Sarcopenia, measured according to the European Working Group on Sarcopenia in Older People (EWGSOP), includes: LMM assessed by skeletal muscle mass index ≤8.90kg/m2 (men) and ≤6.37kg/m2 (women); low muscle strength (LMS) assessed by handgrip strength <30kg (men) and <20kg (women); and low physical performance (LPP) assessed by gait speed ≤0.8m/s. Diagnosis of sarcopenia required LMM plus LMS or LPP. Dynapenia was defined as handgrip strength <30kg (men) and <20kg (women). Covariates included socio-demographic and behavioral variables, medical conditions, hospitalization, depressive symptoms, cognition, perception of vision, hearing and body mass index. *Outcomes:* Disability in mobility or instrumental activities of daily living (IADL) or disability in activities of daily living (ADL) and IADL. *Results:* The incidence density of mobility or IADL disability was 43.4/1000 person/year and 22.6/1000 person/year for IADL and ADL disability. There was no significant difference in incidence density according sarcopenia or dynapenia status. After controlling for all covariates, sarcopenia was associated with mobility or IADL disability (relative risk ratio = 2.23, 95%Confidence Interval: 1.03-4.85). Dynapenia was not associated with disability. *Conclusions:* Sarcopenia according to the EWGSOP definition can be used in clinical practice as a screening tool for early functional decline (mobility or IADL disability).

Key words: Disability, mobility, ADL, IADL, sarcopenia, dynapenia.

Introduction

Originally, the term sarcopenia was defined as a decrease in muscle mass related to aging (1). However, it has since become a general term to define loss of muscle mass and muscle strength related to aging (2). Despite the large number of publications, there are divergences about the mechanisms, definitions and measurements of sarcopenia. The main point of discussion is the inclusion of muscle mass and strength in the same concept because the decline in muscle strength can be attributed to a combination of muscular and neural factors and not only to reduced muscle mass (3-5).

Recently, Manini and Clark synthesized the results from seven studies that analyzed muscle strength and nine that analyzed muscle mass and their effect in physical disability, finding that muscle strength is a better predictor of disability (5).

To improve the identification and treatment of the syndrome and reduce associated adverse outcomes, the European Working Group on Sarcopenia in Older People (EWGSOP) recommends a diagnosis of sarcopenia using the presence of low muscle mass (LMM) plus low muscle strength (LMS) or low physical performance (LPP) in clinical practice (3).

The EWGSOP concept of sarcopenia has been found to be associated with mortality in frail elderly 80 years and older (6). However, few studies or none have examined this association with disability incidence. The aim of the present study is to contrast the association of EWGSOP-defined sarcopenia versus dynapenia with incidence of disability over a four-year period.

Methods

Study population

Data are from SABE Study (Saúde, Bem-Estar e Envelhecimento/Health, Wellbeing and Ageing), a study of three cohorts, that began in 2000, with a probabilistic sample representative of the urban population aged 60 years and older in the city of São Paulo, Brazil, composed of 2,143 individuals.

In 2006, 1,115 individuals from the first cohort were interviewed in person, 11 were institutionalized, 51 had moved to another city, 178 refused to participate, 139 were lost to follow up and 649 deaths were confirmed through the state and municipal mortality records of Brazil. That same year, a new cohort of 298 individuals, representative of the urban population aged 60–64 years in the same city, was added to the original cohort for a total sample of 1,413.

The present study used data from the cohort interviewed in

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2006. Of 1,413 participants interviewed in 2006, the 478 who reported no disability in mobility, ADL or IADL activities made up the final sample.

Participants signed statements of informed consent and the SABE study received approval from the Human Research Ethics Committee of the institution. Figure 1 shows the study design.

Measures

Dependent variable: Disability

Respondents were asked if they had difficulty performing activities of daily living (ADL) (transferring, toileting, bathing, dressing and feedings) using a modified version of the Katz ADL scale (7, 8). If the respondents indicated difficulty or inability in performing one or more of the tasks, they were scored as having ADL disability (9, 10). Despite its importance with regard to functionality in elderly individuals, incontinence was not included in ADL because it does not necessarily imply physical limitation (11). For the instrumental activities of daily living (IADL), respondents were asked if they were able to perform eight activities (using a telephone, shopping, preparing meals, performing light housework, taking medications, managing money, doing heavy housework and using transportation), using a modified version of the Lawton IADL scale (12). If respondents indicated difficulty or inability in performing one or more of the tasks, they were scored as having IADL disability. Respondents were asked if they could walk across a room; if they indicated difficulty or inability in performing this activity, they were scored as having mobility limitation. A summary score for mobility, ADL and IADL variables was computed. The final disability variable was hierarchical, with three levels. A score of 0 indicated no mobility, ADL or IADL limitation; 1 indicated any IADL limitation or a mobility limitation; and 2 indicated IADL and ADL limitations (13).

The hierarchical score was based on the hierarchical loss of independence in the elderly through the scaling technique developed by Guttman (14). The applicability of this scale has shown that older people first lose the ability to perform instrumental activities of daily living, followed by mobility, and finally the activities of daily living (15). Thus, the use of the hierarchical score proposed by Ottenbacher et al. (13), with three levels, would be able to identify risk factors associated with two distinct types of disability: the transition from independence to a premature type of disability (IADL or mobility) or the transition from independence to a more complex level of disability (ADL and IADL).

Independent Variables

Muscle mass was estimated by appendicular skeletal muscle mass (ASM) using the Lee equation as follow (16):

ASM = (0.244 * body weight) + (7.8 * height) + (6.6 * gender) – (0.098 * age) + (race – 3.3)

Body weight was measured in kilograms (kg) and height was measured in meters. The value 0 is attributed to women and 1 to men; in addition, 0 was used for White, 1.4 for Black and –1.2 for Asian subjects (16). This equation has been validated in the Brazilian population using dual-energy X-ray absorptiometry (DXA) as a gold standard with a high correlation between methods ($r=0.86$ for men and $r=0.90$ for women, respectively, $p<0.05$). The agreement between DXA and the predictive equation to determine sarcopenia prevalence is strong ($k=0.74$; $p<0.001$) with high specificity (89%) and sensitivity (86%) (17).

After estimating the values, we adjusted the ASM by height squared to create the skeletal muscle mass index (SMI). Following the studies of Delmonico et al. (18) and Newman et al. (19), the cutoff for LMM used was based on the 20% lowest percentile of the population distribution, representing SMI of ≤6.37 kg/m2 for women and ≤8.90 kg/m2 for men.

Muscle strength was assessed with handgrip strength in kg using a hand-held dynamometer (Takei Kiki Kogyio TK 1201). Grip size was adjustable so that each participant felt comfortable while squeezing the grip. The test was performed twice in the dominant limb with a 1-minute rest between tests, and the higher value of the two trials was used for scoring. Cut-off values of <30 kg for men and <20 kg for women were considered to represent LMS (3, 20).

Physical performance was assessed with gait speed (in meters/second), determined using the walk test of the Short Physical Performance Battery Assessing Lower Extremity Function. The faster of the two trials was used for analyses (21). The cut-off point of ≤0.8 m/s was used to represent LPP (3, 20).

Sarcopenia was defined using the EWGSOP criteria. Participants with LMM plus either LMS or LPP were considered as having sarcopenia (3).

Dynapenia was defined using the criteria of Laurentani et al. (20): <30 kg for men and <20 kg for women.

Covariates

Socio-demographic characteristics included age, gender, marital status, income and years of schooling. Age was grouped in three 10-year categories, with individuals aged 80 years or older combined into a single group. Marital status was classified as married (married or in a stable relationship) and not married (divorced, separated or widowed). Income, in terms of Brazilian monthly minimum salary (R$ 350.00 = US$ 161.74), was classified in three categories: up to two (US$ ≤323.50), two to five (>US$ 323.50 and ≤US$ 808.70) and more than five times the minimum salary (>US$ 808.70). Schooling was analyzed in years as a continuous variable.

Smoking status was assessed by asking participants if they were non-smokers, former smokers or current smokers.

Alcohol intake was assessed by asking participants if they were non-drinkers, drank once a week, drank two to six days a week or drank every day.

Physical activity was assessed using the Brazilian version of the International Physical Activity Questionnaire (IPAQ) (22). The calculation of caloric expenditure involved the metabolic equivalent of the activities performed by the participant, the number of days per week each activity was performed, the time spent performing the activity and the individual's body weight (23). Men and women with a caloric expenditure <390.5 kcal and <478.15 kcal, respectively (smallest quintile), were classified as having a sedentary lifestyle.

Health status was assessed through self-report of hypertension, diabetes, cancer, lung disease, heart disease, stroke, osteoarthritis, falls and hospitalizations in the previous 12 months and the number of diseases. Perceptions of hearing (good/poor) and close and far vision (good/poor) were also

Table 1

Characteristics of the total sample and by sarcopenia and dynapenia status at baseline in 478 elderly residents of São Paulo, Brazil (2006)

	Total Sample n = 478	**No Sarcopenia n = 394 (86.6%)**	**Sarcopenia n = 84 (13.4%)**	**No Dynapenia n = 307 (70.5%)**	**Dynapenia n = 171 (29.5%)**
Socio-demographic variables					
Age	68.9 ± 0.4	68.3 ± 0.4*	72.9 ± 0.8*	68.3 ±0.4*	70.4 ± 0.7*
60 – 69 years	n = 216 (61.1%)	n = 197 (64.2%)*	n = 19 (40.8%)*	n = 156 (64.4%)*	n = 60 (53.2%)*
70 – 79 years	n = 182 (33.4%)	n = 149 (32.1%)*	n = 33 (42.3%)*	n = 118 (32.4%)*	n = 64 (36.0%)*
80 or more years	n = 80 (5.5%)	n = 48 (3.7%)*	n = 32 (16.9%)*	n = 33 (3.2%)*	n = 47 (10.8%)*
Gender (female)	n = 274 (56.5%)	n = 230 (57.0%)	n = 44 (53.2%)	n = 162 (51.1%)*	n = 112 (69.5%)*
Marital status (married)	n = 265 (59.9%)	n = 232 (61.9%)*	n = 33 (46.9%)*	n = 181 (62.7%)	n = 84 (53.4%)
Income					
>US$ 808.70	n = 65 (14.0%)	n = 58 (15.2%)*	n = 7 (6.3%)*	n = 47 (15.8%)	n = 18 (9.7%)
>US$ 323.50 and ≤US$ 808.70	n = 129 (24.4%)	n = 101 (23.0%)*	n = 28 (33.2%)*	n = 85 (24.6%)	n = 44 (23.7%)
US$ ≤323.50	n = 165 (32.1%)	n = 126 (30.3%)*	n = 39 (43.8%)*	n = 92 (29.5%)	n = 73 (38.3%)
Missing	n = 119 (29.5%)	n = 109 (31.5%)*	n = 10 (16.7%)*	n = 83 (30.1%)	n = 36 (28.3%)
Schooling (years)	5.1 ± 0.3	5.1 ± 0.3	5.3 ± 0.5	5.3 ± 0.3	4.7 ± 0.4
Behavioral variables					
Smoking					
Never smoked	n = 257 (52.9%)	n = 214 (53.7%)	n = 43 (47.8%)	n = 153 (49.2%)	n = 104 (61.8%)
Ex-smoker	n = 170 (34.0%)	n = 142 (34.7%)	n = 28 (29.5%)	n = 119 (36.9%)	n = 51 (26.8%)
Current smoker	n = 51 (13.1%)	n = 38 (11.6%)	n = 13 (22.7%)	n = 35 (13.9%)	n = 16 (11.4%)
Weekly alcohol intake					
None	n = 312 (62.9%)	n = 255 (62.9%)	n = 57 (63.1%)	n = 189 (59.4%)	n = 123 (71.4%)
Once a week	n = 97 (21.2%)	n = 82 (21.3%)	n = 15 (20.7%)	n = 66 (22.7%)	n = 31 (17.6%)
Two to six days a week	n = 41 (9.3%)	n = 32 (8.9%)	n = 9 (11.7%)	n = 29 (10.0%)	n = 12 (7.6%)
Every day	n = 28 (6.6%)	n = 25 (6.9%)	n = 3 (4.5%)	n = 23 (7.9%)	n = 5 (3.4%)
Sedentary Lifestyle (yes)	n = 55 (10.4%)	n = 43 (10.5%)	n = 12 (10.3%)	n = 37 (11.3%)	n = 18 (8.5%)
Health Status					
Systemic arterial hypertension (yes)	n = 265 (55.3%)	n = 224 (56.0%)	n = 41 (51.3%)	n = 163 (54.1%)	n = 102 (58.3%)
Diabetes (yes)	n = 74 (15.9%)	n = 59 (15.1%)	n = 15 (20.6%)	n = 41 (13.9%)	n = 33 (20.5%)
Cancer (yes)	n = 18 (3.1%)	n = 14 (4.0%)	n = 4 (5.9%)	n = 12 (3.8%)	n = 6 (5.5%)
Chronic lung disease (yes)	n = 39 (9.8%)	n = 34 (10.4%)	n = 5 (5.8%)	n = 31 (12.0%)*	n = 8 (4.6%)*
Heart disease (yes)	n = 77 (15.4%)	n = 64 (15.5%)	n = 13 (14.8%)	n = 44 (14.4%)	n = 33 (17.8%)
Stroke (yes)	n = 16 (4.3%)	n = 14 (4.2%)	n = 2 (4.7%)	n = 11 (4.6%)	n = 5 (3.5%)
Osteoarthritis (yes)	n = 129 (26.7%)	n = 115 (28.3%)	n = 14 (16.3%)	n = 82 (26.2%)	n = 47 (27.8%)
Number of diseases	1.4 ± 0.1	1.4 ± 0.1	1.3 ± 0.1	1.4 ± 0.1	1.5 ± 0.1
Falls (yes)	n = 109 (21.3%)	n = 91 (21.7%)	n = 18 (18.9%)	n = 56 (16.8%)*	n = 53 (32.0%)*
Hospitalization (yes)	n = 22 (4.7%)	n = 18 (4.7%)	n = 4 (5.0%)	n = 11 (4.1%)	n = 11 (6.2%)
Score on Mini Mental State Exam	17.3 ± 0.1	17.3 ± 0.1	17.1 ± 0.2	17.3 ± 0.1	17.1 ± 0.1
GDS (≥ 6 points)	n = 33 (7.2%)	n = 25 (6.5%)	n = 8 (11.6%)	n = 17 (6.6%)	n = 16 (8.7%)
Perception of hearing (poor)	n = 109 (21.9%)	n = 88 (22.0%)	n = 21 (21.2%)	n = 66 (21.7%)	n = 43 (22.4%)
Perception of close vision (poor)	n = 101 (19.5%)	n = 83 (20.0%)	n = 18 (16.1%)	n = 63 (19.7%)	n = 38 (18.9%)
Perception of far vision (poor)	n = 116 (22.5%)	n = 97 (23.0%)	n = 19 (18.9%)	n = 74 (22.6%)	n = 42 (22.2%)
Body mass index (kg/m2)	26.4 ± 0.2	27.3 ± 0.2*	20.9 ± 0.2*	26.5 ± 0.2	26.2 ± 0.4

GDS – Geriatric Depression Scale. Data expressed as mean ± standard error. * The difference by sarcopenia and dynapenia status is significant at $\alpha \leq 0.05$. Wald test with Rao-Scott correction used to compare means; chi-square test with Rao-Scott correction used to compare proportions. Proportions were calculated considering the weight of the sample.

Table 2

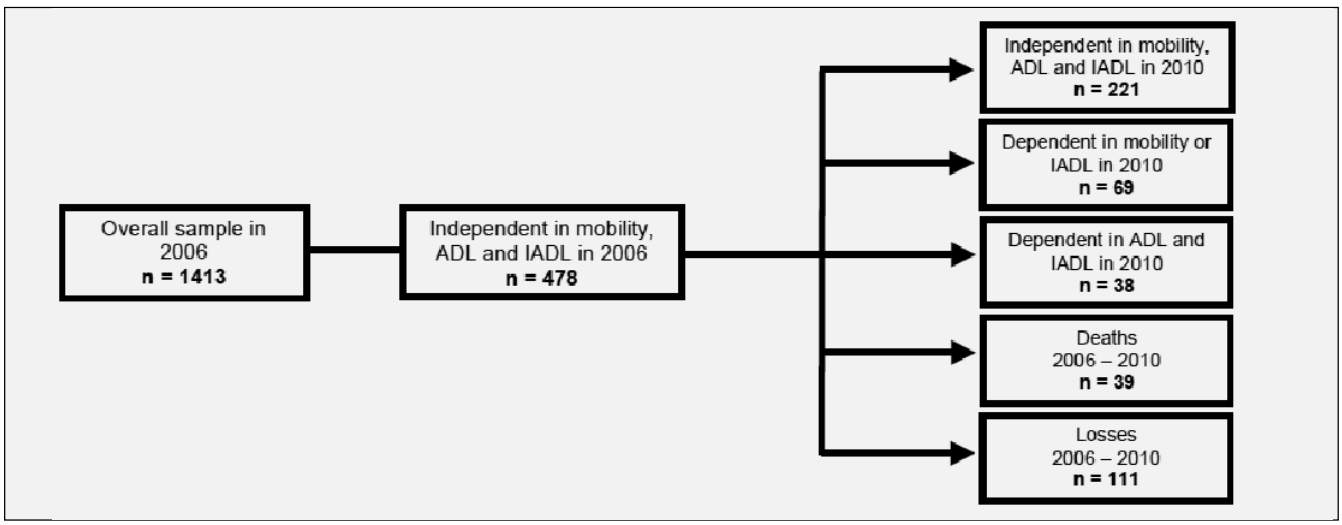
Total Incidence density of disability and according sarcopenia and dynapenia status (per 1000 person/year and 95%CI), São Paulo, Brazil, 2006-2010 (n=328).

	Total	No Sarcopenia	Sarcopenia	No Dynapenia	Dynapenia
IADL disability	62.6 (50.4 – 78.4)	56.5 (44.2 – 73.2)	108.5 (70.1 – 172.7)	53.7 (40.5 – 72.5)	85.9 (62.0 – 121.4)
Mobility disability	10.7 (6.3 – 19.4)	9.2 (5.1 – 18.3)	21.9 (6.1 – 129.2)	5.4 (2.5 – 13.8)	24.5 (12.2 – 56.6)
ADL disability	31.2 (23.1 – 43.1)	30.4 (21.9 – 43.2)	37.3 (16.4 – 101.1)	24.0 (16.0 – 37.5)	50.0 (32.4 – 81.2)
IADL or mobility disability	43.3 (33.4 – 57.3)	39.2 (29.0 – 54.2)	75.3 (45.3 – 130.8)	36.4 (25.7 – 53.1)	61.9 (41.9 – 94.4)
IADL and ADL disability	22.6 (15.9 – 33.2)	21.2 (14.4 – 32.4)	33.2 (13.5 – 101.8)	20.0 (12.9 – 32.6)	29.6 (16.5 – 58.1)

IADL - Instrumental Activities of Daily Living. ADL - Activities of Daily Living.

Figure 1

Study design (2006 – 2010)



analyzed. Cognitive status was assessed using the modified version of the Mini Mental State Exam (MMSE) to accommodate the low level of schooling of the Brazilian elderly population (24, 25). Depressive symptoms were assessed using the Geriatric Depression Scale (26). Participants with a score of ≥6 were considered to have depressive symptoms (26).

Body mass index (BMI) was computed by dividing weight in kilograms by height in meters squared (kg/m2).

Statistical Analyses

To compute the incidence density, the numerator was the number of elderly individuals who developed disability in the period analyzed and the denominator was the summed period of observation for the population in question. For those who died, the period of observation was the interval between the date of the interview in 2006 and the date of death. For those who did not develop disability, the period of observation was the interval between the interviews in 2006 and 2010. For those who developed disability, the period of observation was half the period between the interviews in 2006 and 2010. Those lost to follow up between 2006 and 2010 were excluded from this analysis (27).

Baseline characteristics of participants who remained independent were compared to those of participants who developed disability in mobility or IADL and with those who developed ADL and IADL disability. Both analyses used Wald test and chi-square test with Rao and Scott correction.

Multinomial regression analysis was used to determine the effect of sarcopenia and dynapenia on disability incidence. Associations $p<0.20$ in the univariate analysis were selected for multinomial regression, for which the forward stepwise method was used. Model 1 includes sarcopenia as an independent variable and model 2 includes dynapenia.

Because our data came from a multistage cluster sampling, sample weights were employed in all analyses. The Stata 10® program (StataCorp, College Station, TX) was used for all data analysis.

Table 3
Weighted multinomial regression analysis for disability, São Paulo, Brazil, 2006-2010 (n=328)

	Mobility or IADL Sarcopenia Model n = 328 RRR (95%CI)	ADL and IADL Sarcopenia Model n = 328 RRR (95%CI)	Mobility or IADL Dynapenia Model n = 328 RRR (95%CI)	ADL and IADL Dynapenia Model n = 328 RRR (95%CI)
Age				
60 – 69 years	1.00	1.00	1.00	1.00
70 – 79 years	1.69 (0.78 – 3.68)	1.47 (0.58 – 3.72)	1.64 (0.75 – 3.58)	1.43 (0.55 – 3.68)
80 or more years	2.64 (1.05 – 6.64)	5.17 (1.84 – 14.51)	2.85 (1.24 – 6.55)	5.45 (1.84 – 16.18)
Gender				
Male	1.00	1.00	1.00	1.00
Female	1.40 (0.66 – 2.96)	1.70 (0.67 – 4.31)	1.31 (0.64 – 2.67)	1.64 (0.66 – 4.09)
Schooling (years)	0.85 (0.76 – 0.96)	0.90 (0.79 – 1.02)	0.86 (0.77 – 0.97)	0.91 (0.80 – 1.02)
Diabetes				
No	1.00	1.00	1.00	1.00
Yes	2.91 (1.41 – 6.00)	2.07 (0.74 – 5.75)	2.73 (1.34 – 5.56)	1.99 (0.75 – 5.28)
Stroke				
No	1.00	1.00	1.00	1.00
Yes	1.65 (0.22 – 12.34)	8.53 (1.75 – 41.5)	1.61 (0.22 – 11.85)	8.51 (1.69 – 42.77)
Osteoarthritis				
No	1.00	1.00	1.00	1.00
Yes	2.15 (1.04 – 4.44)	1.84 (0.79 – 4.27)	1.97 (0.93 – 4.17)	1.77 (0.78 – 4.05)
Cancer				
No	1.00	1.00	1.00	1.00
Yes	5.26 (0.84 – 32.84)	7.04 (1.60 – 31.07)	6.02 (0.90 – 40.38)	7.88 (1.63 – 37.96)
Sarcopenia				
No	1.00	1.00		
Yes	2.23 (1.03 – 4.85)	1.63 (0.54 – 4.97)		
Dinapenia				
No			1.00	1.00
Yes			1.70 (0.86 – 3.36)	1.37 (0.54 – 3.49)

RRR – Relative Risk Ratio. IADL – Instrumental Activities of Daily Living. ADL – Activities of Daily Living.

Results

The mean age ± standard deviation of the participants was 68.9 ± 0.4 years; 56.5% were female, 59.9% were married and the mean years of schooling was 5.1 ± 0.3. The most prevalent medical conditions were hypertension (55.3%), osteoarthritis (26.7%) and diabetes (15.9%). Sarcopenia and dynapenia were present in 13.4% and 29.5% of the participants, respectively. Table 1 shows the baseline characteristics of the total sample and by sarcopenia and dynapenia status. Participants with sarcopenia and dynapenia were significantly more likely to be older and had lower BMI. Those with dynapenia were more female and reported more lung disease and falls, while those with sarcopenia had lower income ($p<0.05$).

The incidence density of mobility or IADL disability was 43.4/1000 person/year (95%CI: 33.4-57.4) and 22.6/1000 person/year (95%CI: 15.9-33.2) for ADL and IADL disability, respectively. Table 2 shown the results of incidence density for each category of disability and for the hierarchical model of disability according to sarcopenia and dynapenia status.

Table 3 presents the weighted multinomial regression analysis for disability. In model 1, the following were risk factors for incidence in mobility or IADL disability: have 80 or more years, diabetes, osteoarthritis and sarcopenia; schooling was a protective factor. The risk factors for ADL and IADL disability were: have 80 or more years, stroke and cancer.

In model 2 the same risk factors were found, except for osteoarthritis and incidence of mobility or IADL disability. However, dynapenia was not associated with disability.

Discussion

Sarcopenia, according the EWGSOP, was associated with incidence of mobility or IADL disability.

Separately, evidence suggests that LMM, LMS and low gait speed can predict early disability. For example, Jansen et al. (28), using bioelectrical impedance analysis (BIA) to define muscle mass, found that severe sarcopenia (SMI ≤8.51 kg/m2 in men and SMI ≤5.75 kg/m2 in women) was an independent risk factor for mobility disability in both genders, and for IADL

disability in women.

Newman et al. (19) used data from the Health Aging and Body Composition Study to find that the lowest quintile of appendicular muscle mass, adjusted for height and body fat mass, was associated with lower extremity performance in both genders; Delmonico et al. (18), using the same data and methodology, found an association with mobility disability.

Rantanen et al. (29), using data from the Honolulu Heart Program and the Honolulu Asia Aging Study, found that handgrip strength (<37 kg or <42 kg) was a strong predictor of reduced gait speed, ADL disability and IADL disability. Al Snih et al. (30), using data from Mexican Americans, examined the relationship between handgrip strength in quartiles and incidence of ADL disability over a seven-year follow up. They found that, in the elderly with low handgrip (lowest quartile), the HR for the incidence of IADL disability was 1.90 (95%CI 1.13 – 3.17) for men and 2.28 (95%CI 1.59 – 3.27) for women.

Laurentani et al. (19) used data from Italy in a cross sectional study to examine age-associated changes in skeletal muscle and the effect of these changes on mobility. Impaired mobility was considered walking speed <0.8m/s or the inability to walk at least 1 km without difficulty. They found that handgrip strength (<30 kg for men and <20 kg for women) is a better measure of impaired mobility than the decrease in muscle mass.

Abellan Van Kan et al. (31), in a systematic review, showed that gait speed is an important predictor of impairment in mobility and ADL disability in the elderly.

When the influence of LMM, LMS and LPP on mobility is analyzed separately, neither IADL nor ADL takes into consideration the complexity of the hierarchical disability process. Also, adding muscle mass, strength and gait speed, as proposed by the EWGSOP, can increase the ability to diagnose sarcopenia, allowing for early interventions to reduce the incidence of negative outcomes such as disability.

Tanimoto et al. (32), in a cross-sectional study, defined sarcopenia according to EWGSOP and found an association between sarcopenia and IADL disability in community dwelling Japanese elderly people.

Using sarcopenia according to EWGSOP and hierarchical patterns of disability allowed us to verify that the presence of sarcopenia seems able to identify the risk of transition to a premature type of disability (IADL or mobility disability). On the other hand, sarcopenia and dynapenia were not associated with the transition from independence to more complex levels of disability (IADL and ADL). However, diseases such as cancer and stroke, even with low prevalence, were strongly associated with this type of transition, indicating that perhaps this type of trajectory cannot be explained only by prior musculoskeletal issues.

The cut-off adopted by Laurentani et al. (20) to define dynapenia could be the reason we did not find statistical significance in associations with disability. However, we also used the lowest quartile of handgrip strength distribution to define dynapenia (30 kg for men and 18 kg for women) and, again, we found no association with mobility or IADL disability or with IADL and ADL disability (data not shown).

Moreover, it is important to note that Rantanen et al. (29), who found an association between handgrip, mobility, IADL and ADL disability used higher cut-offs to define dynapenia in a younger sample at baseline. Also, Al Snih et al. (30) found an association between the lower quintile of handgrip and disability in ADL, but not ADL and IADL disability.

Finally, despite the confirmed ability of handgrip to represent overall muscle strength, lower extremity strength such as knee extensor strength, if used to define dynapenia, could have shown an association with disability in mobility or IADL disability.

This study has some limitations. First, the use of the regression equation to estimate muscle mass may under or overestimate the prevalence of sarcopenia. However, the use of DXA in community dwelling population studies is limited and this equation was validated in American and Brazilian populations, showing high correlation with magnetic resonance imaging and DXA, respectively (16,17). Second, the missing data could be considered an important limitation, but the differences in characteristics at baseline between those interviewed and those lost to follow up were significant only for men and lung disease. Thus, this loss may be considered random. Third, the time to develop disability can be long; however, it was still possible to identify the risk factors most commonly cited in the literature. Fourth, the low number of cases of disability in ADL and IADL may have hampered the power to identify statistically significant differences in the analysis.

This study also has two strengths. First, it was conducted on a large sample of community-dwelling elderly people that represents the elderly population in a large Latin American city. Second, as far as we are aware, this study is the first to analyze sarcopenia using the EWGSOP criteria and to compare this method with dynapenia as a risk factor for the incidence of mobility, IADL disability and ADL disability.

In conclusion, sarcopenia, according to the EWGSOP, can be used in clinical practice as a screening tool for early functional decline (mobility or IADL disability).

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