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Association between chronic diseases and handgrip strength in older adults residents of Florianópolis – SC, Brazil

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Abstract *This paper aims to verify the association between chronic diseases and handgrip strength (HS) in the older adults of Florianópolis, SC. This is a cross-sectional analysis of a longitudinal population-based study. HS was measured by dynamometer. Independent variables included 10 chronic diseases and falls. Simple and multiple linear regression analyses were performed. In the final model, in women, arthritis/rheumatism/arthrosis (β: -1.27; 95%CI: -2.55; -0.20) was associated with lower HS and bronchitis/asthma (β: 1.61, 95%CI: 0.21; 3.00) was associated with higher HS. Regarding men, in the final model, diabetes (β:-3.78; 95%CI: -6.51; -1.05) was associated with lower HS. The trend analysis evidenced a lower HS with increased number of chronic diseases in both genders. There was an association between some chronic diseases and HS, with differences between genders. It is essential to overhaul health policies aimed at maintaining the independence and autonomy of the older adults population.*

Key words *Muscle strength dynamometer, Elderly health, Cross-sectional studies, Chronic diseases*

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Introduction

Handgrip strength (HS) has been mentioned as a good predictive indicator for total muscle strength[1-3] and is essential for the maintenance of functional independence and autonomy[4] of the older adults. It is also one of the widely used methods of evaluating muscle function in epidemiological studies with the older adults population, especially since it is affordable and easy to implement[1-3].

It is known that, with age, older adults are more susceptible to suffer non-transmissible chronic diseases, which can translate into reduced HS[2]. Some diseases, such as osteoporosis, diabetes mellitus and hypertension trigger metabolic and nutritional dysfunctions[5] and induce unhealthy behaviors and lifestyles that contribute to loss of muscle strength[6,7]. Other chronic health conditions commonly observed in the older adults include falls[8] and disabilities[9]. When associated with lower HS, these chronic conditions may lead to a worse quality of life[10,11] and a higher mortality risk[11].

While HS is a risk factor for certain chronic diseases[6,12,13], few studies have investigated the association between multimorbidity in the same subject (including comorbidities) and HS values[2,14-16]. These studies are scarce and show gaps in relation to the diseases associated among genders, as well as to the direction of these associations.

The study by Pessini et al[14], conducted with Brazilian older adults, found that diabetes, coronary disease and pulmonary disease were associated with lower HS in men, while cancer and depression were associated with lower HS in women. Associations were verified regardless of sociodemographic characteristics, lifestyle and other chronic diseases. In two other studies[15,16], also performed with older adults individuals, the associations were inversely verified, considering HS as an exposure variable and chronic diseases as outcomes. Cheung et al.[15] found that lower HS was associated with a higher occurrence of stroke, anxiety, hyperthyroidism and airway obstruction in men; as well as anemia, falls and kyphosis in women. Amaral et al.[16] found that lower HS was associated with higher probability of hypertension, diabetes, and musculoskeletal disorders only among men.

Therefore, it is necessary to obtain a better knowledge of the relationship between different chronic diseases and HS, since this measure is an important indicator for older adults general health surveillance. This study aimed to verify the association between chronic diseases and HS in older adults, residents of Florianópolis, Santa Catarina, Brazil.

Methods

Study area and population

Data of this study are part of the longitudinal research on the health conditions of the older adults' population of Florianópolis called *Epi-Floripa Idoso* (www.epifloripa.ufsc.br). This is a cross-sectional analysis of a longitudinal population-based study conducted with older adults individuals (60 years of age or older) living in the urban area of Florianópolis, Santa Catarina state, southern Brazil, in 2013/2014 (baseline 2009/2010).

Details of the site, study population and sampling were previously published[8] and will be described briefly. A two-stage sampling strategy was used to select the study baseline sample. In the first, 80 tracts (eight in each income decile) were systematically drawn from 420 municipal census tracts. The units of the second stage were households, which were systematically drawn. All the older adults residents in the randomized households were invited to participate in the study, and 1,705 individuals were interviewed in 2009/2010 (baseline). In the second wave of the study, conducted in 2013/2014, 217 deaths were excluded, resulting in 1,488 eligible elders. During the interviews conducted in 2013/14, all the older adults were invited to attend the premises of the Federal University of Santa Catarina to perform clinical and laboratory tests, among them HS. Interviews not held after four attempts (including at night and at weekends) were considered as losses and refusals when people chose not to respond to the questionnaire. In this analysis, the sample consists of the older adults who attended exams, and data collected in household interviews of 2013/14 and during examinations were used.

Data collection

A structured face-to-face interview tool with computerized data entry in netbooks was used for data collection. Interviewers were previously trained for tool application, refinement and calibration (precision and accuracy) of the tests.

Data consistency was checked weekly and

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quality control was performed over the phone with the application of a short questionnaire in 10% of randomly selected interviews.

Dependent variable

The HS [kilogram force (kgf)] was verified using the dynamometer (Takei Kiki Kogyio® TK 1201, Japan), using the arm with the greatest strength (according to the information reported by respondents). During the test, respondents remained seated, resting their elbow on a table, forearm extended frontally, palm facing upwards and exerting the greatest strength possible on the dynamometer[17]. HS was analyzed as a continuous variable.

Chronic health conditions: each chronic disease was assessed individually and the number of self-reported morbidities (discrete; from 0 to 9) was assessed from the following question: *"Has any doctor or health professional ever said to you that you have/had…?"*, which included the following disease options (questionnaire of the National Household Sample Survey - PNAD[18]): systemic arterial hypertension, diabetes mellitus, cancer, chronic pulmonary disease (asthma, bronchitis, emphysema), coronary disease, chronic renal failure, cerebrovascular disease (embolism, stroke, ischemia, cerebral thrombosis), arthritis / rheumatism / arthrosis and depression. Falls in the last year were verified by the question: "Have you suffered any fall in the last year?", with a "yes" or "no" response.

Fit variables

The fit variables used were age (full years), household arrangement (living alone, living with someone), schooling in years of study (no schooling, 1-4, 5-8, 9-11 and ≥ 12 years), smoking (current smoker, former smoker or never smoked), leisure physical activity verified through the International Physical Activity Questionnaire (IPAQ)[19], long version (0-149 minutes and ≥ 150 minutes of physical activities/week). The cognitive status (normal and probable cognitive impairment) was investigated by the Mini Mental State Examination (MMSE), with cut-off points that take into account the schooling level according to Almeida[20]. BMI for the older adults was evaluated using measures of body mass and height [BMI = body mass (kg) / height^2 (m)] and were performed according to standardized procedures[21].

Functional disability was assessed using the Brazilian Questionnaire on Multidimensional Functional Assessment[22] adapted from the Old Americans Resources and Services (BOMFAQ/OARS) questionnaire, which investigates the accomplishment of 15 basic and instrumental activities of daily living (BADL/IADL). Disability was classified according to the number of activities: none, one to three, and four or more activities.

These fit variables were chosen because some studies show that muscle strength can be altered with age, schooling[23,24], smoking[23], cognitive status[3,24] and BMI[2,3].

Data analysis

Descriptive analyses were performed for all variables, with calculation of prevalence and confidence intervals (95% CI) for the categorical variables; and means and standard deviation for the continuous variables, stratified by gender. The chi-square test (categorical variables) and t-Student test (continuous variables) were used for the bivariate analysis. For the bivariate and adjusted analyses, linear regression was used estimating crude and adjusted (β coefficients, with their respective confidence intervals (95% CI). Three fit models were considered in the association for each chronic disease and HS: Model 1) adjusted for age, schooling and household arrangement; Model 2) adjusted for age, schooling and household arrangement, smoking, physical activity, body mass index, functional disability and cognitive status; Model 3) adjusted for age, schooling and household arrangement, smoking, physical activity, body mass index, functional disability, cognitive status and for all chronic health conditions (systemic arterial hypertension, diabetes mellitus, cancer, chronic lung disease [asthma, bronchitis, emphysema], coronary disease, chronic renal failure, cerebrovascular disease [embolism, stroke, ischemia, cerebral thrombosis], arthritis / rheumatism / arthrosis, depression and falls) to eliminate the possible confounding effect of the presence of multiple chronic diseases. A level of statistical significance of 5% was considered.

The HS trend was analyzed for each gender by the number of morbidities. For this, HS predictive mean was calculated from a linear regression model, adjusted for age, schooling, household arrangement, smoking, physical activity, body mass index, functional disability and cognitive status. The significant difference was verified from the 95% confidence interval.

Data review was conducted in the statistical program Stata 13.0 (Stata Corp., College Station, USA). All the analyses carried out considered the effect of the sample design by conglomerates and incorporating the sample weights by means of the *svy* command.

Ethical considerations

The Committee of Ethics in Human Research of the Federal University of Santa Catarina approved the project through the Certificate of Presentation for Ethical Assessment (CAAE). Respondents were asked to sign the Informed Consent Form. Authors declared no conflict of interest.

Results

Of the total number of older adults eligible for the study (1,705-217 deaths = 1,488), 1,197 were interviewed in 2013/14 (2 duplicates, 1 incompatible age, 159 losses and 129 refusals), with a response rate of 80.1 %. Of these, 604 older adults attended to perform the clinical exams, of which 599 underwent HS evaluation, and this was the analytical sample of the study. Most of the individuals who underwent clinical exams were from younger age group (60-69 years), was working, consuming alcohol, physically active, with low level of dependence, normal cognitive status, with no suspected depression and had a health plan.

The mean HS was 17.9 (standard deviation: 5.4) kg/force for females and 29.3 (standard deviation: 8.7) kg/ force for males.

Data in Table 1 show that there was a difference between genders in relation to schooling, household arrangement, smoking, cognitive status, physical activity, functional disability and falls. Most women reported having 1-4 years of schooling (39.1%), living with someone (71.2%), never smoked (78.8%), normal cognitive status (75.3%), practiced 0-149 minutes of leisure physical activity (56.7%), reported disability in 1-3 ADLs (38.5%), and have not suffered any fall in the last year (66.2%), while most men had 12 or more years of schooling (32.9%), were living with someone (89.3%), former smokers (58.5%), had normal cognitive status (84.2%), practiced 150 minutes or more of activity (51.2%) and reported no functional disability (48.0%).

The results of associations between HS and the independent variables for women are shown in Table 2. In the crude analysis, arthritis/rheumatism/arthrosis, stroke and osteoporosis were associated with lower HS. In Model 1, arthritis / rheumatism / arthrosis and osteoporosis maintained the association and chronic lung disease was associated with the highest HS, considering fit variables (age, schooling, household arrangement, smoking, physical activity, BMI, cognitive status and functional disability). In Models 2 and 3, after adjustments, only arthritis/rheumatism/arthrosis (β: -1.37; 95%CI: -2.55; -0.20) maintained association with lower HS and chronic lung disease (β: 1.61, 95%CI: 0.21, 3.00) maintained the association with the highest HS.

Regarding males (Table 3), in the crude analysis, diabetes, stroke and reporting falls in the last year were associated with lower HS. In Models 1, 2 and 3, considering fit variables, only diabetes (β: -3.78; 95%CI: 6.51; -1.05) showed an independent association with lower HS.

Figure 1 shows the chart for predictive mean of HS according to the number of chronic diseases in men and women. A declining HS mean with increased number of chronic diseases for both genders was observed. Regarding women, there was a significant reduction in the predictive mean of HS among those who had two or more morbidities when compared to those who did not have morbidities. Among men, reduction was also significant with three or more morbidities, when compared to those with no morbidities (Table 4).

Discussion

The results showed differences between genders in relation to the chronic conditions associated with HS, even after adjustment for all morbidities and other fit factors. In women, arthritis/rheumatism/arthrosis was associated with lower HS values, while chronic lung disease was associated with higher HS values. For men, diabetes was associated with lower HS values. In relation to the trend analysis, there was a significant reduction of HS with the increased number of chronic diseases for both genders.

The association between arthritis/rheumatism/arthrosis and lower HS values in women is consistent with the results of a previous study[13]. The study by Li et al.[13], with 2,398 individuals aged 65 years and over, showed association between arthritis / rheumatism / arthrosis and lower HS, even after adjusting for other diseases and socioeconomic factors. Decreased HS in individuals with arthritis / rheumatism / arthrosis can be explained by the fact that, in patients with these

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Table 1. Description of the sample and bivariate analysis, according to demographic, socioeconomic, lifestyle and health conditions in older adults in Florianópolis, Santa Catarina, Brazil, 2013/2014.

Variables	Women		Men		p-value
	n	Mean (SD)	n	Mean (SD)	
Age	390	72.4(6.2)	209	72.1(6.5)	0.962
Body Mass Index (kg/m²)	389	28.6(5.5)	206	27.1(4.2)	0.748
Handgrip strength (Kg/f)	390	17.9(5.4)	209	29.3(8.7)	≤ 0.001
Number of chronic diseases	390	3.8(2.0)	206	2.8(1.90)	≤ 0.001
	n	%	n	%	p-value
Schooling (n=598)					≤ 0.001
No schooling	26	6.2	15	5.6	
1 to 4 years	154	39.1	60	24.4	
5 to 8 years	72	18.4	35	20.3	
9 to 11 years	70	18.6	24	16.8	
≥ 12 years	67	17.8	75	32.9	
Household arrangement (n =594)					≤ 0.001
Living alone	104	28.8	22	10.7	
Living with someone	282	71.2	186	89.3	
Smoking (n = 599)					≤ 0.001
Never smoked	300	74.8	76	31.0	
Smoked and stopped smoking	67	19.5	112	58.5	
Currently smoking	23	5.6	21	10.5	
Cognitive state (n = 596)					0.040
Normal	297	75.3	171	84.2	
Probable cognitive impairment	90	24.8	38	15.9	
Physical activity (n = 599)					0.027
<150 minutes / week	169	57.3	102	45.8	
≥ 150 minutes / week	221	42.7	107	54.2	
Functional disability (n = 596)					0.008
None	116	32.1	100	48.0	
1 to 3	160	38.5	67	33.7	
4 and over	114	29.4	39	18.3	
Falls in the last year (n = 599)					0.012
No	260	66.2	160	75.7	
Yes	130	33.8	49	24.3	
Arthritis / rheumatism / arthrosis (n = 599)					≤ 0.001
No	218	57.0	161	76.6	
Yes	172	43.0	48	23.4	
Bronchitis or asthma (n = 599)					0.294
No	321	85.5	169	85.3	
Yes	69	14.5	30	14.7	
Cancer (n = 599)					0.002
No	357	90.2	174	83.7	
Yes	33	9.9	35	16.4	
Depression (n = 599)					≤ 0.001
No	247	65.6	174	86.2	
Yes	143	34.4	35	13.9	
Diabetes (n = 599)					0.055
No	284	73.3	167	80.7	
Yes	106	26.7	42	19.3	
Coronary disease (n = 599)					0.042
No	265	69.7	131	60.3	
Yes	125	30.3	78	39.8	

it continues

Table 1. continuation

Variables	n	%	n	%	p-value
Cerebrovascular disease (n=599)					0.013
No	362	93.8	181	87.8	
Yes	28	6.2	28	12.2	
Hypertension (n=599)					≤ 0.001
No	119	31.4	91	45.5	
Yes	271	68.6	118	54.5	
Chronic renal failure (n=599)					0.099
No	381	98.2	199	96.1	
Yes	9	1.8	10	3.9	
Osteoporosis (n=599)					≤ 0.001
No	263	68.9	201	96.1	
Yes	127	31.1	8	3.9	

Captions: SD: Standard Deviation.

Table 2. Multiple linear regression analysis for association test between each chronic disease and handgrip strength in women. Florianópolis, Santa Catarina, Brazil, 2013/2014.

Variables	Crude analysis		Model 1	
	β (CI95%)	P-value	β (CI95%)	P-value
Arthritis / rheumatism / arthrosis	-3.01 (-4.54; -1.49)	≤0.001	-2.06 (-3.24;-0.88)	0.001
Bronchitis or asthma	1.23 (-0.60;3.10)	0.186	1.52 (0.06;2.98)	0.042
Cancer	1.25 (-1.70;4.20)	0.402	0.49 (-1.63;2.62)	0.644
Depression	-0.68 (-2.43;1.07)	0.443	-0.59 (-2.17;0.99)	0.460
Diabetes	-1.56 (-3.27;0.15)	0.074	-0.77 (-2.31;0.77)	0.322
Coronary disease	-0.88 (-2.34;0.59)	0.237	0.47 (-0.93;1.87)	0.506
Cerebrovascular disease	-2.22 (-4.24; -0.20)	0.032	0.00 (-1.93;1.94)	0.996
Hypertension	-1.36 (-2.86;0.14)	0.074	0.21 (-1.24;1.66)	0.774
Chronic renal failure	1.23 (-2.98;5.45)	0.562	2.50 (-0.94;5.94)	0.152
Osteoporosis	-2.78 (-4.32;-1.25)	0.001	-1.46 (-2.84;-0.73)	0.039
Falls in the last year	-0.94 (-2.53;0.66)	0.246	-1.10 (-2.39;0.18)	0.092

Variables	Model 2		Model 3	
	β (CI95%)	P-value	β (CI95%)	P-value
Arthritis / rheumatism / arthrosis	-1.45 (-2.63;-0.27)	0.017	-1.37 (-2.55;-0.20)	0.022
Bronchitis or asthma	1.57 (0.22;2.92)	0.016	1.61 (0.21;3.00)	0.024
Cancer	0.42 (-1.62;2.48)	0.683	0.19 (-1.70;2.08)	0.844
Depression	-0.65 (-2.08;0.77)	0.365	-0.47 (-1.86;0.91)	0.500
Diabetes	-0.04 (-1.65;1.56)	0.955	-0.25 (-1.72;1.22)	0.736
Coronary disease	0.61 (-0.87;2.09)	0.413	0.76 (-0.66;2.19)	0.291
Cerebrovascular disease	0.85 (-1.35;3.04)	0.445	0.68 (-1.52;2.88)	0.538
Hypertension	0.85 (-0.67;2.37)	0.268	0.67 (-0.75;2.09)	0.354
Chronic renal failure	2.08 (-1.27;5.44)	0.220	1.81 (-1.19;4.82)	0.233
Osteoporosis	-0.99 (-2.34;0.36)	0.148	-0.92 (-2.19;-0.36)	0.156
Falls in the last year	-0.59 (-1.81;0.63)	0.341	-0.56 (-1.85;0.72)	0.385

Caption: ADL: Activities of Daily Living.
Note: Model 1. Age, schooling, household arrangement. Model 2. Age, schooling, household arrangement, smoking, physical activity, body mass index (BMI), cognitive status and functional disability. Model 3 (final): Adjusted for all previous variables and for all chronic health conditions (systemic arterial hypertension, diabetes mellitus, cancer, chronic lung disease (asthma, bronchitis and emphysema), coronary disease, chronic renal failure, cerebrovascular disease [embolism, stroke, ischemia, and cerebral thrombosis], arthritis / rheumatism / arthrosis, depression and falls). β: Beta coefficient; CI95%: 95% Confidence Interval.

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Table 3. Multiple linear regression analysis for association between each chronic disease and handgrip strength in men. Florianópolis, Santa Catarina, Brazil, 2013/2014.

Variables	Crude analysis		Model 1	
	β (CI95%)	P-value	β (CI95%)	P-value
Arthritis / rheumatism / arthrosis	-1.30 (-4.89;2.30)	0.475	-0.86 (-3.74;2.02)	0.553
Bronchitis or asthma	-1.76 (-5.99;2.47)	0.410	-0.70 (-4.06;2.65)	0.677
Cancer	-1.32 (-5.86;3.22)	0.565	-1.73 (-5.82;2.35)	0.401
Depression	0.03 (-2.75;2.80)	0.985	0.75 (-2.21;3.72)	0.614
Diabetes	-4.29 (-7.60;-0.98)	0.012	-4.11 (-7.26;-0.97)	0.011
Coronary disease	-0.94 (-4.13;2.24)	0.558	-0.97 (-3.75;1.81)	0.489
Cerebrovascular disease	-4.67 (-7.72;-1.62)	0.003	-2.62 (-5.91;0.67)	0.117
Hypertension	-0.94 (-4.57;2.68)	0.606	1.19 (-2.10;4.49)	0.472
Chronic renal failure	-0.54 (-8.56;7.47)	0.893	1.10 (-4.02;6.22)	0.670
Osteoporosis	-3.30 (-10.31;3.70)	0.351	0.58 (-7.06;8.22)	0.880
Falls in the last year	-4.38 (-8.29;-0.46)	0.029	-3.65 (-7.35;0.04)	0.052

Variables	Model 2		Model 3	
	β (IC95%)	P-value	β (IC95%)	P-value
Arthritis / rheumatism / arthrosis	-0.49 (-3.26;2.27)	0.725	-1.32 (-4.04;1.41)	0.141
Bronchitis or asthma	0.29 (-2.72;3.31)	0.848	-0.99 (-3.98;2.00)	0.512
Cancer	-0.62 (-4.33;3.09)	0.741	-0.03 (-3.50;3.45)	0.987
Depression	-1.92 (-1.01;4.85)	0.195	1.85 (-1.03;4.73)	0.205
Diabetes	-3.73 (-6.54;-0.93)	0.010	-3.78 (-6.51;-1.05)	0.007
Coronary disease	-1.57 (-3.98;0.84)	0.199	-1.42 (-3.78;0.96)	0.240
Cerebrovascular disease	-0.62 (-4.51;3.27)	0.752	-0.28 (-3.93;3.37)	0.879
Hypertension	1.58 (-1.48;4.64)	0.308	2.34 (-0.54;5.21)	0.110
Chronic renal failure	2.41 (-2.76;7.58)	0.356	1.72 (-3.09;6.53)	0.479
Osteoporosis	1.43 (-4.52;7.37)	0.634	1.66 (-4.31;7.62)	0.582
Falls in the last year	-1.89 (-4.80;0.10)	0.199	-1.83 (-5.06;1.40)	0.263

Caption: ADL: Activities of Daily Living.
Note: Model 1. Age, schooling, household arrangement. Model 2. Age, schooling, household arrangement, smoking, physical activity, body mass index (BMI), cognitive status and functional disability. Model 3 (final): Adjusted for all previous variables and for all chronic health conditions (systemic arterial hypertension, diabetes mellitus, cancer, chronic lung disease (asthma, bronchitis and emphysema), coronary disease, chronic renal failure, cerebrovascular disease [embolism, stroke, ischemia, and cerebral thrombosis], arthritis / rheumatism / arthrosis, depression and falls). β: Beta coefficient; CI95%: 95% Confidence Interval.

diseases, muscular weakness is frequent and usually occurs due to disuse atrophy. In addition, the process of systemic inflammation, joint pain and stiffness contribute to functional and structural alterations related to the neuromuscular system, such as reduced voluntary neural activation and muscular atrophy[25].

The report of chronic lung disease was associated with higher HS values in women, contrary to previous studies[2,26]. Some studies did not identify differences in HS in healthy individuals when compared to those with chronic lung disease[27,28], and cases where such association was found[2,26] are rather explained by nutritional characteristics of the sample, such as lower amount of lean muscle mass, than by reduced lung function. Asthma and bronchitis are chronic diseases that may appear both in the exacerbation and remission stages, which modify the way the medication is used, as well as behaviors associated with the practice of physical activity and feeding, which may interfere directly in HS[29]. Such characteristics may have influenced the result found in this study.

Diabetes was associated with lower HS, as verified in previous studies[6,12,14]. Diabetes metabolic alterations can lead to connective tissue disor-

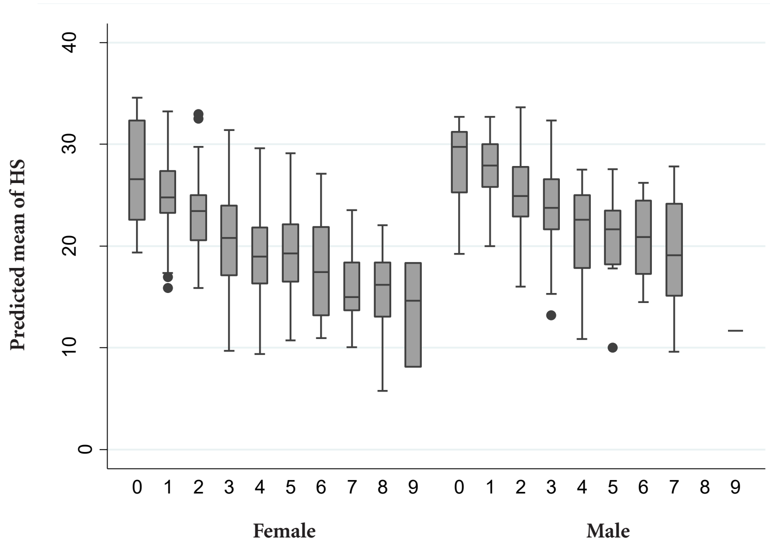

Figure 1. Analysis chart of the predicted mean distribution of handgrip strength (HS) and number of chronic diseases in men and women in the city of Florianópolis, Santa Catarina, Brazil.

Table 4. Distribution of predicted mean handgrip strength and number of chronic diseases in men and women.

Morbidity	Women		Men	
	Mean	CI95%	Mean	CI95%
0	26.95	24.35-29.55	28.05	25.77-30.33
1	24.92	23.76-26.08	27.55	26.55-28.54
2	23.31	22.30-24.32	25.41	24.32-26.51
3	20.87	19.57-22.17	23.85	22.46-25.25
4	19.01	18.05-19.96	21.25	19.47-23.03
5	19.28	18.27-20.29	20.57	18.07-23.06
6	17.87	16.47-19.27	20.66	18.72-22.60
7	15.59	14.19-16.99	19.46	15.95-22.96
8	15.54	12.96-18.12	11.67	-
9	13.71	7.85-19.56	-	-

Captions: CI95%: 95% Confidence Interval.

ders, neuropathies, skeletal striated muscle atrophy, motor disorders[30] and, consequently, muscle strength. A study[12] performed with older adults diabetic men showed that they had lower appendicular skeletal muscle mass, worse functional performance and lower HS, when compared to other non-diabetic older adults. In addition, they are more prone to the risk of falls, depression and frailty[31], which may have repercussions on functional disability and worse HS.

The coexistence of two or more chronic diseases, evaluated in the trend analysis reduced the predictive mean of HS in both genders. This coexistence is very frequent among the older adults and has repercussions on the health of individuals, especially at more advanced ages, such as functional disability, loss of quality of life and high health costs[32,33]. While scarce, some studies[14-16] proposed to investigate the relationship between HS and multiple chronic diseases and

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also found reduced HS values in the presence of chronic diseases.

The limitations of this study are self-reported information and the use of respondent Proxy, as they may have repercussions on the respondent's misinterpretation and/or omission of legitimate answers when the older adults received the assistance of the caregiver/accompanying person, thus affecting information bias. In addition, the tool used in this study to collect data on chronic diseases did not allow investigating the stage, type or severity of the disease. Furthermore, the use of certain medicines was not adopted as a fit variable because this information is unavailable.

One of the strengths is that this is the first Brazilian study performed with a representative sample of older adults from a population-based capital to analyze the association between muscular strength and chronic diseases. We also emphasize that the evaluation of HS is widely used in literature and the tool and procedure applied in this research have been used in studies with different older adults populations[13,15,17]. In addition, the investigation and counting of chronic diseases in individuals is one of the most commonly adopted measures in primary care[10] and can provide important information for planning health care actions.

HS is an objective measure and is a good indicator of the health status, disease progression and effectiveness of rehabilitation programs, especially in the older adults. Its measurement facilitates the analysis of the impact of chronic diseases in the peripheral muscular force and is essential for general health surveillance.

Thus, the development of health policies and intervention programs based on exercises can aim at the promotion and recovery of strength, muscle mass and, consequently, the functional capacity of the older adults population, in addition to indirectly promoting positive perception of health and better quality of life of this population.

According to the results achieved, we note the importance evaluating HS among older adults with chronic diseases, as these can have repercussions on physical and functional health impairment. Maintaining muscular strength has repercussion on the independence and autonomy of the older adults, which are factors that promote healthy ageing[34], and should be the focus of preventive actions and interventions.

Contributions

SC Confortin contributed substantially to the design, planning, data review and interpretation, drafting elaboration, critical review of the work and approval of the work's final version. DL Antes contributed to the design, planning, data review and interpretation, drafting elaboration, critical review of the work and approval of the work's final version. AL Danielewicz contributed to the design, data review and interpretation, critical review of content and approval of the work's final version. LM Ono contributed to the design, planning, data review and interpretation, critical review of content and approval of the work's final version. E d'Orsi contributed to the design, planning, data interpretation, critical review of content and approval of the work's final version. AR Barbosa contributed to the design, planning, data review and interpretation, critical review of content and approval of the work's final version.

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