http://dx.doi.org/10.1590/1678-98652018000400004

ORIGINAL

Factors associated with handgrip strength in older adults residents in *Florianópolis*, Brazil: EpiFloripa Aging Study

Fatores associados à Força de Preensão Manual em idosos residentes em Florianópolis, Brasil: Estudo EpiFloripa Idoso

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ABSTRACT

Objective

To investigate the association between sociodemographic factors, lifestyle, health conditions and low Handgrip Strength in older adults.

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Support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) (Protocol nº 475.904/2013-3).

Como citar este artigo/How to cite this article

Confortin SC, Ono LM, Meneghini V, Pastorio A, Barbosa AR, d´Orsi E. Factors associated with handgrip strength in older adults residents in *Florianópolis*, Brazil: EpiFloripa Aging Study. Rev Nutr. 2018;31(4):385-95. http://dx.doi.org/10.1590/1678-98652018000400004

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Methods

A cross-sectional study was conducted in a sample of 598 older adults. The Handgrip Strength (first quartile) was verified using a dynamometer. Independent variables included age group, schooling, living arrangement, paid work, alcohol consumption, smoking, leisure-time physical activity and transportation, disability in activities of daily living and instrumental activities of daily living, history of falls and probable cognitive impairment. Logistic regression analyses were performed (crude and adjusted).

Results

Age group, disability in instrumental activities of daily living and physical inactivity were associated with low Handgrip Strength for women. For men, there was no association.

Conclusion

Low Handgrip Strength was positively associated with age, disability in instrumental activities of daily living, and negatively associated with the practice of physical activity in women.

Keywords: Cross-Sectional Studies. Health of the Elderly. Muscle Strength Dynamometer. Activities of Daily Living.

RESUMO

Objetivo

O objetivo deste estudo foi verificar a associação entre fatores sociodemográficos, estilo de vida e condições de saúde, e a Força de Preensão Manual baixa em idosos.

Métodos

Trata-se de estudo transversal, de base populacional, com 598 idosos. A Força de Preensão Manual baixa (primeiro quartil) foi verificada por meio de dinamômetro. As variáveis independentes incluíram grupo etário, escolaridade, arranjo familiar, trabalho atual, ingestão de bebida alcoólica, tabagismo, atividade física de lazer e deslocamento, dependência funcional nas Atividades Básicas e Atividades Instrumentais da Vida Diária, histórico de quedas e provável déficit cognitivo. Foram realizadas análises de regressão logística (bruta e ajustada).

Resultados

O grupo etário, a dependência nas Atividades Instrumentais da Vida Diária e a inatividade física foram associadas à Força de Preensão Manual baixa para o sexo feminino. Já para o sexo masculino, não houve associação.

Conclusão

A Força de Preensão Manual baixa foi associada positivamente ao grupo etário à dependência nas Atividades Instrumentais da Vida Diária; e negativamente associada à prática de atividade física, no sexo feminino.

Palavras-chave: *Estudos transversais. Saúde do idoso. Dinamômetro de Força Muscular. Atividades cotidianas.*

INTRODUCTION

One of the characteristics of aging is the progressive loss of strength and muscle mass, known as dynapenia and sarcopenia, respectively, which compromise muscle function [1]. Reduced muscle strength has a negative impact on health that may lead to impairments in the quality of life [2] and autonomy of individuals, in addition to increasing fear of falls [3], institutionalization and mortality in the older adults population [4].

Different methods may be used to assess muscle strength. The Handgrip Strength (HGS) test is widely used to measure strength in older adults [5]. This is a relatively simple, non-invasive and low-cost measurement, and handgrip strength has been associated with physical performance [6,7]. The HGS is also related to nutritional status, and its reduction is consistently associated with functional impairment, increased postoperative complications and hospitalization time [8].

Low HGS is associated with muscle weakness. In Brazil, the prevalence of low HGS

ranges from 19.0% to 31.9% in men [9-11] and 18.8% to 26.6% in women [10-12]. Previous studies have shown that the factors associated with HGS differ between genders and age is a determining factor for its reduction [10]. Data from studies conducted in Brazil have shown that low HGS in women was associated with age advancement, not working, and altered cognitive status [12]. Aging, not being able to read and write, and reporting three or more morbidities were associated with low HGS in men [9]. In addition, the Body Mass Index [10] and physical disability [13] were associated with low HGS in the older adults for both genders. These findings suggest that HGS is important to establish a plan of action to decrease the negative consequences of the muscle strength reduction in older adults and help promote health interventions.

Thus, the aim of the present study was to investigate the association of low HGS with demographic, socioeconomic, lifestyle and health conditions of older adult residents in *Florianópolis*, a city in the south of Brazil.

METHODS

This cross-sectional study, named EpiFloripa Aging, which is part of a population-based longitudinal study entitled 'Health Conditions of older adults in *Florianópolis*', consisted of a sample of older adults (aged 60 years and over) (baseline: 2009/2010, follow-up: 2013/2014) living in the urban area of the city of *Florianópolis*, Brazil. Details of population and sampling can be found in a previously published paper [14].

The data used in the present analysis were obtained in the follow-up phase in two stages: first, the elderly participants of the cohort were interviewed at their homes (2013/14) and they were all invited to participate in examinations to measure their physical functional capacity at the *Universidade Federal de Santa Catarina* (UFSC, Federal University of *Santa Catarina*) (2014/15). The analytical sample of this study was composed of 598 older adults (6 were excluded because they were bedridden and information on the HGS tests was inadequate).

Dependent variable

The evaluation of the HGS was performed in the arm chosen by the participant as the dominant one. Handgrip strength was measured with a Takei Kiki Kogyo Handgrip mechanical dynamometer (TK 1201, Takei Scientific Instruments Co., Niigata, Japan) with size adjustment for the hands. The test was performed with the individual seated, elbow flexed and supported on a table, forearm extended forward, and the palm facing upward. The individual was asked to squeeze the grip with maximum force [15]. The procedure was performed twice with an interval of one minute. The best measure in kg was recorded. The performance of men and women was calculated from the test values distributed in quartiles, which was established according to the Body Mass Index (BMI): BMI<22kg/m², low weight; ≥22,0kg/m² and ≤27kg/m², normal weight and; >27kg/m², overweight [16]. Low HGS was considered as the first quartile of values and classified as follows: for women, low weight: ≤15kg, normal weight: ≤12.5kg, overweight: ≤14.4kg; for men, low weight: ≤22.5 kg, normal weight: ≤18.5 Kg and overweight: ≤24.5 kg.

Independent variables

Demographic and socioeconomic variables were as follows: age group (60-69, 70-79, 80 years and over), years of schooling (0-4, 5-11, 12 or more), living arrangement (living alone; living accompanied), and currently working (no; yes).

Lifestyle variables included: alcohol consumption (non-consumption, non-abusive consumption, abusive consumption) [17] and leisure-time physical activity and transportation

http://dx.doi.org/10.1590/1678-98652018000400004

[18] [sufficiently active (≥150 minutes per week) and insufficiently active (<150 minutes per week)].

Health conditions: Activities of Daily Living (ADL) and disability in Instrumental Activities of Daily Living (IADL) [19] [no difficulties carrying out activities (no) and difficulties carrying out one or more activities (yes)]. The occurrence of falls over the last year (no; yes) and the probable cognitive deficit (MMSE, Mini-Mental State Examination), categorized by cutoffs that consider the educational level according to Almeida [20] (absence of probable cognitive deficit, presence of probable cognitive deficit).

Data analysis

For the descriptive analysis, the prevalence and respective confidence intervals (95%CI) of low HGS were calculated according to the nature of the exposition, according to sex. Logistic regression was used to estimate the crude and adjusted *Odds Ratio* (OR) of the outcome variable and independent variables. The variables that presented statistical significance of at least 20% ($p \leq 0.20$) in the crude analysis were included in the adjusted analysis for each gender. The significance level adopted was $p \leq 0.05$. Data were analyzed using the Stata 13.0 Statistical Program (Stata Corp., College Station, United States). All analysis considered the effect of the sample design by conglomerates, incorporating the sample weights using the survey [svy] command.

Ethical Considerations

The research project was approved by the Human Research Ethics Committee of the UFSC (CAAE nº 16731313.0.0000.0121, protocol nº 1.957.977). Participants or their legal representatives signed the free and informed consent term for each step of the research.

RESULTS

The present study consisted of a sample of 598 individuals (391 women). The proportion of women and men who presented low HGS was 33.1% (95%CI:26.61-40.40) and 29.2% (95%CI:22.42-36.95), respectively. Tables 1 and 2 show the distribution of participants according to sociodemographic characteristics, lifestyle, and health conditions. A higher prevalence of women aged 70-79 years did not receive formal schooling or had received up to 4 years of schooling, lived accompanied, were physically active, did not work or consume alcoholic beverages, did not have ADL disability, but had IADL disability, did not suffer falls over the last year and did not present probable cognitive deficit. For men, the highest prevalence was among the younger group aged 60-69 years old who received 5-11 years of schooling, lived accompanied, were physically active, did not work, were alcohol abusers, did not have ADL disability, but had IADL disability, did not suffer falls and did not present probable cognitive deficit.

The results of the associations with the crude and adjusted analyses between low HGS and the independent variables for women and men are shown in Tables 3 and 4, respectively. For women, in the adjusted analysis, the odds for low HGS were 2.28 (95%CI:1.12-5.07) and 3.68 (95%CI:1.35-10.00) times greater for those in the age groups of 70-79 years and 80 years or over, respectively, when compared with the younger ones (60-69 years). Regarding physical activity, physically active women were 55% less prone (OR:0.45, 95%CI:0.25-0.82) to low HGS when compared with their peers. The women with IADL disability were 3.81 (95%CI:1.60-9.08) times more prone to low HGS when compared with those without the disability. For men, no variables remained associated with the adjusted analysis.

DISCUSSION

There were differences between genders concerning the characteristics associated with

Table 1. Description of the sample and prevalence of low handgrip strength according to demographic, socioeconomic, lifestyle and health conditions in older women. *Florianópolis* (SC), Brazil, 2013-2015.

Variables	Female		
	n	%(95%CI)	%Low HGS
Age Group (391)			
60-69 years	160	40.48(34.09-47.20)	15.74(10.25-23.40)
70-79 years	170	42.31(35.78-49.10)	39.30(28.51-51.24)
80 years and over	61	17.21(12.93-22.79)	59.34(43.96-73.09)
Schooling (390)			
No formal schooling or up to 4 years	181	45.42(37.41-53.65)	42.26(35.81-55.07)
5-11 years	142	36.86(31.20-42.91)	25.19(16.87-35.83)
≥12 years	67	17.72(12.97-23.74)	18.52(6.67-42.02)
Living arrangement (387)			
Living alone	104	28.76(22.92-35.41)	31.47(17.97-49.05)
Living accompanied	283	71.24(64.59-77.08)	33.68(26.92-41.19)
Currently works (355)			
No	309	89.05(85.04-92.08)	35.58(28.00-43.95)
Yes	46	10.95(7.91-14.96)	19.90(10.64-34.13)
Alcohol consumption (391)			
Non-consumption	270	69.02(62.54-74.84)	41.11(32.63-50.14)
Non-abusive consumption	97	24.36(19.19-30.39)	18.03(10.17-29.93)
Abusive consumption	24	6.62(4.01-10.70)	6.23(1.46-23.02)
Leisure-time physical activity and transportation (391)			
Insufficiently active	192	48.52(42.30-54.78)	46.90(38.34-55.65)
Sufficiently active	199	51.48(45.22-57.70)	20.18(12.98-30.01)
ADL disability (391)			
No	247	65.63(59.09-71.62)	25.71(18.42-34.66)
Yes	144	34.37(28.37-40.91)	47.40(38.09-56.90)
IADL disability (391)			
No	125	33.34(27.36-39.92)	13.73(7.54-23.70)
Yes	266	66.66(60.08-72.64)	42.92(34.46-51.38)
Occurrence of falls over the last year (391)			
No	260	66.12(61.18-70.73)	30.00(22.45-38.81)
Yes	131	33.88(29.27-38.81)	39.31(28.22-51.63)
Cognitive deficit (387)			
Absence of probable cognitive deficit	296	75.00(68.78-80.33)	26.77(19.86-35.03)
Presence of probable cognitive deficit	91	25.00(19.66-31.21)	51.30(43.38-59.22)

Note: ADL: Disability in Activities of Daily Living; IADL: Instrumental Activities of Daily Living; 95% CI: 95% Confidence Interval; HGS: Handgrip Strength.

low HGS. In older women (≥70 years), IADL disability was associated with higher odds of low HGS, while physical activity was associated with lower odds of low HGS.

Older women (≥70 years) were more prone to low HGS when compared with those aged 60-69 years, as found in other studies [21,22]. The HGS is considered a marker for

 http://dx.doi.org/10.1590/1678-98652018000400004

Table 2. Description of the sample and prevalence of low handgrip strength according to demographic and socioeconomic data, lifestyle, and health conditions in the older men. *Florianópolis* (SC), Brazil, 2013-2015.

Variables	Male		
	n	%(95%CI)	%Low HGS
Age Group (207)			
60-69 years	93	45.51(36.58-54.73)	17.67(9.46-30.06)
70-79 years	82	40.02(32.28-48.29)	37.60(24.98-52.16)
80 years and over	32	14.47(9.08-22.27)	41.63(24.42-61.15)
Schooling (207)			
No formal schooling or up to 4 years	74	29.75(22.37-38.36)	18.52(6.66-42.02)
5-11 years	58	37.15(29.58-45.41)	40.86(27.67-55.51)
≥12 years	75	33.10(28.85-41.24)	16.43(9.05-27.99)
Living arrangement (206)			
Living alone	21	10.54(6.58-16.48)	31.62(12.33-58.18)
Living accompanied	185	89.46(83.52-93.42)	28.66(21.79-36.69)
Currently works (204)			
No	160	77.58(67.91-84.97)	33.71(25.32-43.25)
Yes	44	22.42(15.02-32.09)	14.13(5.63-31.21)
Alcohol consumption (207)			
Non-consumption	76	33.72(25.93-42.50)	34.00(22.60-47.61)
Non-abusive consumption,	64	29.17(22.41-37.00)	29.06(16.78-45.41)
Abusive consumption	67	37.11(28.36-46.80)	24.88(12.76-42.84)
Leisure-time physical activity and l transportation (206)			
Insufficiently active	64	27.31(20.07-35.98)	39.19(26.53-53.47)
Sufficiently active	142	72.69(64.02-79.92)	25.30(17.10-35.73)
ADL disability (206)			
No	163	79.97(71.99-86.11)	25.98(19.09-34.31)
Yes	43	20.03(13.89-28.01)	41.82(24.69-61.19)
IADL disability (206)			
No	103	49.41(41.47-57.37)	16.80(9.30-28.46)
Yes	103	50.59(42.62-58.53)	41.15(29.30-54.11)
Occurrence of falls over the last year (207)			
No	160	76.13(68.63-82.29)	25.38(17.90-34.67)
Yes	47	23.87(17.71-31.37)	41.13(23.53-61.33)
Cognitive deficit (207)			
Absence of probable cognitive deficit	172	85.44(76.49-91.36)	26.64(19.38-35.43)
Presence of probable cognitive deficit	35	14.56(8.64-23.51)	43.82(27.34-61.79)

Note: ADL: Disability in Activities of Daily Living; IADL: Instrumental Activities of Daily Living; 95%CI: 95% Confidence Interval; HGS: Handgrip Strength.

muscle quality [23]. With aging, particularly after the age of 75 years [23], the amount and size of the muscular fibers (especially fast type II muscle fibers) can weaken the musculature [24]. Furthermore, problems in muscle function associated with aging (such as decreased quality

Table 3. Crude and adjusted analyses for women in relation to factors associated with low Handgrip Strength. *Florianópolis* (SC), Brazil, 2013-2015.

Variables	Female			
	Crude Analysis		Adjusted Analysis*	
	OR(95%CI)	*p*-value	OR(95%CI)	*p*-value
Age Group		≤0.001		0.008
60-69 years	1		1	
70-79 years	3.47(1.73-6.93)		2.28(1.12-5.07)	
80 years and over	7.81(3.29-18.53)		3.68(1.35-10.00)	
Schooling		0.013		0.708
No formal schooling or up to 4 years	1		1	
5-11 years	0.41(0.25-0.67)		0.64(0.33-1.25)	
≥12 years	0.27(0.07-1.05)		1.05(0.28-3.54)	
Living arrangement		0.802		-
Living alone	1		-	
Living accompanied	1.10(0.50-2.44)		-	
Currently works		0.059		0.208
No	1		1	
Yes	0.45(0.20-1.03)		0.65(0.26-1.61)	
Alcohol consumption		≤0.001		0.086
Non-consumption	1		1	
Non-abusive consumption	0.31(0.14-0.71)		0.47(0.17-1.26)	
Abusive consumption	0.09(0.02-0.45)		0.25(0.04-1.75)	
Leisure-time physical activity and transportation		≤0.001		0.007
Insufficiently active	1		1	
Sufficiently active	0.29(0.15-0.51)		0.45(0.25-0.82)	
ADL disability		≤0.001		0.345
No	1		1	
Yes	2.60(1.57-4.31)		0.74(0.39-1.41)	
IADL disability		≤0.001		0.004
No	1		1	
Yes	4.72(2.19-10.17)		3.81(1.60-9.08)	
Occurrence of falls over the last year		0.196		0.265
No	1		1	
Yes	1.51(0.80-2.83)		1.49(0.79-2.79)	
Cognitive deficit		0.002		0.221
Absence of probable cognitive deficit	1		1	
Presence of probable cognitive deficit	2.88(1.49-5.55)		1.52(0.71-3.24)	

Note: *Adjusted for variables with $p<0.20$ (age group, schooling, work, smoking, alcohol consumption, physical activity, functional dependence in ADL and IADL, falls and cognitive decline). OR: Odds *Ratio*; 95%CI: 95% confidence interval; ADL: Disability in Activities of Daily Living; IADL: Instrumental Activities of Daily Living; HGS: Handgrip Strength.

 http://dx.doi.org/10.1590/1678-98652018000400004

Table 4. Crude and adjusted analyses for men in relation to factors associated with low Handgrip Strength. *Florianópolis* (SC), Brazil, 2013-2015.

Variables	Male			
	Crude Analysis		Adjusted Analysis*	
	OR(95%CI)	*p*-value	OR(95%CI)	*p*-value
Age Group		0.013		0.239
60-69 years	1		1	
70-79 years	2.81(0.99-7.97)		2.18(0.73-6.48)	
80 years and over	3.32(1.16-9.53)		1.57(0.39-6.33)	
Schooling		0.013		0.064
No formal schooling or up to 4 years	1		1	
5-11 years	0.65(0.25-1.72)		0.59(0.19-1.79)	
≥12 years	0.28(0.10-0.76)		0.29(0.09-0.89)	
Living arrangement		0.806		-
Living alone	1		-	
Living accompanied	0.87(0.28-2.71)		-	
Currently works		0.057		0.192
No	1		1	
Yes	0.32(0.10-1.04)		0.42(0.12-1.42)	
Alcohol consumption		0.359		-
Non-consumption	1		-	
Non-abusive consumption,	0.79(0.30-2.12)		-	
Abusive consumption	0.64(0.25-1.68)		-	
Leisure-time physical activity and transportation		0.134		0.109
Insufficiently active	1		1	
Sufficiently active	0.53(0.22-1.22)		0.40(0.16-1.04)	
ADL disability		0.122		0.896
No	1		1	
Yes	2.05(0.82-5.10)		1.04(0.33-3.29)	
IADL disability		0.011		0.100
No	1		1	
Yes	3.46(1.34-8.93)		2.45(0.82-7.29)	
Occurrence of falls over the last year		0.150		0.250
No	1		1	
Yes	2.05(0.77-5.49)		1.70(0.66-4.32)	
Cognitive deficit		0.071		0.722
Absence of probable cognitive deficit	1		1	
Presence of probable cognitive deficit	2.15(0.93-4.94)		0.87(0.26-2.82)	

Note: *Adjusted for variables with $p<0.20$ (age group, schooling, work, smoking, alcohol consumption, physical activity, functional dependence in ADL and IADL, falls and cognitive decline). OR: Odds *Ratio*; 95%CI: 95% Confidence Interval; ADL: Disability in Activities of Daily Living; IADL: Instrumental Activities of Daily Living; HGS: Handgrip Strength.

of muscles, tendons, and sarcomeres) may impair muscle strength in older people [23]. It was expected that the HGS of men would also be associated with older age [25], but it appears

that the decline in the HGS of men was not enough to change the classification category for the population of the present study.

The results showed that women who physical activity for at least 150 minutes per week were less prone to low HGS. The literature is controversial [22,26] and there seems to be no consensus regarding the association between regular physical activity and HGS levels. The controversial data can be explained by the variety of instruments used to measure HGS and physical activity, as well as the characteristics of the samples studied. In addition, the classification of the type and intensity of physical activity and transportation was not performed. However, the practice of physical activity can positively influence HGS [27] and, together with an adequate diet, it is a feasible strategy for the maintenance and gain of muscle mass and strength in older adults [28].

The IADL disability increased the chance of low HGS among women. This relationship is a consequence of the reduction of the percentage of muscle mass, common in the aging process, which can lead to the loss of global muscle strength and hinder the daily activities of older adults, leading to limitations and functional dependence [29,30]. Thus, a reduction in handgrip strength can be considered an important predictor of functional impairment and frailty in older adults [31,32], and HGS is important to maintain and promote healthy aging and prevent adverse health outcomes [33].

Self-reported information, as well as the use of Proxy, may lead to a misunderstanding of information and it is considered a limitation. Only the older adults who were in better health conditions were able to attend the place where the tests were performed, which may underestimate the prevalence of low HGS.

The contribution of the present study was the use of the HGS test and the application of validated questionnaires. These instruments and procedures are widely used in epidemiological studies, as described in the literature, for in-home data collection involving different populations of older adults.

CONCLUSION

The results show that low HGS in women was positively associated with the age group (≥70 years), IADL disability; and negatively associated with the practice of physical activity. It was found that preventive strategies are required to reduce the loss of muscle strength and reduce/control the prevalence of low HGS among the older adults.

CONTRIBUTORS

SC CONFORTIN, LM ONO and V MENEGHINI contributed to the design, analysis and interpretation of the data, and preparation of the manuscript. A PASTORIO contributed substantially to the interpretation of the data and preparation of the manuscript. AR BARBOSA and E d'ORSI contributed to the design and interpretation of data. All authors contributed substantially to the critical review and approval of the final version of the article.

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Received: November 9, 2017
Final version: September 14, 2018
Approved: October 1, 2018