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Factors associated with decreased hand grip strength in the elderly

Fatores associados à força de preensão manual diminuída em idosos

Factores asociados con la fuerza de prensión manual disminuida en ancianos

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Abstract

Objective: To investigate the factors associated with decreased hand grip strength in the elderly. **Methods:** A cross-sectional quantitative study was performed with a sample of 203 elderly users of primary health care. Data were collected between January and April 2013 by a socio-demographic/clinical questionnaire and hand grip strength test. Descriptive statistics and chi-square test were applied and values of $p \leq 0.05$ were considered to be significant. **Results:** A total of 48.8% of the elderly had decreased hand grip strength associated with the variables sex ($p < 0.001$), age ($p < 0.012$), marital status ($p < 0.005$), level of education ($p < 0.027$), falls ($p < 0.001$) and assistive technologies ($p < 0.024$). **Conclusion:** The high percentage of decreased hand grip strength in the elderly is alarming because it is a limiting factor for the activities of daily living. The significant association between some variables reinforces these restrictions. To investigate factors associated with decreased hand grip strength helps nurses in the management of frailty, and it can prevent outcomes for the syndrome of physical frailty.

Keywords: Frail elderly; Hand strength; Muscle strength dynamometer; Geriatric nursing.

Resumo

Objetivo: Investigar os fatores associados à diminuição da Força de Preensão Manual (FPM) em idosos. **Métodos:** Estudo quantitativo transversal, cuja amostra foi constituída por 203 idosos da atenção primária à saúde. Os dados foram coletados entre janeiro e abril de 2013 mediante questionário sociodemográfico/clínico e teste de FPM. Aplicou-se estatística descritiva e teste *qui*-quadrado, considerados significativos os valores de $p \leq 0,05$. **Resultados:** 48,8% dos idosos apresentaram FPM diminuída, associada às variáveis sexo ($p < 0,001$), idade ($p < 0,012$), estado civil ($p < 0,005$), escolaridade ($p < 0,027$), quedas ($p < 0,001$) e tecnologias assistivas ($p < 0,024$). **Conclusão:** Foi elevada a distribuição da FPM diminuída, isso é preocupante, uma vez que é um fator limitante para as atividades de vida diária. A associação significativa entre algumas variáveis reforçam essas restrições. Investigar os fatores associados à diminuição da FPM instrumentaliza os enfermeiros para a gestão da fragilidade e ela poderá evitar desfechos para a síndrome da fragilidade física.

Palavras-chave: Idoso fragilizado; Força da mão; Dinamômetro de força muscular; Enfermagem geriátrica.

Resumen

Objetivo: Investigar los factores asociados con la disminución de la Fuerza de Prensión Manual (FPM) en ancianos. **Métodos:** Estudio cuantitativo transversal. Participaron 203 ancianos de la Atención Primaria a la Salud. Los datos fueron recogidos entre enero y abril de 2013, por cuestionario clínico/sociodemográfico y prueba de FPM. Se aplicó la estadística descriptiva y la prueba de chi-cuadrado, considerados valores significativos de $p \leq 0,05$. **Resultados:** El 48,8% de los ancianos presentaron FPM disminuida, asociada con variables de género ($p < 0,001$), edad ($p < 0,012$), estado civil ($p < 0,005$), educación ($p < 0,027$), soledad ($p < 0,008$), caídas ($p < 0,001$) y tecnologías de apoyo ($p < 0,024$). **Conclusión:** La alta frecuencia de disminución de FPM preocupa, ya que es un factor limitante para las actividades diarias. La asociación significativa entre algunas variables refuerza estas restricciones. La investigación de estos factores permite la práctica de enfermería para la gestión de la fragilidad, y se puede prevenir la síndrome de fragilidad física.

Palabras clave: Anciano frágil; Fuerza de la mano; Dinamómetro de fuerza muscular; Enfermería geriátrica.

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INTRODUCTION

Hand strength is one of the most relevant functional aspects in the maintenance of elderly individuals' independence and quality of life. When decreased, it can have an impact on their functional capacity, cause dependence in activities of daily living and increase disabilities.

Decreased Hand Grip Strength (HGS) is considered to be one of the components of the phenotype of physical frailty in the elderly, according to a group of researchers[1]. This phenotype includes other four components such as unintentional weight loss, self-reported fatigue, reduction in walking speed and decrease in physical activities. Elderly individuals showing three or more components of this phenotype are regarded as frail. Those with one or two characteristics are found to be in a previous stage of frailty, or pre-frailty, thus having a high risk of development of this syndrome[2].

Physical frailty is defined as "a medical syndrome with multiple causes characterized by the reduction in strength, endurance and physiological functions, thus increasing an individual's vulnerability to the development of and increase in dependence and/or death"[1:393]. The decrease in muscle strength in the elderly, followed by a reduction in musculoskeletal performance and quality, a process known as sarcopenia, is associated with a series of systemic diseases and dysfunctions prevalent in the elderly, apart from causing complications with the advance of age and leading to the syndrome of frailty[3].

Sarcopenia mainly affects the lower limbs, harming walking speed, followed by upper limbs, where there is a decrease in hand grip, the focus of the present study. Recognized as an increasing variable, HGS begins during childhood and progresses until adulthood, when it reaches a maximum value. With old age, HGP gradually decreases in both sexes and the reduction in strength in the upper limbs harms the performance of manual tasks that require pronation and supination of the forearm[4].

HGS has been used in studies as an indicator of muscle strength in the entire body[4]. A meta-analysis aimed at determining HGS values for different age groups, according to the recommendations of the American Society of Hand Therapists (ASHT), revealed that HGS is a good predictor of general muscle strength and that it is associated with other variables comprising the phenotype of frailty[5].

Frailty and sarcopenia are overlapping conditions, i.e. frail elderly individuals are more exposed to sarcopenia and those with sarcopenia show more frailty[6]. Sarcopenia and frailty can be characterized as a common state of impairment of physical function[7]. Moreover, sarcopenia is associated with low physical capacity, functional limitation and disability, in addition to other factors such as comorbidities, social conditions, life habits and falls[8].

The identification of factors associated with the reduction in muscle strength and power in the upper limbs among elderly individuals provides important resources to plan health care for this population[9], which is highly heterogeneous in terms of prevalence of physical frailty conditions. The characteristics of the sample, comprised of elderly individuals waiting for a consultation at a Primary Care Unit (PCU), were adopted as one of the innovative strategies. A study considered to be relevant on a national level[10] used a simple random sample of urban census sectors. In contrast, the present study includes a different sample of the population, that which requires health care.

On reduced levels, < 26 kg/s and < 16 kg/s for men and women respectively[11], HGS has been considered to be an important predictor of disability, morbidity and mortality, mainly associated with frailty in elderly individuals[4-5,11]. For this reason, the assessment of HGS must be an essential type of geriatric nursing care when dealing with physical frailty.

A study[10] performed with a probabilistic sample of 689 elderly individuals (72.28 ± 5.40 years; 68.21% females) found a significant association between low HGS, age (≥ 80 years) and physical inactivity (considering the weekly energy expenditure). Another study investigated the relationship between reduction in HGS and associated factors in 157 oldest old, showing that the decrease in HGS was associated with age and body mass index (BMI)[12].

In view of what has been described, the present study aimed to investigate the factors associated with decreased hand grip strength in the elderly. The results can support the management of frailty, especially regarding the effort to develop strategies/interventions that include gains and/or stabilization of strength levels; guidance on factors associated with loss of muscle strength; and the recognition of the initial picture about the need to apply new instruments to assess elderly individuals, particularly HGS.

METHODS

A cross-sectional quantitative study was performed in a Primary Care Unit (PCU) included in the Boa Vista Health District, in the city of Curitiba, Southern Brazil. This district is the second largest region in the city with 248,698 inhabitants, nearly 14.2% of the city population. Elderly individuals (≥ 64 years) total 20,336 inhabitants and represent 8.18% of the population[13].

The Matriz Health District comprises 13.28% of the elderly population of the city of Curitiba and it is the region with the highest number of elderly individuals[13]. However, this is a model center that serves the elderly population of the entire city (not characterized as a community, defined by socio-demographic and economic factors). For this reason, The Boa Vista Health District was selected for this study. The target population was comprised by elderly individuals aged ≥ 60 years who were waiting for a consultation at the PCU, between January and April 2013.

This study is part of a research project entitled "Effect of Frailty and Quality of Life Associated with the Health of Elderly in the Community", for which the sample size was determined based on the estimate of the proportion of population, considering a confidence interval of 95% and sample error of

5% and according to the formula below[14]. At the time of this study, the Primary Care Unit covered nearly 19,000 inhabitants and an elderly population of 1,050 registered individuals, providing services to approximately 23 of them on a daily basis.

$$n = \frac{Z_{\alpha/2}^{2} \cdot p \cdot q}{E^2}$$

$Z_{\alpha/2}^{2}$ - corresponds to the critical value calculated from the level of significance;
p.q - variance of the variable investigated;
E^2 - maximum estimation error; sample error.

A total of 10% was added to the sample size due to possible losses and refusals, thus totaling 203 elderly individuals. Those waiting for a consultation at the PCU were randomly invited to participate in the present study and selected according to the following inclusion criteria: to be aged 60 years or more and to obtain a score higher than the cut-off point in the cognitive assessment of the Mini Mental State Exam (MMSE)[15]. Such cut-off points were adopted due to the categorization of level of education used in this study, which were more adequate for the elderly of the community studied, considering the high number of illiterate individuals and those with a low level of education.

The following exclusion criterion was used: to have been previously diagnosed with severe mental and physical impairments or diseases that could compromise the assessment of phenotype of frailty. A total of 251 elderly individuals were approached, 33 refused to participate, eight were excluded as they showed a cut-off point below that established for MMSE and seven were excluded due to physical impairments or diseases.

After cognitive screening, a socio-demographic and clinical questionnaire designed for the present study and the HGS test were applied. The socio-demographic and clinical variables of interest were as follows: sex, age, marital status, individuals living with them, level of education, health problems, history of falls, urinary incontinence, use of assistive technology (cane, walker, crutches), use of glasses, tobacco and alcohol use, use of medications and hospitalization in the previous 12 months. These variables were selected due to their relationship with the cycle of physical frailty[2], the object of study of the main research project.

The outcome variable, HGS, was measured with a JAMAR hydraulic dynamometer in kilogram/strength (kg/s), in accordance with the recommendations from the American Society of Hand Therapists (ASHT)[5]. For this test, elderly individuals were instructed to perform the procedure once before measurements were taken (to become familiar with the dynamometer). During data collection, individuals had to be sitting with their feet touching the floor and the upper limb being tested (dominant hand) was positioned with the shoulder in abduction, elbow flexed at 90º and forearm in a neutral position. The examiner adjusted the handle in the participant's dominant hand, so that the second phalanx of their second, third and fourth fingers touched the device's curved bar. A total of three grips were performed, with one-minute intervals for their strength to return, and the highest measurement was taken into consideration[4]. After adjusting for sex and body mass index (BMI), the lowest quartile of HGS values was considered as the marker of frailty, described as decreased HGS.

Data were organized and stored in the 2007 Excel® software, using double data entry to reduce the probability of errors. Results were analyzed using the EpiInfo software, version 6.04. In addition, descriptive statistics (frequency, mean, standard deviation) and the non-parametric test (Chi-square) were used for association between variables. The results were considered to be statistically significant when $p \leq 0.05$.

The present study was approved by the Human Research Ethics Committee of the Health Science Sector, under CEP/SD: 913.038.10.04 and CAAE: 0023.0.091.000-10, in accordance with the current legislation. The ethical principles of voluntary participation and consent of each individual were respected.

RESULTS

Among all elderly individuals investigated (n = 203), the mean HGS was 29.57 ± 10.36 Kg/s, with a minimum value of 12 Kg/s and maximum value of 62 Kg/s. Elderly males (n = 80) showed a higher mean value (38.59 ± 9.09Kg/s) when compared to females (n = 123) for this variable (23.70 ± 6.03 Kg/s). Decreased HGS was found in 99 (48.8%) individuals. Table 1 shows the association between HGS and socioeconomic variables among the elderly. There was a significant association between HGS and sex ($p < 0.001$), age ($p = 0.012$), marital status ($p = 0.005$) and level of education ($p = 0.027$).

Table 2 shows the association between HGS and the clinical variables among the elderly. There was a significant statistical association between HGS and falls in the previous 12 months ($p < 0.001$), presence of urinary incontinence ($p < 0.001$) and use of assistive technology ($p = 0.024$) during data collection.

DISCUSSION

The results reveal that a significant number of elderly individuals have decreased hand grip strength. This percentage (48.8%) is more than double of that found in the pioneering study on *Fragilidade em Idosos Brasileiros* (FIBRA - Frailty in Brazilian Elderly Individuals), where 20.5% of elderly individuals showed decreased hand grip strength[16], and in the study conducted by Fried, where the prevalence of this component was 20%[2]. In the present study, this higher figure was attributed to the sample characteristics of sex and age of participants. The majority of elderly individuals with decreased HGS were aged ≥ 70 years (56.6%) and females (86.9%), factors considered to be determinants of reduction in HGS by certain researchers[2-10,12].

The prevalence of frailty in elderly women, observed in national and international studies, is influenced by gender differences[2-12,17]. According to a study that associated body composition with physical frailty in 235 elderly individuals of the city of São Paulo, SP, women have higher risks of scoring in frailty

Table 1. Association between hand grip strength and socio-demographic variables. Curitiba, PR, Brazil, 2013

Variable	Classification	Decreased HGS n (%)	Normal HGS n (%)	Total n (%)	*p*-value*
Sex	Male	13 (6.4)	67 (33.0)	80 (39.4)	< 0.001*
	Female	86 (42.4)	37 (18.2)	123 (60.6)	
Age	60 to 69 years	43 (21.2)	57 (28.1)	100 (49.3)	0.012*
	70 to 79 years	34 (16.8)	39 (19.2)	73 (36.0)	
	80 years or more	22 (10.8)	8 (3.9)	30 (14.7)	
Marital status	Married	38 (18.8)	65 (32.0)	103 (50.7)	0.005*
	Divorced	8 (3.9)	8 (3.9)	16 (7.9)	
	Single	8 (3.9)	5 (2.5)	13 (6.4)	
	Widowed	45 (22.2)	26 (12.8)	71 (35.0)	
Individuals living with them	Spouse	17 (8.5)	28 (13.8)	45 (22.2)	0.131
	Family	62 (30.5)	63 (31.0)	125 (61.5)	
	Alone	20 (9.8)	13 (6.4)	33 (16.3)	
Level of education	Illiterate	19 (9.5)	8 (3.9)	27 (13.4)	0.027*
	Incomplete primary education	61 (30)	60 (29.6)	121 (59.6)	
	Complete primary education	8 (3.9)	10 (4.9)	18 (8.8)	
	Incomplete secondary education	0 (0.0)	6 (2.9)	6 (2.9)	
	Complete secondary education	10 (4.9)	18 (8.9)	28 (13.8)	
	Complete higher education	1 (0.5)	2 (1.0)	3 (1.5)	
Total		99 (48.8)	104 (51.2)	203 (100)	

* Chi-square test, $p < 0.05$; HGS: hand grip strength.

criteria, as they frequently have less muscle mass and decreased HGS, when compared to men[18].

Both age and sex are biologically, psychologically, culturally and historically influenced, representing indicators of conditions accumulated throughout life[18]. The discrimination against women in terms of access to education, salary, food and political power has led to cumulative disadvantages that cause them to be poorer and to have more disabilities in advanced ages[17].

The results of the study[12] aimed at assessing HGS in the oldest old and associated factors showed a higher prevalence of women with decreased HGS, attributed to their advanced age group, ≥ 80 years. The mean value of HGS in the oldest old was significantly higher in men (29.1 Kg/s ± 10.5) when compared to women (17.9 Kg/s ± 4.9), which can be justified by men's greater muscle mass.

Of all elderly individuals found in the 60-to-69-year age group, 43% of them had decreased HGS. This percentage rose to 46.5% among those in the 70-to-79-year age group and to 73.3% among those aged 80 years or more. Therefore, the older an elderly individual is, the lower their HGS. These results agree with those found in the literature[4-5,9,18]. Authors stated that HGS becomes inversely proportional to age throughout the years. Consequently, the incidence is higher among older individuals.

Marital status was significantly associated with decreased HGS (p = 0.005) and 45.5% of elderly individuals with HGS reported they were widowed. Moreover, 62.6% of elderly individuals with decreased HGS live with their family. These results suggest that, when losing their spouse, these individuals usually begin to live with their sons/daughters/relatives. In their turn, for safety purposes, their sons and daughters restrict the amount and frequency of activities performed by the elderly. Such restrictions interfere with basic, instrumental and advanced activities of their daily living, thus having an influence on decreased HGS.

A study[19] conducted with 958 elderly individuals living in an urban area in the state of Minas Gerais, Southeastern Brazil, and aimed at identifying the occurrence of and factors associated with pre-frailty and frailty conditions in the elderly corroborates the previously mentioned data. Among other variables, such as age group (70 to 79 years and 80 years or older), polypharmacy, a higher number of morbidities, functional disability for instrumental activities of daily living and negative perception of health, "without a partner" was the factor significantly associated with the pre-frailty condition in the elderly, in the multivariate model of multinomial logistic regression model ($p < 0.001$).

Table 2. Association between hand grip strength and clinical variables. Curitiba, PR, Brazil, 2013

Variable	Classification	Decreased HGS n (%)	Normal HGS n (%)	Total n (%)	*p*-value*
Health problems	Yes	92 (45.3)	88 (43.3)	180 (88.6)	0.099
	No	7 (3.5)	16 (7.9)	23 (11.4)	
Falls in the previous 12 months	Yes	41 (20.2)	20 (9.8)	61 (30)	< 0.001*
	No	58 (28.6)	84 (41.4)	142 (70.0)	
Urinary incontinence	Yes	44 (21.7)	17 (8.4)	61 (30.1)	< 0.001*
	No	55 (27.1)	87 (42.8)	142 (69.9)	
Tobacco use	Yes	7 (3.4)	11 (5.4)	18 (8.8)	0.527
	No	92 (45.4)	93 (45.8)	185 (91.2)	
Alcohol use	Yes	8 (3.9)	19 (9.4)	27 (13.3)	0.053
	No	91 (44.8)	85 (41.8)	176 (86.7)	
Use of assistive technology	Yes	9 (4.4)	2 (1.0)	11 (5.4)	0.024*
	No	90 (44.4)	102 (50.2)	192 (94.6)	
Use of medications	Yes	87 (42.9)	92 (45.4)	179 (88.2)	0.929
	No	12 (5.9)	12 (5.8)	24 (11.8)	
Hospitalizations in the previous 12 months	Yes	13 (6.4)	22 (10.8)	35 (17.2)	0.184
	No	86 (42.4)	82 (40.4)	168 (82.8)	
Use of glasses	Yes	74 (36.4)	89 (43.9)	163 (80.3)	0.077
	No	25 (12.4)	15 (7.3)	40 (19.7)	
Total		99 (48.8)	104 (51.2)	203 (100)	

* Chi-square test, $p < 0.05$; HGS: hand grip strength.

Level of education was another variable that was significantly associated with HGS and the majority of elderly individuals with decreased HGS had a low level of education. This result is similar to what was found by a national study[20] that investigated the factors associated with muscle strength in the oldest old and showed a significant association between reduced HGS and illiteracy, with a p-value = 0.038. Elderly individuals with a low level of education frequently had fewer resources and possibilities of access to information and opportunities and they often showed little understanding of healthy eating habits and determining factors of diseases. In this sense, a low level of education contributes to worse socioeconomic conditions and higher susceptibility to health problems.

The percentage of elderly individuals with decreased HGS who had suffered episodes of fall in the previous 12 months was nearly two times higher than the percentage of those who had a normal HGS. Likewise, the percentage of elderly individuals using assistive technology and who had decreased HGS was higher than that of others with normal HGS. Considering the fact that HGS is a good predictor of general muscle strength[5], this result can indicate that decreased HGS is associated with higher risk of falls among the elderly or, yet, with their reduced physical capacity and mobility.

"Falls in the previous 12 months" and "use of assistive technology" were significantly associated with decreased HGS ($p < 0.001$ and $p = 0.024$, respectively). A study[9] that aimed to analyze factors associated with the reduction in muscle strength and power in the upper limbs of elderly individuals living in the rural area of a city of Northeastern Brazil showed a similar result for "falls". The results revealed that decreased muscle strength was associated with greater exposure to falls ($p = 0.001$).

These results are important for the work of nurses, so that they can identify the factors associated with HGS and take into consideration the risk of falls. When considering this as an adverse event that can cause significant functional limitations in the elderly, falls can generate new demands on health professionals and family members, who often need to reorganize their routine so that elderly individuals can be best treated.

With regard to elderly individuals with urinary incontinence, the number of participants with decreased HGS was almost three times higher (21.7%) than those with normal HGS (8.4%). A study[21] conducted with 1,399 Japanese women aged 75-84 years corroborates data from the present study, as it revealed a statistical association between decreased HGS and the presence of urinary incontinence ($p < 0.001$). This result emphasizes the fact that a reduction in HGS can be associated with a decrease in functional capacity and, consequently, with dependence in activities of daily living among the elderly[12].

In the present study, it should be emphasized that not all socio-demographic and clinical variables that were associated with HGS can be changed, such as sex, age, marital status and level of education. However, knowledge about these variables enables nurses to identify elderly individuals who are more likely to have decreased HGS and direct their work towards geriatric care.

For the variables that could be changed (falls, urinary incontinence and assistive technology), it is suggested that nurses encourage elderly individuals to practice physical activities, especially resistance exercises developed with a physical educator. Such exercises are part of the current physical training and rehabilitation programs, particularly for the elderly. They promote the improvement in muscle strength and resistance, maintain and improve lean body mass, develop coordination, reaction speed and balance, and prevent and treat injuries and disabilities[22].

It is understood that, in an inter-disciplinary way, geriatric nursing follows and guides exercises and energy-protein supplementation, as it is recommended as part of the geriatric care in the management of physical frailty[1].

CONCLUSIONS

It can be concluded that there was a high frequency of decreased HGS in the elderly individuals investigated. This result showed a significant association among socio-demographic variables such as sex, age, marital status and level of education. Likewise, decreased HGS was associated with the following clinical variables: falls in the previous 12 months, urinary incontinence and use of assistive technology.

Considering the fact that HGS is one of the components of the phenotype of frailty, the identification of the factors associated with decreased HGS corroborates geriatric nursing care in the management of the frailty syndrome. When intervening in factors associated with decreased HGS that can be changed, it is possible to prevent or slow down the frailty process.

With regard to the decreased HGS, resistance training is recommended as an alternative of intervention, as it enables muscle strength gain and has a positive influence on aspects associated with elderly individuals' balance, mobility and functional capacity. Changing variables such as load, number of series, weekly frequency, interval of recovery and order of exercises are important aspects for an effective development of muscle strength and, for this reason, the relevance of the work of a multi-professional team should be emphasized.

Another possible intervention is energy-protein supplementation, which requires promoting the consumption of proteins in all meals of the elderly, adapting foods according to nutritional requirements and socioeconomic level. The importance of combining nutritional counseling and geriatric assessment should be emphasized in geriatric nursing care.

The type of study used in this research project was a limiting factor, as the cross-sectional design does not enable the analysis of cause and effect, thus not evidencing the outcomes between certain socio-demographic/clinical variables and hand grip strength in the elderly. It is suggested that cohort and longitudinal studies should be performed in an attempt to define these relationships.

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