






ORIGINAL ARTICLE

The reduction in grip strength is associated with a decrease in the distance covered in the 6MWT in elderly people residing in a long-stay institution

A redução da força de preensão está associada a diminuição da distância percorrida no TC6 em idosos residentes em uma instituição de longa permanência

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KEYWORDS

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Homes for the aged

ABSTRACT

Objective: To evaluate the relationship between handgrip strength (HGS), anthropometric parameters, perception of fatigue, and the distance covered in the 6-minute walk test (6MWD) in elderly people living in a long-stay care institution (LSCI).

Methods: Elderly people (n = 17; 77 ± 7 years) of both sexes, living in an LSCI in Espírito Santo, Brazil, participated in the study. Volunteers were evaluated using the 6-min walk test (6MWT), HGS, and Chalder's Fatigue Scale (EFC).

Results: The means of the 6MWD (276 ± 81.6 m) and HGS (19.4 ± 10.5 Kg/f) of the elderly were below the predicted values. The 6MWD showed a moderate positive correlation with HGS (right r = 0.6; p = 0.008; left r = 0.5; p = 0.03) and with apex expansion (r = 0.5; p = 0.03), as well as a negative correlation with the body mass index (BMI) (r = -0.6; p = 0.01).

Conclusion: In the environment of an LSCI, where there is a high prevalence of functional limitations and cardiovascular diseases (CVD) in the elderly, comprehensive health care is a complex challenge. Thus, knowledge of these associations can highlight the importance of ensuring strategies to mitigate muscle weakness and immobility.

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PALAVRAS-CHAVE

Fadiga
Idoso
Instituição de longa
permanência para
idosos

RESUMO

Objetivo: avaliar a relação entre a força de preensão manual (FPM), os parâmetros antropométricos, a percepção à fadiga e a distância percorrida no teste da caminhada de 6 min (DTC6) em idosos residentes em uma instituição de longa permanência (ILPI).

Métodos: Participaram do estudo idosos ($n = 17$; 77 ± 7 anos), de ambos os sexos, residentes em uma ILPI do Espírito Santo, Brasil. Os voluntários foram avaliados por meio do teste de caminhada de 6 min (TC6), FPM e escala de fadiga de Chalder (EFC).

Resultados: As médias da DTC6 ($276 \pm 81,6$ m) e da FPM ($19,4 \pm 10,5$ Kg/f) dos idosos estavam abaixo dos valores previstos. A DTC6 apresentou correlação positiva moderada com a FPM (direita $r = 0,6$; $p = 0,008$; esquerda $r = 0,5$; $p = 0,03$) e com a expansibilidade de ápice ($r = 0,5$; $p = 0,03$), bem como correlação negativa com o índice de massa corpórea (IMC) ($r = -0,6$; $p = 0,01$).

Conclusão: No ambiente de uma ILPI, onde é grande a prevalência de limitações funcionais e doenças cardiovasculares (DCV) em idosos, a assistência à saúde integral é um desafio complexo. Desta forma, o conhecimento destas associações pode ressaltar a importância de garantir estratégias para mitigar a fraqueza muscular e o imobilismo.

INTRODUCTION

Brazil has shown considerable growth in the number of elderly people in recent years¹. There is a consensus in the literature about the loss of muscle mass and reduction of muscle strength during the aging process^{2,3}. Longitudinal studies evaluating muscle mass and strength with age have shown a much faster reduction in strength than in muscle mass in the elderly. This suggests an impairment of muscle quality during aging^{4,5}. Reduced muscle strength is associated with disability and dependence in older people and can trigger frailty syndrome and sarcopenia⁶. One way to assess muscle strength in the elderly is manual dynamometry. Handgrip strength (HGS) is an important parameter because it is related to overall muscle strength and a predictor of causes of mortality, and a tool for life prognosis in the elderly population⁶⁻⁸. HGS is a strong predictor of cardiovascular mortality. A reduction in HGS is associated with higher lethality rates in people who develop cardiovascular disease (CVD)⁹. Every decade of life, the incidence of CVD in adults approximately doubles; this situation represents a significant challenge to the health care system¹⁰.

The demographic transition in Brazil is occurring in a context of significant social, cultural, and economic transformations in the value system and the configuration of family arrangements¹¹. The aging of the Brazilian population increases the number of dependent elderly who demand specific care and do not have a family environment to provide it¹². In Brazil, the long-stay care institutions for the elderly (LSCI) are alternatives when the family cannot provide home care¹³. However, it is essential to point out that the prevalence of functional limitations and CVD makes the care of institutionalized elderly people complex¹⁴. Therefore, it is necessary to understand the factors that influence the health conditions of institutionalized elderly people so that health interventions can address the specific demands of care. Thus, this study evaluated the relationship between the HGS, the anthropometric parameters, the perception of fatigue, and the distance walked in the 6 min walk test (6MWT) in elderly residents of a long-stay care institution.

METHODS

A cross-sectional observational study was conducted with a convenience sample of 17 elderly residents in an LSCI located in the State of Espírito Santo, Brazil, in 2018. The project was approved by the Research Ethics Committee of the Health Sciences Center of the Federal University of Espírito Santo (CCS-UFES) (CAAE: 17544313.2.0000.5060, opinion n° 494.084) and conducted in accordance principles that guide research with human beings of the Declaration of Helsinki and the research integrity recommendations of the Hong Kong Principles. The research followed resolution 466/2012 of the National Research Ethics Committee (CONEP), complemented by resolution CNS 510/2016. Elderly people living in a long-stay care institution who agreed to participate voluntarily in the research were included in the study. Those at the peak of their severe cardiopulmonary disease, with sequelae of neurological diseases, who did not walk, presented some restriction in performing some of the tests, or difficulty in understanding were excluded. After signing the informed consent form, all the individuals were submitted to anamnesis (identification and sociodemographic data) and physical examination [mass, height, and waist-hip ratio (WHR)]. Additionally, 6MWD, HGS, and the perception of fatigue were evaluated.

The 6MWT is a clinical assessment performed using a submaximal effort that estimates the functional capacity of patients by measuring the 6MWD on a flat corridor for a period of 6 minutes¹⁵. The test is simple, reproducible, reliable, and requires low-cost equipment¹⁶. Regarding the interpretation of the 6MWT data, the main measurement is the 6MWD. The result obtained from this distance must be compared to the predicted value for the patient, which considers the sex, age, height, weight, and HGS. Two reference equations were employed to determine the predicted 6MWD of the elderly living in a long-stay care institution. Predicted 6MWD 1 = $299.296 - (2.728 \times \text{age}) - (2.160 \times \text{weight (kg)}) + (361.731 \times \text{height (cm)}) + (56.38 \times \text{sex})$ and Predicted 6MWD 2 = $109.764 - (1.794 \times \text{age}) - (2.383 \times \text{weight (kg)}) + (423.110 \times \text{height (cm)}) + (2.422 \times \text{HGS (kg)})$ ^{17,18}.

The HGS estimates the global physical strength, besides being used to detect other health outcomes, especially in the elderly¹⁹. The HGS was evaluated with

a portable palmar grip dynamometer, with a graduation scale from 0 to 100 kgf. The test to evaluate the HGS was performed three times in both upper limbs, followed by an interval of ten seconds between each execution, and the measurement with the highest value was considered²⁰.

Fatigue perception was assessed by the Chalder Fatigue Scale (CFS). It contained 11 questions about fatigue symptoms. It is a Likert-type scale, with scores ranging from 0 to 3 for each item, related to symptom intensity, and its calculation is performed in a bimodal score, where values zero and one are considered zero, and values two and three are considered one. The sum with a value greater than or equal to four characterizes fatigue²¹.

The results were expressed as mean, standard deviation, relative and absolute frequency. Graph Pad Prism 5 (San Diego, CA, USA) software was used. A test for normality, Shapiro Wilk Test, was performed. Variables that passed the normality test were treated with Student's t-test and Pearson's Correlation. Values of $p < 0.05$ were considered significant.

RESULTS

The sample was primarily composed of men; however, the mean age of women was higher. Most of the elderly individuals evaluated were single and had incomplete elementary school education (Table 1).

Table 2 shows the anthropometric variables, HGS, fatigue score, and the distance walked in the 6MWT. Height, WHR, and right and left HGS were higher in men. The scores obtained in the Chalder Fatigue Scale were not different between men and women. In both genders, the 6MWD mean was statistically lower than the values predicted by Dourado's equation (6MWD Predicted 1 and 6MWD Predicted 2)¹⁸.

During the 6MWD test, the cardiorespiratory control variables were measured before, during the third and sixth minutes, and the first minute after the end. Among all variables assessed, only the Borg's Scale Score showed a difference between the beginning and the end of the test (Table 3).

Regarding the 6MWD, it was possible to observe a significant correlation between the right and HGS, the BMI, and the apex chest expansion. Alternatively, the HGS and WHR scores obtained in the baseline chest expansion showed no significant correlation with the 6MWD (Table 4).

DISCUSSION

This study aimed to evaluate the relationship between HGS, anthropometric parameters, the perception of fatigue, and the 6MWD in elderly people living in a long-stay care institution. The 6MWD correlated positively with HGS and apex chest expansion and inversely with BMI. However, there was no correlation of the 6MWD with the Chalder Fatigue Score and Waist-hip ratio.

The mean handgrip of the evaluated elderly was below the expected, according to the reference values,

Table 1 – Sociodemographic characteristics and mean time of institutionalization of the elderly residing in a long-stay institution (LCI) (N = 17).

Features	values
Sex, n(%)	
Female	5 (29,4)
Male	12 (70,5)
Age (years), mean (\pm SD)	
Women	83 (\pm 5)
Men	72 (\pm 9)*
Marital Status, n(%)	
Single	10 (66,6)
Divorced	1 (6,6)
Widower	4 (26,6)
Education, n(%)	
Illiterate	5 (33,3)
Incomplete Primary Education	9 (60,0)
High School Complete	1 (6,6)
Institutionalization time (months), mean (\pm SD)	89 (\pm 61)

Unpaired t-test, * $p = 0.032$.

gender, and age group²². The reduction in handgrip found is corroborated by the results of another research that found a significant decrease in muscle strength, assessed by handgrip dynamometry in elderly participants of socializing groups²³. Longevity elderly people, users of Primary Health Care services, also showed a reduction in the handgrip predicted for their age²⁴. The reduction in strength associated with aging is well described in the literature and occurs due to the decline in physiological reserves, evidenced by the reduction in the number and size of muscle fibers, primarily type II fibers, also called fast-twitch fibers, which produce large amounts of force²⁵⁻²⁶.

The mean 6MWD of the elderly assessed in this study was considered lower than the values predicted by Dourado's Equation¹⁸. A multicenter study developed in six Brazilian homes for the aged and another conducted in a home in the Rio Grande do Sul found a similar mean 6MWD, suggesting a reduction in cardiopulmonary capacity in these elderly²⁷⁻²⁸. Additionally, the elderly living in the long-stay care institutions evaluated in the present study presented a positive correlation between HGS and 6MWD. Therefore, the higher the HGS, the greater the distance walked by the elderly in the 6MWT. With the same instruments, a study that evaluated elderly residents in a nursing home in the state of São Paulo found a moderate positive correlation between muscle strength and functional capacity²⁹. Similar to the results found in this study, another study also found a correlation between handgrip strength and 6MWD. However, the sample was composed of hypertensive individuals³⁰. Due to its strong correlation with other measures of muscle strength, HGS is considered a very accurate and reliable clinical method for estimating overall strength³¹. It is known that the gradual loss of muscle strength contributes to reducing the individual's functional performance³². Thus, it is possible to speculate that the progressive reduction of muscle

strength during aging, with substantial loss of muscle mass, is associated with a shorter walked distance on the 6MWT. Especially in the setting of the long-stay care institutions for the elderly, this association may highlight

the importance of ensuring strategies to mitigate muscle weakness and immobility since the limitations of mobility and ambulation are commonly observed in elderly residents of the long-stay care institutions³³.

Table 2 – Anthropometric variables, handgrip strength, fatigue score, and distance walked in the six-minute walk test of elderly residents in a long-stay care institution (LSCI). Values in mean ± standard deviation.

Variables	Men (n = 12)	Women (n = 5)	Total (N = 17)	p-value
Body Mass (kg)	65,0 ± 14,9	54,1 ± 9,0	62,5 ± 14,2	0,266
Height (m)	1,6 ± 0,08	1,4 ± 0,06*	1,6 ± 0,1	0,022
WHR	0,9 ± 0,06	0,8 ± 0,1*	0,9 ± 0,09	0,029
BMI (kg/m ²)	23,9 ± 4,8	25,6 ± 4,9	24,3 ± 4,7	0,605
CFS	1,8 ± 2,3	2,6 ± 2,4	2,0 ± 2,3	0,571
HGS Right (Kg/f)	24,0 ± 9,4	9,4 ± 2,6*	19,4 ± 10,5	0,012
HGS Left (Kg/f)	22,4 ± 8,9	10,0 ± 3,1*	18 ± 9,5	0,025
6MWD min (m)	297 ± 83,7	227 ± 54,8	276 ± 81,6	0,107
DTC6 Predicted 1 (m)	612 ± 42,0 ⁺	491 ± 35,4 ⁺⁺	584 ± 65,9	0,009
DTC6 Predicted 2 (m)	585 ± 46,4 [†]	479 ± 35,0 ^{*†}	561 ± 63,1	0,041

Waist-to-hip ratio (WHR), Body Mass Index (BMI), Chalder Fatigue Score (CFS), Handgrip Strength (HGS), Distance Traveled in the 6-minute Walk Test (6MWD). DTC6 Predicted 1 (Dourado): 299.296 - (2.728 vs. age) - (2.160 vs. weight) + (361.731 vs. height) + (56.386 vs. gender). DTC6 Predicted 2 (Dourado): 109.764 - (1.794 vs. age) - (2.383 vs. weight) + (423.110 vs. height) + (2.422 vs. FPM). *Unpaired t-test (men vs. women). +Pairwise t-test (DTC6min vs. DTC6 Predicted 1) and †Pairwise t-test (DTC6min vs. DTC6 Predicted 2).

Table 3 – Cardiorespiratory control variables assessed during the 6-minute walk test (6MWT) in elderly residents of a long-stay care institution (LSCI) (N = 17).

Variables	Before	3rd min	Final	1st min Rec	Δ	ΔRec
HR (bpm)	82 ± 12	89 ± 17	90 ± 15	84 ± 13	8,0 ± 3,2	6,2 ± 1,8
SatO2 (%)	96 ± 1,6	95 ± 2,5	96 ± 2,5	96 ± 1,9	-0,4 ± 0,9	-0,4 ± 0,6
Borg	1,3 ± 2,0	1,7 ± 2,5	2,7 ± 3,2*	1,8 ± 2,1	1,3 ± 1,2	0,8 ± 1,0
SBP (mmHg)	118 ± 13,6	-	-	127 ± 16,8	-	-
DBP (mmHg)	79 ± 11,9	-	-	80 ± 9,3	-	-

Heart Rate (HR), Oxygen Saturation (SatO2), Systolic (SBP) and Diastolic Blood Pressure (DBP), Third minute after the beginning of the 6MWT (3rd min), Recovery in the first minute after the end of the 6MWT (Rec 1st min), Measurement obtained by subtracting the value presented before the 6MWT and at the end of the 6MWT (Δ= Final- Before 6MWT), Measurement obtained by subtracting the value presented at Rec 1st min from the value at the end of the 6MWT. (ΔRec= Final - Rec 1st min). Paired t test, significant values *p=0.03 (Borg Scale Before 6MWT vs. Borg Scale Final).

Table 4 – Correlation between the distance walked in the 6- minutes walk test and the fatigue score, handgrip strength, waist-to-hip ratio, body mass index, chest expansion of lung apex and base in elderly residents in a long-stay care institution (LSCI) (N = 17).

Variables	DTC6	
	r	p
CFS	-0,3	0,1
HGS Right	0,6	0,008
HGS Left	0,5	0,030
WHR	-0,2	0,212
BMI	-0,6	0,010
Thoracic Expandability Apex	0,5	0,032
Base Thoracic Expandability	0,08	0,701

Distance walked in the 6 min Walk Test (6MWD), Chalder Fatigue Score (CFS), Right Hand Grip Strength (RHGS) and Left Hand Grip Strength (LHGS), Waist to Hip Ratio (WHR), Body Mass Index (BMI), Pearson Correlation (r).

The 6MWD correlated negatively with the BMI (the higher the BMI, the lower the 6MWD). Other studies, conducted with physically active elderly people, also observed an association between being overweight and the ability to perform motor activities³⁴⁻³⁶.

The study used two forms for tracking fatigue perception, the Chalder Fatigue Scale and the Borg Scale. The CFS assessed, through a questionnaire, specific aspects of physical and mental fatigue. The elderly were asked to report the subjective feeling of fatigue related to their perceptions over the past two weeks²¹. The Borg Scale assessed perceived exertion, defined as the subjective intensity of effort, tension, discomfort, or fatigue experienced during aerobic and strength physical exercises³⁷.

The elderly scored below what is indicated as physical and mental fatigue by the CFS. There was no correlation between perceived fatigue and the 6MWD. It is possible to speculate that the fatigue assessment may

have been compromised by the difficulty in understanding the questionnaire since most of the subjects had a low level of education.

Among the variables evaluated during the 6MWT, only the Borg Scale score showed statistically significant differences when compared the moment before the beginning and immediately at the end of the test. Unlike the present analysis, a study that evaluated the 6MWD in 132 individuals aged between 20 and 80 years found no difference between the Borg Score assessed at the beginning and the end of the test¹⁷.

The apex thoracic expansibility showed a positive correlation with the 6MWD. The replacement of muscle tissue by fat and the loss of lung elasticity are some changes in the respiratory and muscular systems that can hinder chest expansion with aging. A lower expansibility can cause lower pulmonary ventilation and, consequently, a loss in blood oxygenation³⁸. Thus, a deficiency in the respiratory system components may have contributed to a limitation in the ability to perform the 6MWT.

It is important to emphasize as limitations of the research that the elderly presented systemic dysfunctions, with different causes, history, and

evolution, which generate multiple osteomyoarticular impairments and, consequently, a significant difficulty in generalizing the results found.

CONCLUSION

The handgrip strength and the distance walked on the 6MWT of the elderly assessed in this study were below the predicted values for age and sex. The decrease in HGS and 6MWD are factors that seem to be related to the reduction of submaximal physical capacity to exercise. Reduced HGS is a strong predictor of cardiovascular mortality and global muscle strength decline in the elderly. The measurement of the handgrip is simple, low-cost, and can monitor the health status of elderly residents in a long-stay care institution. The 6MWT showed a moderate positive correlation with HGS and apex expansibility and a negative correlation with body mass index. In the environment as long-stay care institution for the elderly, these associations may highlight the importance of ensuring strategies to mitigate muscle weakness and immobility.

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