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RELATION BETWEEN HAND GRIP STRENGTH, LOWER LIMB FUNCTIONAL ABILITY, FUNCTIONAL MOBILITY AND DEPRESSION IN ADULTS AND ELDERLY PEOPLE

RELAÇÃO ENTRE FORÇA DE PREENSÃO PALMAR, APTIDÃO FUNCIONAL DOS MEMBROS INFERIORES, MOBILIDADE FUNCIONAL E DEPRESSÃO EM ADULTOS E IDOSOS

RELACIÓN ENTRE LA FUERZA DE PRENSIÓN MANUAL, LA APTITUD FUNCIONAL DE LAS EXTREMIDADES INFERIORES, LA MOVILIDAD FUNCIONAL Y LA DEPRESIÓN EN ADULTOS Y ANCIANOS

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ABSTRACT

Introduction: In the aging process, physiological changes occur, such as decreased muscle and bone mass, mobility, proprioceptive and sensory responses and degradation of cognitive and mental status. With the deterioration of the musculoskeletal system, the functionality of the elderly person decreases, with responsible causes, for example, the decline in the function of the lower limbs. In turn, limited mobility may trigger situations that lead to the development of depression. Our objective was to evaluate the relationship between handgrip strength, functional fitness of the lower limbs, functional mobility and depression in adults and the elderly people.

Material and Methods: Co-relational, cross-sectional and non-experimental study, with a sample of 72 subjects aged between 55 and 96 years-old (76.92±11.78). Handgrip strength, functional fitness of the lower limbs (30-Second Chair Stand Test), functional mobility (TUG) and depression were evaluated using the 4-item Geriatric Depression Scale.

Results: A moderate negative association was found between the handgrip strength and the TUG (r_s=-0.488) (p=0.000) and also between the TUG and the 30-Second Chair Stand Test (r_s= 0.632) (p=0.000) and a low association between the handgrip strength and the 30-Second Chair Stand Test (r_s=0.328) (p=0.005). No correlations with statistical significance with the Geriatric Depression Scale.

Conclusion: It is concluded that the decrease in muscle strength of the upper and lower limbs is associated with the decline in functional mobility.

Keywords: Aging; Depression; Mobility Limitation; Muscular Strength; Physical Functional Performance.

RESUMO

Introdução: No processo de envelhecimento ocorrem alterações fisiológicas, como a diminuição da massa muscular e óssea, da mobilidade, das respostas propriocetivas e sensoriais e a degradação do estado cognitivo e mental. Com a deterioração do sistema músculo-esquelético, a funcionalidade do idoso diminui, tendo como causas responsáveis, por exemplo, o declínio da função dos membros inferiores. Por sua vez, a limitação da mobilidade poderá desencadear situações propensas ao desenvolvimento da depressão. O objetivo foi avaliar a relação entre força de preensão palmar, aptidão funcional dos membros inferiores, mobilidade funcional e depressão em adultos e idosos.

Material e Métodos: Estudo correlacional, transversal e não experimental, com uma amos-

tra de 72 sujeitos com idades entre os 55 e 96 anos (76,92±11,78). Avaliou-se a FPP, a aptidão funcional dos membros inferiores (*30-Second Chair Stand Test*), a mobilidade funcional (TUG) e a depressão com a Escala de Depressão Geriátrica de 4 itens.

Resultados: Foi encontrada uma associação negativa moderada entre a FPP e o TUG (r_s=-0,488) (p=0,000) e também entre o TUG e o *30-Second Chair Stand Test* (r_s=0,632) (p=0,000) e uma associação baixa entre a FPP e o *30-Second Chair Stand Test* (r_s=0,328) (p=0,005). Sem correlações com significado estatístico com a Escala de Depressão Geriátrica.

Conclusão: Conclui-se que a diminuição da força muscular dos membros superiores e inferiores está associada ao declínio da mobilidade funcional.

Palavras-chave: Depressão; Desempenho Físico Funcional; Envelhecimento; Força Muscular; Limitação da Mobilidade.

RESUMEN

Introducción: En el proceso de envejecimiento, se producen cambios fisiológicos, como disminución de la masa muscular y ósea, movilidad, respuestas propioceptivas y sensoriales y degradación del estado cognitivo y mental. Con el deterioro del sistema musculoesquelético, la funcionalidad de las personas mayores disminuye, con causas responsables, por ejemplo, la disminución de la función de las extremidades inferiores. A su vez, la movilidad limitada puede desencadenar situaciones que conducen al desarrollo de la depresión. El objetivo era evaluar la relación entre la fuerza de agarre, la aptitud funcional de las extremidades inferiores, la movilidad funcional y la depresión en los adultos y los mayores.

Material y Métodos: Estudio correlacional, transversal y no experimental, con una muestra de 72 sujetos de edades comprendidas entre 55 y 96 años (76,92±11,78). La fuerza de agarre, la aptitud funcional de las extremidades inferiores (*30-Second Chair Stand Test*), la movilidad funcional (TUG) y la depresión se evaluaron mediante la Escala de Depresión Geriátrica de 4 ítems.

Resultados: Se encontró una asociación negativa moderada entre la fuerza de agarre y el TUG (r_s=-0,488) (p=0,000) y también entre el TUG y el *30-Second Chair Stand Test* (r_s=0,632) (p=0.000) y un valor bajo asociación entre la fuerza de agarre y el *30-Second Chair Stand Test* (r_s=0,328) (p=0,005). No hay correlaciones con significación estadística con la Escala de Depresión Geriátrica.

Conclusión: Se concluye que la disminución en la fuerza muscular de las extremidades superiores e inferiores se asocia con la disminución de la movilidad funcional.

Descriptores: Depresión; Envejecimiento; Fuerza Muscular; Rendimiento Físico Funcional; Limitación de la Movilidad.

INTRODUCTION

The increase in average life expectancy is a global reality that has been reflected in an increasingly aging population. Aging is characterized by physiological, morphological, biochemical and psychological changes[1]. One of the most affected systems is the musculoskeletal system, which changes gradually and acquires its own characteristics, mainly the loss of muscle mass, muscle strength and bone mass making the elderly people more susceptible to the development of limitations and disabilities[2].

A measure strongly correlated with muscular strength and promising for the assessment of physical function is the hand grip strength (HGS), which represents the maximum voluntary force that the hand can produce[3]. This correlates negatively with advancing age and in a positive way with the circumference of the wrist, the size of the palm and with the muscle mass of the arm. Other factors that can interfere with the strength performed are the body mass index (BMI), the individual's height and the position of the elbow and wrist[3].

According to a study that intended to describe the PGF values of the Portuguese population aged 65 or older, concluded that the values obtained are lower (<16 kg in women and <26 kg in men) compared to other countries, being associated muscle weakness and limited mobility[4].

Deterioration of the musculoskeletal system is one of the main causes of decreased functionality[5]. These changes are responsible for one of the most common problems in the elderly population, falls. Approximately 30% of the elderly population aged 65 and over fall at least once a year and about 15% fall two or more times a year[6]. An important risk factor associated with falls in the older adults is the decrease in the function of the lower limbs, resulting, for example, in the reduction of gait speed and in the reduction of balance, which may lead to decreased mobility and the subjects' dependence[7].

In turn, decreased mobility leads to restricted activities, social isolation, declining health, increased institutionalization and increased predisposition to the development of depression[8]. Currently, it is estimated that around 350 million people are affected by depression and according to the World Health Organization (WHO) it is predicted that in 2020 it will be the third leading cause of disability in the world[9]. Depression is defined as a heterogeneous disease characterized by bad mood, loss of interest and pleasure in normally pleasant activities, loss of energy, difficulty in thinking and making decisions, disorders of appetite and sleep, psychomotor disorders and thoughts of suicide[10].

A cohort study showed that patients with depressive symptoms and with lower hand grip strength (HGS) or who experienced physical deficits remained in a depressed state for several years. This suggests that lower handgrip strength may be associated with decreased subjects' mental health[11]. Another study demonstrated that the restriction of activities of daily living is associated with increased levels of depression in the elderly people who have impaired functionality[12].

The present study aimed to evaluate the relation between handgrip strength, functional fitness of the lower limbs, functional mobility and depression in a sample of subjects aged 55 years-old or older.

MATERIAL AND METHODS

The present study is a correlational, cross-sectional and non-experimental type, having been carried out in different districts of Portugal. The study presents a sample of convenience and probabilistic character, consisting of 72 individuals.

The sample selected included subjects aged 55 or older who agreed to participate in the study and who did not have conditions that could interfere with the tests to be performed (pain in the upper and/or lower limbs, surgeries in the upper limbs and/or lower six months, upper or lower limb prostheses, sequelae of neuro-musculoskeletal diseases and diagnosis of neuro degenerative diseases).

After the application of the sample's sociodemographic characterization form and informed consent, the necessary scales and tests were applied to the subjects.

In measuring the HGS, in kilograms, a portable Jamar dynamometer was used to measure the maximum possible muscle strength. The test was performed according to the recommendations of the American Society of Hand Therapist (ASHT) for HGS, that is, sitting in a chair without lateral supports, with the spine aligned, the elbow flexed at 90° and the wrist in a neutral position[13].

Participants were instructed to exercise maximum strength with the dominant hand alternating with the contralateral hand. In order to obtain the maximum reliability of the collected data, each subject performed the evaluation three times with a rest of approximately 60 seconds between each attempt, to overcome fatigue. With the three values obtained from the evaluation, the measurement was chosen whose value was highest for further analysis[14]: the Jamar dynamometer, which has reliability ($r>0.98$) and validity ($v>0.95$)[15].

To evaluate the functional fitness of the lower limbs, the 30-Second Chair Stand Test was performed. At the beginning of the test, the participants sat down, with the spine aligned, feet on the floor and hands on the opposite shoulder, crossing their arms. Verbal instructions were given that a count of three would elapse and when it was over, they should get up and sit down as quickly as possible, repeating the procedure during the 30 seconds of the test. The test score is the total number of times that the participant got up and sat down again during the test, being later categorized by gender and by established age intervals[16].

The 30-Second Chair Stand Test has good test-retest reliability (r=0.860.92) and was also validated against the maximum pressure test in the case of a repetition (r =0.71-0.78)[16].

To assess functional mobility, the Timed Up and Go (TUG) test was used. The time required for a subject to get up from a chair, walk 3 meters at a comfortable pace, turn, walk back to the chair and sit down again was timed. The test was performed 3 times and the best time was chosen for further analysis[17].

The TUG presents reference values divided into three age groups, namely between 60-69 years-old 8.1 seconds with an interval between 7.1-9.0 seconds, between 70-79 years-old 9.2 seconds with an interval between 8.2-10.2 seconds, and between 80-99 years-old 11.3 seconds with an interval between 10.0-12.7 seconds[17].

To evaluate Depression, the 4-item Geriatric Depression Scale was used, which is presented as a dichotomous questionnaire, with a "yes" or "no" answer, in a total of 4 questions. The score varies depending on the question, with 1 point for each answer with the uppercase option and 0 points for each lowercase answer. The total score varies between 0 and 4, with a score equal to 0 indicating absence of depression, 1 suspected depression and between 2 and 4 the subject has depression[18].

Statistical analysis was performed using the Statistical Package for the Social Sciences version 23.0 for Windows (SPSS Inc.). Descriptive statistics were applied to describe the sample variables. To determine the sample's normality, the Kolmogorov-Smirnov test (n>30) was used, in which it was concluded that the variables HGS, TUG and 30-Second Chair Stand Test do not present a normal distribution. Thus, to assess the correlations between the variables, Spearman's Correlation was used. The level of statistical significance adopted was $p<0.05$.

RESULTS

The study sample consists of 72 subjects who are mostly female (69.4%), with an average age of 76.92±11.78 years. Of the sample, 52.8% of the subjects are institutionalized in day care centers or homes and 47.2% are inserted in the community. Regarding falls in the last 6 months, the subjects had an average of 0.72±1.37 falls.

Table 1 – Sample characterization – continuous variables.

	n	Minimum | Maximum	Mean and standard deviation
Age	72	55 | 96	76.92±11.78
Weight (kilograms)	72	47.1 | 104	70.45±12.68
Height (meters)	72	1.31 | 1.77	1.59±0.09
BMI	72	19.57 | 45.61	27.78±4.86
Literary abilities (years of schooling)	72	0 | 16	5.43±3.98
Falls in the last 6 months	72	0 | 6	0.72±1.37

Regarding the assessment of the hand grip strength, they present an overall average of 16.69±7.22 kg, with an average of 14.48±5.21 kg in women and 21.73±8.66kg in men. In the age group from 55 to 64 years-old an average of 24.07±8.60 kg was obtained, from 65 to 79 years-old it was 17.55±5.46 kg and in the age group aged 80 or older it is 13.00±4.65 kg.

In the TUG the sample has a global average of 11.76±5.63s, with an average of 7.95±1.32s from 55 to 64 years-old, from 65 to 79 years-old an average of 11.37±6.58s and aged 80 or older, 13.65±5.33s were obtained.

In the 30-Second Chair Stand Test, the participants have a global average of 11.26±3.73 repetitions, with an average of 14.40±3.11 repetitions from 55 to 64, from 65 to 79 years--old of 11.68±3.30 repetitions and aged 80 or older was 9.66±3.34 repetitions.

Table 2 – Descriptive analysis of measurement instruments.

	n	Minimum | Maximum	Mean and standard deviation
HGS (kg)	72	6.00 | 42.00	16.69±7.22
TUG (seconds)	72	5.72 | 36.10	11.76±5.63
30 Second Chair Stand Test (repetitions)	72	0.00 | 20.00	11.26±3.73

In the descriptive analysis of the 4-item Geriatric Depression Scale, it is observed that 33.3% of the sample obtained 0 points, with no signs of depression, 31.9% had 1 point, with suspected depression, 20.8% obtained 2 points, 6.9% have a score of 3 points and 6.9% have a score of 4 points, with the last three levels showing depression. Stratified by age groups, from 55 to 64 years-old 26.7% of the subjects have presented depression, and from 65 to 79 years-old it increases to 50% and with age equal to or above 80 years-old, it decreases to 28.6% the subjects who present depression.

Table 3 – Descriptive analysis of the 4-item Geriatric Depression Scale.

	Frequency	Percentage (%)
0	24	33.3
1	23	31.9
2	15	20.8
3	5	6.9
4	5	6.9
Total	72	100

Based on Spearman's correlations, there was a moderate negative association between hand grip strength and Timed Up and Go (r_s=-0.488) (p=0.000), a low association (r_s=0.328) (p=0.005) between the HGS and the 30-Second Chair Stand Test and a moderate negative association (r_s=-0.632) (p=0.000) between the TUG and the 30-Second Chair Stand Test.

Table 4 – Correlations between HGS, TUG and 30-Second Chair Stand Test.

		HGS	TUG	30-Second Chair Stand Test
HGS	Co-relation Coefficient	1.000	-.488**	.328**
	Sig (bilateral)	.	.000	.005
TUG	Co-relation Coefficient	-.488**	1.000	-.632**
	Sig. (bilateral)	.000	.	.000
	Sig. (bilateral)	.005	.000	.

Note: **. The correlation is significant at the 0.01 level (bilateral).

DISCUSSION

Throughout life there is a clear difference in HGS between genders; men have higher values. The mean HGS results of the present study are the same as the data from the published study on the Portuguese population aged 65 or older, in which values of less than 16 kg in women and less than 26 kg in men were concluded[4]. Studies show that the differences between genders are due to neuromuscular activation, changes in muscle temperature induced by hormones, differences in blood flow, in muscle dimensions and by lower resistance to fatigue[19].

Regarding the mobility of the elderly people assessed by the TUG, the results stratified by age groups showed that the older adults aged 60 to 69 performed an average of 7.39±1.80 seconds, while the literature standardizes 8.1 seconds (7.1-9.0 seconds), from 70 to 79 obtained an average of 11.78±6.77 seconds, waiting for 9.2 seconds (8.2-10.2 seconds) and between 80 and 99 years-old, 13.65±5.33 seconds, unlike the 11.3 seconds (10.0-12.7 seconds) that the literature references. Therefore, it is possible to conclude that only individuals between 60 and 69 years-old had a good level of functional mobility, since the remaining sample exceeded the thresholds established by the evidence[17]. This variation in the execution time of the TUG can be explained by the difference in the number of individuals in each age group, by the large number of subjects of higher age groups in a situation of institutionalization and by the different conditions related to the wear of the shoes, the floor, the chair seat height and the high number of institutio-nalized subjects[20-21].

However, as expected, the mobility of elderly people aged 60-69 was significantly better than that of elderly people aged 80 and older. These results corroborate the study by Almeida *et al* and Ferrantin *et al* who demonstrated that as age increases, the results of TUG also increase[20].

The 30-Second Chair Stand Test, since it is an indicator of the functional fitness of the lower limbs, is fundamental to be considered, since the decrease in the functionality of the lower limbs is a predictor of the increase in the number of falls[16]. In the present study, comparing the average of falls in the last 6 months with the average of repetitions in the 30-Second Chair Stand Test by age group, it was found that subjects from 55 to 64 years-old had an average of 0.07±0.26 falls and 14.40±3.11 repetitions, from 65 to 79 years-old an average of 1.00±1.41 falls and 11.68±3.30 repetitions and subjects aged 80 or older have 0.83±1.54 average falls and 9.66±3.34 repetitions, resulting in a greater number of falls also indicating a lower number of repetitions in the 30-Second Chair Stand Test.

Regarding the evaluation of depression, it is observed that 34.6% of the sample has depression. One study determined that the depressive symptoms observed in old age are mostly related to advancing age, female gender, living alone, divorce, low education, functional disorders, physical illnesses, cognitive impairment, tobacco and alcohol consumption, economic problems and institutionalization. These risk factors are in line with some of the characteristics of the study participants[22].

Analyzing the study correlations, it is observed that subjects with higher HGS values need less time to perform the TUG and, consequently, have better mobility. Several studies have shown a close relation between decreased muscle strength and functional decline, which increases the incidence of disabilities and the risk of mortality[23].

Regarding the association between the HGS and the 30-Second Chair Stand Test it was found that a greater hand grip strength is associated with a greater number of repetitions in the 30-Second Chair Stand Test. Studies have been demonstrating that a lower hand grip strength is related to frailty, increasing the functional decline and the risk of falls, corroborating the association presented[16].

Regarding the correlation between the TUG and the 30-Second Chair Stand Test, it is observed that the shorter the time of the TUG, the greater the number of repetitions in the 30-Second Chair Stand Test and, consequently, a greater functional fitness of the lower limbs is a predictor of better mobility. Studies have shown that age-related muscle loss has been shown to be an important precursor to mobility impairment in the elderly people[24].

In the correlation between the Geriatric Depression Scale and the Hand Grip Strength, no association with statistical significance was obtained (r_s=-0.136) (p=0.154). However, several studies have been showing that lower hand grip strength is associated with an increased risk of mental health disorders[8].

In the analysis of the Geriatric Depression Scale, it was observed that it is in the interval between 65 and 79 years-old that there is a higher incidence of depression, although this group is not the one with the worst indicators of functionality. However, according to the literature, subjects with impaired functionality have decreased mobility and, consequently, restrictions in activities of daily living, which is why they develop higher levels of depression[12]. As physical health declines, mental health may continue to deteriorate. Therefore, true relations between functionality and depressive symptoms may have been masked[25].

The present study had some limitations, as the sample did not present a normal distribution and the high number of institutionalized participants. However, this high number of institutionalized participants may introduce greater variability in the sample than if it had only been collected from subjects living in the community, enhancing the analysis of the results of the correlations carried out.

CONCLUSION

It is concluded that the decrease in muscle strength at the level of the upper and lower limbs is associated with the decline in functional mobility. Thus, studies that relate variables associated with physical and psychological changes resulting from the aging process, such as hand grip strength, functional fitness of the lower limbs, functional mobility and depression in the elderly people, are fundamental to the advancement of scientific knowledge, benefiting each time plus the elderly population.

Ethical Disclosures

Conflicts of interest: The authors have no conflicts of interest to declare.

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Confidentiality of Data: The authors declare that they have followed the protocols of their work center on the publication of data from patients.

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