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Relationship between anthropometry, physical activity, and functionality of female adults and elderly women

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Abstract

The aim of this study is to analyze the relationship between physical performance, age, anthropometric variables, and the condition of physical activity in female adults and physically active elderly women. This was a cross-sectional, analytical study with 152 women, between 49 and 84 years old, participants of the Open University for the Elderly program, evaluated through age, anthropometric variables, Mini Mental State Examination, Handgrip Strength, Sit-to-Stand Test from the Ground and Chair, and International Physical Activity Questionnaire. Participants' mean age was 67.4 years, were classified as 44.4% eutrophic, 41.7% overweight and 13.9% underweight, 65.1% active and 34.9% insufficiently active. There was a weak negative correlation between the values from the Sit-to-Stand Test from the Ground when compared to age and Body Mass Index ($p < 0.001$). A weak correlation was observed between the Sit-to-Stand Test from the Ground and the Handgrip Strength. Handgrip strength was correlated with height ($p < 0.001$). Indirect strength tests in female adults and physically active elderly women were weakly related. Moreover, there was a weak correlation between global muscle strength and physical-functional capability, evaluated by the aforementioned tests, with age and BMI, in which greater age and higher BMI were correlated with lower strength and physical performance.

Keywords: Woman. Aging. Hand Strength. Physical aptitude. Physiotherapy.

INTRODUCTION

In Brazil, the elderly population exceeds that of young people in 2031[1], making preventive measures essential for this age transition, which guarantee functional independence in society. Aging is accompanied by a reduction in muscle strength and height, and an increase in body weight and in the circumference of the arm and calf[2,3].

The Body Mass Index (BMI) is a simple method adopted in the assessment of the individual's nutritional condition[4], helping to predict cardiovascular diseases, which often result in the decrease of quality of life and the increase of mortality, especially in obese individuals[5].

The joint analysis of body composition and physical activity conditions influence functionality, which may reflect on mobility, activities of daily living (ADLs) and quality of life[6]. Inciting the need for strategies that keep the individual functional and reduce the effects of senescence, such as the practice of physical activity.

The practice of activities such as water aerobics, weight training, among others, is effective in improving balance[7], functional capability[8],

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quality of life, controlling depression and anxiety[9], and muscle strength, which is considered fundamental in maintaining life at any age[10,11].

Thus, assessment measures of muscle strength are necessary, which can be indicated by the Handgrip Strength Test (HGS)[12]. HGS can be related to physical fitness and functional capability tests[13,14], such as the Sit-to-Stand Test (SST), which indirectly assesses the strength of the lower limb muscles, the ability to perform activities of daily living independently through the action of sitting and standing[15].

Therefore, the study of indirect strength tests is essential, due to its rapid and low-risk application, aiming at the development of preventive measures and therapeutic treatments, which accompany the accelerated growth of the elderly population. Therefore, the aim of the study was to analyze the relationship between HGS, SST and the variables age, nutritional condition, weight, height and level of physical activity.

MATERIAL AND METHODS

This was an analytical cross-sectional study, carried out at the Movement's Laboratory Dr. Cláudio de Almeida Borges, State University of Goiás (UEG) - ESEFFEGO. Sample of 152 women from Open University for the Elderly – UEG, stratified into female adults (49 - 64 years, n = 52) and elderly women (> 65 years, n = 100) according to the World Health Organization (WHO)[16].

The sample calculation for tests to compare means between independent samples was performed using an online calculator[17], with reference to the study by Caporrino, *et al.* 1998[18], considering a standard deviation of 7.5 kg for handgrip strength, an acceptable difference of 5 kg, power of 80%, and alpha error of 5%. Thus, the minimum sample was 36 women in each group, totaling 72 women.

Women aged 49 and over were included, with a score greater than or equal to 13, considering the influence of schooling on the Mini-Mental (MMSE)[19], who agreed to participate in the research through the informed consent form (ICF). Excluding those who used prostheses (partial, total or endoprosthesis) of the lower limbs, they reported a state of acute crises of vertigo syndromes close to the evaluation date and consumed alcohol up to 24 hours before the evaluations were performed.

The collections were carried out in the morning, obtaining data on age, date of birth, sex, weight, height, body mass index, type of physical activity, frequency and time of practice in months and manual dominance[20].

BMI is calculated by dividing weight by height squared[21], classifying it as underweight (< 22 kg/m^2), normal weight (22 - 27 kg/m^2) and overweight (> 27 kg/m^2)[22].

The MMSE, a questionnaire with eleven questions about cognition, detects cognitive losses whose maximum score is 30 points[19]. Higher values indicate greater cognitive performance.

The Jamar® dynamometer quantified HGS, according to the protocol of the American Society of Hand Therapists – ASHT[23]. Three grip measurements were performed with a 30-second rest between measurements and verbal encouragement, with the grip adjusted for each participant.

The SST ground quantified how many assistive devices the subject used to sit and stand from the ground, assigning independent scores for sitting and standing[24]. The maximum score is 5 for each action, losing one point for using assistive devices or half a point for noticeable

imbalance.

The SST chair analyzed the maximum number of sitting-standing repetitions from a chair in 30 seconds, without the use of the upper limbs as an aid[25], classifying them as dependent on performing ADLs with up to 9 repetitions.

The international physical activity questionnaire (IPAQ) quantified the period of physical activity practiced, with 27 questions about the practice of physical activities, obtaining the frequency of maintenance of physical activity during the week[26], the women were grouped into two groups: insufficiently active or physically active (combining the active and very active categories). The type of physical activity practiced was also collected, the options being: gymnastics, walking, weight training, Pilates, water aerobics, volleyball and other unspecified activities.

Characterization variables (age, weight, height, MMSE, BMI, and physical activity condition) and functional tests (SST ground and chair and HGS) were described according to mean, standard deviation, minimum and maximum values, frequency, and percentage. The normality and homogeneity of the data were tested using the Shapiro-Wilk and Levene tests, the comparison between the tests and the characterization data was performed using the ANOVA and the Student's t test, using the Bonferroni post hoc test when necessary. Correlations were performed using Pearson's test. For non-parametric data, the Kruskal-Wallis Test was adopted. Data were analyzed using the IBM SPSS Statistics 20 software, with a significance level of $p < 0.05$.

It was approved by the Ethics Committee of the Federal University of Goiás, under opinion letter 3.646.405/2019. The Informed Consent Form was signed by the participants.

RESULTS

The 152 women in the study had no cognitive impairment, they were stratified according to age into adults (n = 52), with a mean age of 59.4 years, and elderly (n = 100) with a mean of 71.55 years.

Among the adult's group, 96.2% were right-handed and 3.8% left-handed, 46.1% eutrophic, 38.4% overweight and the remainder underweight, 48.1% practiced water aerobics, 23.1% weight training, 15.2% walking, 13.4% gymnastics, 9.6% Pilates, 1.9% volleyball, and 3.8% other activities. 68.6% were classified as physically active and 31.4% as insufficiently active.

The elderly group consisted of 95% right-handed and 5% left-handed, 43.3% eutrophic, 43.3% overweight and 13.1% underweight, 63% were water aerobics practitioners, 30% gymnastics, 28% weight training, 21% Pilates, 16% walking, 2% volleyball and 3% other activities. 62.2% were classified as physically active and 37.7% as insufficiently active.

In strength tests, the average HGS of the right and left hand was higher in the adult's group, respectively 24.9 and 23.9, when compared to the elderly, with an average of 23.3 and 22.3. There was also a higher SST ground score among adults, with a mean of 3.3 in sitting and 2.52 in standing, when compared to the elderly, with a mean of 2.49 for sitting and 1.60 for standing. In the SST chair the average of repetitions for the adults was 11.62, with 86.5% of those classified as independent in the ADLs and 13.5% dependent, while for the elderly the average was 11.22 repetitions, with 81% considered independent in ADLs and 19% dependent.

The characterization of age groups is shown

in Table I.

Right and left HGS showed a weak positive correlation with weight and SST ground for standing, weak negative correlation with age and time of activity in months and moderate positive correlation with height, as shown in Table II. Moreover, a strong correlation was obtained between the strength of the right and left hands, with a coefficient of 0.815 ($p < 0.001$).

The SST ground showed a weak negative correlation with age ($p < 0.001$), with a higher mean score for adults in sitting (3.30) and standing (2.52) when compared to the elderly group who obtained 2.49 for sitting and 1.6 for standing, there was a weak negative relationship with BMI, in which the underweight group (n = 21) had a higher mean score for sitting (3.48) and standing (2.40) when compared to the overweight group (n = 63), with a mean score of 2.40 and 2.07, respectively, and a weak negative relationship with weight ($p < 0.001$).

The SST for standing established a weak negative relationship with the time of activity in months ($p = 0.011$). There was a strong positive correlation between sitting and standing from the ground, with a coefficient of 0.663 ($p < 0.001$). It is noteworthy that in standing none of the groups reached the maximum score.

The SST chair was correlated only with the SST ground, assuming a weak positive correlation with both standing ($p = 0.002$) and sitting ($p < 0.001$).

Table II shows the correlations between the functional tests and the characterization variables, with the p and F values and the correlation coefficient.

Table 1 – Characterization of the sample regarding variables age, weight, height, BMI, physical activity, MMSE, muscle strength tests, and comparison of results between age groups (n = 152). Goiania, GO, 2019.

Characterization variables	General values (n=152)	Adult group (n=52)	Elderly group (n=100)	p value	F Value
	Mn ± SD (Min-Max)	Mn ± SD	Mn ± SD		
Age (in years)	67.4 ± 7.25 (49-84)	59.4 ± 3.7	71.55 ± 4.8	< 0.001	5.319
Weight (in Kg)	65 ± 11.3 (41-115)	65.3 ± 9.9	64.9 ± 12	0.857	1.149
Height (in meters)	1.56 ± 0.07 (1,35-1.75)	1.6 ± 0.1	1.55 ± 0.07	0.281	0.005
BMI (in kg/m2)	26.75 ± 4.3 (18.9- 41.7)	26.6 ± 3.8	26.9 ± 4.5	0.685	0.672
Activity time (in months)	50.95 ± 61.45 (0-348)	19.73 ± 23.98	67.35 ± 68.5	< 0.001	30.549
MMSE (score)	27.09 ± 3.26 (15-30)	27.3 ± 3.3	27 ± 3.2	0.627	0.062
RHGS (in Kgf)	23.8 ± 5.1 (12 - 46)	24.9 ± 5	23.3 ± 5.1	0.066	0.049
LHGS (in Kgf)	22.85 ± 5 (10 - 36)	23.9 ± 5	22.3 ± 4.96	0.071	0.000
SST ground sit (score)	2.16 ± 1.25 (0-5)	3.3 ± 1.21	2.49 ± 1.19	< 0.001	0.005
SST ground stand (score)	1.91 ± 1.26 (0-5)	2.52 ± 1.26	1.60 ± 1.15	< 0.001	0.214
SST chair (repeats)	11.36 ± 2.73 (0-20)	11.62 ± 2.87	11.22 ± 2.65	0.399	0.040

Mn – mean; SD – standard deviation; Min - minimum value; Max – maximum value; MMSE- Mini Mental State Examination; RHGS – right handgrip strength; LHGS – left handgrip strength.

Table 2 – Significant correlations between indirect strength tests and sample characterization variables (n=152). Goiania, GO, 2019.

Functional tests	Comparison variables	Correlation coefficient (r)	p Value	F Value
RHGS	Age in years	-0.235	0.004	1.766
	Weight	0.257	0.001	1.951
	Height	0.483	< 0.001	3.074
	Activity time in months	-0.214	0.008	2.430
	SST ground stand	0.279	0.001	1.376
LHGS	Age in years	-0.194	0.017	0.969
	Weight	0.309	< 0.001	1.704
	Height	0.490	< 0.001	3.165
	Activity time in months	-0.170	0.037	0.727
	SST ground stand	0.223	0.006	1.022
SST ground sit	Age in years	-0.303	< 0.001	2.785
	Weight	-0.289	< 0.001	4.468
	BMI	-0.327	< 0.001	3.507
SST ground stand	Age in years	-0.391	< 0.001	4.823
	Weight	-0.206	0.011	1.211
	BMI	-0.281	< 0.001	1.887
	Activity time in months	-0.206	0.011	1.162
SST chair	SST ground sit	0.289	< 0.001	1.739
	SST ground stand	0.250	0.002	1.788

RHGS – Right handgrip strength; LHGS – Left handgrip strength; p-value – significance value.

DISCUSSION

The study identified weak relationships between clinical tests, SST ground and chair and the level of muscle strength, considering female adults and physically active elderly women. Therefore, women, according to the physically active age spectrum of the sample, showed weak relationship between age and physical-functional capability, based on verification by indirect tests.

Moura *et al.*[27], in an analysis of HGS throughout human development, found mean values slightly lower than those of the present sample, for the middle-aged and elderly age groups. Costa *et al.*[28], observed a negative correlation between age and HGS of elderly women, suggesting a decline in strength with advancing age, corroborating the present study.

The loss of muscle strength is proportional to advancing age and stems from a multifactorial process that encompasses hormonal, genetic, metabolic and lifestyle factors[29], which would justify variations in strength among people in the same age group.

Lower limb muscle strength can also be affected by age, as observed through the SST, in which elderly women need more support when compared to adults, Melo *et al.*[30], in a similar study with women from UNATI, observed higher scores for female adults than for elderly women. This correlation is due to the decrease in lower limb muscle strength, ba-

lance and mobility with advancing age, and the need for these components in daily activities[31].

Losses in muscle strength and physical capability are commonly accompanied by an increase in body fat, especially in the abdominal region, and a decrease in lean body mass, which aligns with the prevalence of overweight and obesity in the sample groups up to 70 years of age[32].

When analyzing the BMI, both age groups presented mean values above 40% for overweight, and that excess weight had a negative influence on the physical capability of women. Corroborating with Ricardo and Araújo[33], who evaluated individuals between 18 and 88 years old, observing that women with higher BMI obtained lower scores in the SST ground.

Excess weight is considered a public health problem and is related to loss of autonomy and quality of life, limiting mobility, resistance and muscle power, consequently interfering with the performance of ADLs, being demonstrated in the decrease of performance in functional tests by individuals with overweight and obesity[34].

The practice of physical activity is considered effective in the decrease of body weight and functional improvement, however, in the present study, IPAQ did not establish correlations and the time of physical activity established weak correlations with the functional tests, in dissonance with the literature, which shows the benefits of physical exercise in cognition, quality of life, muscle strength gain and autonomy[35].

It is believed that the lack of control over assiduity, specificity and intensity of physical training performed by the sample influenced the behavior of the variables, since women are not individually oriented about their training. This fact reiterates the importance of specialized professional monitoring in the provision of health care for this population[36].

There was a weak correlation between SST ground and HGS, in line with a study by Puerro Neto and Brito[37] with active elderly women. The relationship between muscle strength, physical capability and fitness demonstrates an impact of muscle strength on the functional performance of daily tasks. The SST ground and chair obtained a positive correlation, since both are adopted in the characterization of mobility and physical capability[38].

Brazilian society is going through an important population aging process, which demands public actions at all levels of health care, to implement strategies that reduce the deleterious effects of senescence.

Finally, it is suggested that future studies collect data with dynamometers, adding time until reaching peak levels and the evaluation of fatigue for broader and more detailed results, in addition to the use of the WHO criteria for classification of the level of physical activity due to its more objective character compared to the IPAQ, which depends on biased memory.

CONCLUSION

The Handgrip Strength Test and the Sit-to-Stand Test from the ground between female adults and physically active elderly women were weakly related, a weak relationship was also found between overall muscle strength and physical-functional capability of the elderly women, analyzed through indirect force tests.

CRediT author statement

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All authors have read and agreed to the published version of the manuscript.

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