ORIGINAL ARTICLE

https://doi.org/10.6063/motricidade.23834

Age-related sarcopenia index and functional capacity in elderly community members: a correlational study

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ABSTRACT

Sarcopenia affects performance in simple activities of daily life, directly impacting the quality of life of the elderly. The objective of the present study was to analyse the correlation between age, sarcopenia index and functional capacity in community-dwelling elderly. The sample comprised 40 community-dwelling elderly, 12 men (69.16± 8.13 years) and 28 women (67.96± 6.23 years). All participants underwent the Electrical Bioimpedance (BIA), Handgrip Strength test (HS), and Timed-Up-and-Go test (TUG). A strong correlation was found between age x TUG in men (r= 0.733; p= 0.021), between age x fat mass in women (r= 0.775; p= 0.032), between HS and TUG in men (r= − 0.713; p= 0.0003), and a weak correlation between HS and Free Fat Mass in women (r= 0.394; p= 0.043). Weak negative correlations were found regarding age in both men and women. In functional performance, concerning test time and age, strong correlations were found for men and weak correlations for women.

KEYWORDS: physical performance; ageing; strength.

INTRODUCTION

The process of world population ageing in recent decades has been treated by many as alarm and concern, particularly in developed countries. Brazil is a model of this affirmation, since the elderly population aged 60 and over grew by 16% between 2012 and 2016, reaching 29.6 million people according to data from the National Household Sample Survey of the Brazilian Institute of Geography and Statistics (IBGE, 2016). This makes various studies on ageing one of the main points encouraged by social, government and medical actors in general.

Among several disorders affecting ageing, sarcopenia has particular attention, since it is a syndrome characterised by loss of strength, quality and quantity of muscle and physical performance (Cruz-Jentoft et al., 2019). In addition, it is accompanied by adversities such as physical disability, risk of falls, poor quality of life, limitations in activities of daily life, increased risk of premature death and even negative outcomes during hospitalisation (Tzeng et al., 2020). Data presented by Martinez et al. (2014), shows that the prevalence of sarcopenia in the world varies between 3 and 30% in elderly community members, and in Brazil, in 2012, with older people over 60, it was found that 36.1% had reduced muscle mass.

With the approach of ageing, there is a reduction in physical abilities, causing impairment of daily activities,

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Conflict of interests: nothing to declare. Funding: nothing to declare.
Received: 03/02/2021. Accepted: 03/14/2022.

followed by adverse diseases that affect the quality of life and may lead to social isolation and depression (Costa et al., 2018). Quality of life is related to self-esteem and personal well-being and encompasses a number of aspects such as functional capacity, socio-economic level, emotional state, social interaction, intellectual activity, self-care, family support, health status itself, cultural, ethical and religious values, lifestyle, job satisfaction and/or daily activities and the environment (Vecchia et al., 2005). Quality of life can also be associated with three relevant principles: functional capacity, socioeconomic level and satisfaction, in addition, it can be associated with other elements: self-protection of health, economic situation, emotional state, physical capacity, social interaction and intellectual activity (Santos et al., 2002).

Therefore, we know that degenerative diseases, such as sarcopenia, affect performance in simple activities of daily life, directly impacting the quality of life of the elderly. Thus, early diagnosis of sarcopenia, and verification of functional ability of participants, can be a tool for guiding strategies to identify and prevent risks associated with ageing. Therefore, the objective of this study was to verify the associations between age, sarcopenia index and functional ability in elderly community members.

METHOD

Sample

It was a descriptive, cross-sectional and correlational study. The research was conducted with older participants at the Academy of the Best Age (ABA) in Tocantinópolis (TO), Brazil. The participants were randomly selected from those who regularly participated in the physical activity programs of ABA. The ABA program is a public community space, accessed by community elders. The systematised exercise program the elderly followed was essentially 2 days/week, with multimodal activities, i.e., dynamic resistance and aerobic (walking/dancing) exercises.

The sample consisted of 40 volunteers, 12 males (69.16± 8.13 years) and 28 females (67.96± 6.23 years), all participants of AMI. The following were considered as inclusion criteria: a) individuals aged 60 years or older; b) participants who did not have physical limitations to perform the tests c) regularly enrolled and frequent in AMI. The exclusion criteria were: a) participants who did not complete the proposed tests; b) voluntary withdrawal from the research.

After the participants knew all the stages and objectives of the research, those who accepted to participate signed a Free and Informed Consent Term. All research followed the ethical precepts recommended by Resolution 466/12 of the National Health Council and was approved by the Ethics and Research Committee of the Federal University of Tocantins (UFT) with nº 3.024.560.

Instruments and procedures

Body mass and height were measured using a 0.100 kg anthropometric scale with a 0.1 cm (Whelmy®) coupled stadiometer. The measurements were performed with the participants in an anatomic position, with as little clothing as possible.

For body composition analysis, the Electric Bioimpedance (BIA) technique was used because it is an accurate and reliable method, especially due to the high speed of information processing, being a non-invasive, practical, reproducible and low-cost method. A Tetrapolar Bioimpedance Body Analyzer (Model BIA 1010, Sanny®) was used for measuring body composition parameters (fat mass in kg, fat mass in %, fat-free mass in kg and fat-free mass in %).

During the analysis of the BIA, the following procedures were adopted: a) fasting for 12 hours; b) no alcohol intake before the tests; c) no high or moderate intensity physical activity in the previous 12 hours; d) no fever on the day of the evaluation; e) be hydrated; f) no use of objects or metallic implants; g) no coffee intake before the evaluation. All the evaluations were carried out in the morning, between 6 and 8 am. The placement of four electrodes fixed in the right hemicorp of the individual being evaluated: in the hand, near the metacarpal phalangeal joint of the dorsal surface; in the wrist, between the distal prominences of the radius and ulna; in the foot, in the transverse arch of the upper surface; and in the ankle, between the medial and lateral malleoli (Letieri et al., 2019).

The skeletal muscle mass (SMM) was calculated using the equation of Lee et al. (2000) (Equation 1):

$$SMM\ (kg) = Htm * (0.244 * BM) + (7.8 * Htm) + (6.6 * sex) - (0.098 * age) + (ethnicity - 3.3) \quad (1)$$

where:
Htm= Height (m);
BM= Body Mass (kg);
Sex: 1= men e 0= women;
ethnicity: 1.2= asian; 1.4= afro-descendants; 0= caucasian.

The value of SMM was used to calculate the muscle mass index (MMI), represented by the ratio between the SMM and height, in meters, squared ($MMI = SMM/Htm^2$).

The verification of muscle quantity was according to the EWGSOP, the parameters being the values < 20 kg for men < 15 kg for women (Cruz-Jentoft et al., 2019).

To evaluate muscle strength, the Handgrip Strength (HS) test was applied using a digital manual handgrip dynamometer (E-Clear®), which shows the values of the manual handgrip force in kg. The test was performed with the individual seated, with shoulder adducted and neutrally rotated, elbow flexed at 90°, forearm in neutral position, and the wrist between 0° and 30° of extension and 0° to 15° of ulnar deviation. The mean of 3 measurements in the dominant limb was used, with an interval of 60" in each measurement (Letieri et al., 2019). The cutting parameters recommended by EWGSOP were adopted, which consider the following values as sarcopenic: < 27 kg for men < 16 kg for women (Cruz-Jentoft et al., 2019).

The physical performance was evaluated through the Timed-Up-and-Go (TUG) test, which is considered appropriate for motor function assessment in relation to mobility (Cedervall et al., 2020). This test is based on the performance of the individual being affected by the reaction time, muscle strength of the lower limbs, balance and the ability to walk (Hsu et al., 2020). The TUG was performed considering the time spent for the elderly to get up from a chair without arms and walk a distance of three meters, making a 180º turn, returning and sitting in the same chair. For TUG performance analysis, according to EWGSOP (Cruz-Jentoft et al., 2019), the values ≥ 20" as a reference for low functional performance in older people.

Statistical analysis

Initially, a descriptive analysis of the data was performed to obtain the mean and standard deviation values. The data were categorised by gender. The normality of the data was verified by the Kolmogorov-Smirnov test, and after the identification of normality, the correlations between the variables were analysed by Pearson's Correlation Coefficient (r) The magnitude of the associations was classified as follows: trivial ($r< 0.1$), small ($r= 0.1$ to 0.3), moderate ($r= 0.3$ to 0.5), strong ($r= 0.5$ to 0.7), and robust ($r= 0.7$ to 0.9) (Furtado et al., 2019). Statistical significance was 95% or $p< 0.05$. Statistical analyses were performed in the Statistical Package for the Social Sciences (SPSS) software version 23 (Armonk, NY: IBM Corp, USA).

RESULTS

In general, the prevalence of sarcopenia was 3.6% of the sample.

Table 1 presents all mean values and standard deviations of variables collected from participants, both sex.

Table 2 presents the general results of the correlations for the functional ability, body composition, skeletal muscle mass and muscle mass index variables.

DISCUSSION

In this study, although not significant, it was possible to verify a strong and inverse correlation between age and HS in men and a weak and inverse correlation in women. In a study by Dodds et al. (2016), the authors found that as age progresses, people tend to have a reduction in manual grip strength and, generally, women have weaker HS compared to men. In a systematic review study with meta-analysis, it was observed that the highest manual grip strength seems to be a

Table 1. Body composition and functional variables of participants in the Baseline.

Variables	Sex	Mean	Standard Deviation
Age (years)	M (n= 12)	69.16	8.133
	W (n= 28)	67.96	6.238
Body Mass (kg)	M (n= 12)	68.50	7.151
	W (n= 28)	65.32	9.136
Height (m)	M (n= 12)	1.61	0.045
	W (n= 28)	1.54	0.067
BMI (kg/m2)	M (n= 12)	26.29	2.906
	W (n= 28)	27.43	4.562
FFM (kg)	M (n= 12)	44.32	4.723
	W (n= 28)	38.71	3.908
FM (kg)	M (n= 12)	35.11	5.465
	W (n= 28)	40.22	5.206
FFM (%)	M (n= 12)	64.88	5.465
	W (n= 28)	59.77	5.206
FM (%)	M (n= 12)	35.11	5.465
	W (n= 28)	40.22	5.206
SMM (kg)	M (n= 12)	27.23	2.012
	W (n= 28)	19.45	2.424
MMI (kg/m2)	M (n= 12)	10.44	0.693
	W (n= 28)	8.14	1.074
TUG test (s)	M (n= 12)	6.70	1.963
	W (n= 28)	6.90	1.691
HS (kg)	M (n= 12)	29.27	5.719
	W (n= 28)	19.37	4.982

M: Men; W: Women; BMI: Body Mass Index; FFM: Free Fat Mass; FM: Fat Mass; SMM: Skeletal Muscle Mass; MMI: Muscle Mass Index; TUG: Timed-And-Up-Go; HS: Handgrip Strength.

Table 2. Correlation values of the variables.

		1	2	3	4	5	6
	AGE						
1	M	---					
	W	---					
	HS						
2	M	-0.531	---				
	W	-0.268	---				
	TUG						
3	M	0.733**	-0.713**	---			
	W	0.364	-0.322	---			
	SMM						
4	M	-0.375	0.254	-0.308	---		
	W	-0.316	0.276	0.189	---		
	MMI						
5	M	-0.064	0.081	-0.116	0.664*	---	
	W	-0.183	0.131	0.218	0.749**	---	
	FFM						
6	M	-0.247	0.146	-0.128	0.829**	0.300	---
	W	-0.121	0.394*	0.044	0.841**	0.493**	---
	FM						
7	M	0.378	-0.138	0.172	0.439	0.814**	0.38
	W	0.037	0.012	0.415*	0.795**	0.905**	0.487**

*p< 0.05; **p< 0.001; in each variable the values of (r) are expressed; M: Men; W: Women; HS: Handgrip Strength; TUG: Timed-Up-and-Go; SMM: Skeletal Muscle Mass; MMI: Muscle Mass Index; FFM: Fat Free Mass in kg; FM: Fat Mass in kg.

protective factor for the decline in cognition, mobility, functional status and mortality in elderly populations (Rijk et al., 2016). In a research conducted by Musalek and Kirchengast (2017), it was found that HS reflects a variety of indices of physical function, and this is considered an important indicator of health and quality of life in the elderly. In this way, it can be said that HS can help predict physical disability, morbidity and mortality (Sayer and Kirkwood, 2015). Cruz-Jentoft et al. (2019) state that muscle strength is a relevant predictor of poor outcomes in people with functional limitations. Thus, HS can be an important tool in clinical practice to identify subjects with poor mobility.

Regarding the physical performance verified in the TUG test associated with age, it was observed in this study a high correlation in men and weak in women. Thus, it can be stated that in the sample of the present study, participants of higher ages performed the test for the longest time. The findings of the physical performance of the participants in this study corroborate with the Soares et al. (2019) study, in which the authors state that ageing is accompanied by a natural physical decline, affecting, above all, muscle strength/mass, and age is, therefore, a significant factor in such changes. Thus, the loss of muscle mass with the ageing process is accompanied by a decrease in functional independence, especially in activities that require strength from the lower limbs, such as: sitting, lifting, walking, and going up and down stairs (Sato et al., 2020). In the study of Binotto et al. (2018), the authors point out that the reduction of walking speed in elderly communities is one of the main pillars of phenotypes of fragility that is strongly related to sarcopenia. Furthermore, a moderate and significant correlation was observed in women between fat percentage and TUG. Souza Saraiva et al. (2019) state that obese people, with reduced physical function and less independence in daily life, are more likely to have low physical performance.

Although age has been negatively correlated with SMM of participants in our study, it is important to understand that the loss of muscle mass can be caused by several factors, including diseases, decreased calorie intake, reduced blood flow to the muscles, mitochondrial dysfunction, decreased anabolic hormone levels, increased pro-inflammatory cytokines, among others. However, disuse associated with ageing is the main underlying cause (Colón et al., 2018).

The results observed between FFM and SMM showed positive correlational values. It is worth noting that elderly people with lower muscle mass tend to have a prevalence of physical disability, decreasing their fitness and physical performance, and may influence their autonomy, well-being and quality of life (Thaweechotiphat et al., 2021). In the study by Costa et al. (2018), it was pointed out the importance of physical exercise programs aimed at the elderly population, moreover, it was verified a positive association between quality of life and the practice of exercises for this group.

It is important to note that sarcopenia is a multifactorial process. The HS and TUG indicators are tools that help in the assessment of clinical practice, but other factors of aging that impact Sarcopenia should be observed, such as age, gender, geography, and individual risk factors (Moreira et al., 2019).

This study has some limitations. First, the diagnosis of sarcopenia was obtained by BIA and HS, which although it presents good sensitivity and specificity, does not measure muscle mass and strength directly, but derives an estimate of muscle mass based on the conductivity of electrical energy of the entire body, which can be influenced by the state of hydration of the patient, and is less accurate than other reference methods (gold standard) in the literature, such as double energy radiological absorption (DEXA) and isokinetic dynamometry. Secondly, the study sample was relatively small, which makes it difficult to extrapolate the results to other populations.

The main strengths of the study were based on the nature, the methods used to obtain the parameters and the ease of access to the target population. In addition, the use of the updated reference for the diagnosis and classification of sarcopenia indices may serve as an academic-scientific subsidy for future studies.

CONCLUSION

In this study, the prevalence of sarcopenia was 3.6% of the total sample. In the variable skeletal muscle mass, weak associations were verified inversely proportional to age, both in men and in women. Regarding manual grip strength, a moderate and inversely proportional association was observed in men, weak and also inversely proportional in women. In functional performance, associations between test time and age were verified, being strong in men and weak in women.

As the population ages, the need to study the factors associated with sarcopenia increases, since better and more effective prevention and treatment strategies and interventions can be developed to minimise disability and optimise the independence of the elderly, thus improving their quality of life.

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