BIOSCIENCE JOURNAL

FUNCTIONAL PERFORMANCE, NUTRITIONAL STATUS AND LEVEL OF PHYSICAL ACTIVITY OF ELDERLY

Vivianne Ramos da Cunha MUNIZ[1], Carla Cristina Carvalho Fonseca MENESES[2], Cecília Maria Resende Gonçalves de CARVALHO[3], Amanda Suellenn da Silva Santos OLIVEIRA[4], Suzana Maria Rebêlo Sampaio da PAZ[4], Marcos David Figueiredo de CARVALHO[5], Maria do Perpétuo Socorro Carvalho MARTINS[4], Daniele Martins de SOUSA[6], Ana Lina de Carvalho Cunha SALES[6], Guilherme Guarino de Moura SÁ[7], Vanessa Brito Lira de CARVALHO[4], Geovanni de Morais LIMA[8], Maria do Carmo de Carvalho e MARTINS[9]

[1]Health Foundation of Municipal Prefecture of Teresina City, Teresina, Piauí, Brazil.
[2]Health Department of Municipal Prefecture of Paulista City, Paulista, Pernambuco, Brazil.
[3]Department of Nutrition, Federal University of Piauí, Teresina, Piauí, Brazil.
[4]Postgraduate Program in Food and Nutrition, Federal University of Piauí, Teresina, Piauí, Brazil.
[5]Department of Zootechny, Federal University of Piaui, Teresina, Piauí, Brazil.
[6]Hospital of the Federal University of Piauí, Federal University of Piauí, Campus Ministro Petrônio Portela, Teresina, Piauí, Brazil.
[7]Federal Institute of Pernambuco, Campus Belo Jardim, Belo Jardim, Pernambuco, Brazil.
[8]Postgraduate Program in Pharmacology, University of São Paulo, São Paulo, Brazil.
[9]Department of Biophysics and Physiology. Federal University of Piauí. Teresina. Piauí. Brazil.

Corresponding author:
Maria do Carmo de Carvalho e Martins
carminhamartins@ufpi.edu.br

How to cite: MUNIZ, V.R.C., et al. Functional performance, nutritional status and level of physical activity of elderly. *Bioscience Journal*. 2022, **38**, e38044. https://doi.org/10.14393/BJ-v38n0a2022-55177

Abstract

The elderly is a risk group for changes in health conditions and as well as in functional performance related to the decline in grip strength and reduced walking speed, which can compromise the performance of activities of daily living. Based on this, the objective was to analyze the factors associated with functional performance in the elderly. For that, a cross-sectional study was developed involving a group of 179 elderly people who received medical care at an outpatient clinic of the public health network. Muscle strength and gait speed were measured. Nutritional status was determined by Body Mass Index (BMI), calf circumference (CC), waist circumference (WC) and waist-to-hip ratio (WHR). Level of physical activity was measured by the adapted version of the Minnesota Leisure Activities Questionnaire. Low muscle strength was found in 20.7% of the elderly and slow gait in 20.1%. Increased risk of cardiovascular disease was found in 40.8% considering WC, and 35.2% by WHR. Most of the elderly had low weight and no loss of muscle mass. Loss of muscle strength was associated with sex and CC and gait speed were associated with sex, age, and presence of a partner ($p < 0.05$). The chance of loss of muscle strength and lower gait speed was higher in elderly women. Loss of muscle mass due to CC was associated with the chance of loss of strength, and the chance of reduced walking speed was greater among the elderly individuals aged 75 years and over.

Keywords: Aged. Gait. Motor Activity. Muscle Strength. Nutritional Status.

1. Introduction

Aging is a multifactorial process characterized by biological changes resulting from diverse cellular and molecular damage, which causes a gradual loss in physiological reserves, an increased risk of acquiring diseases, and a decrease in intrinsic capacity (Seene and Kaasik 2012). The world's population is aging as an evident result of scientific and technological achievements and progress made in the twentieth century. According to the World Health Organization (WHO 2017), in 2050 there will be at about 2 billion of elderly people in the world, and according to the Brazilian Institute of Geography and Statistics (IBGE 2018), projections in Brazil show that 25.49% of individuals will be in the elderly age group by 2060. This rapid increase of people over 60 years in the population makes "aging" the subject of discussions and requires reflection and research, especially because of the natural condition of frailty of older people (Bez and Neri 2014).

The elderly faces many diseases that affect the body and mind, especially causing cognitive and metabolic decline (Raju 2018). This is because aging produces changes in the musculoskeletal system, including the decline in muscle strength and muscle mass related to sarcopeny, which can compromise the ability to carry out activities of daily living without assistance (Bez and Neri 2014). Muscle strength is a critical element to maintain functional activity in the elderly (Papa et al. 2017), since it is having an independent role in the prevention of chronic diseases (Volaklis et al. 2015).

Another component of functional performance that is influenced by age is walking speed, which is a sensitive parameter of health conditions and overall survival (Pirker and Katzenschlager 2017). In the elderly, slow gait is related to a higher occurrence of falls, which in turn is significantly associated with greater risk of morbidity and mortality (Osoba et al. 2019).

Some studies conducted in Brazil to know the living conditions of the elderly also evaluated aspects related to functional performance. Among the main ones, the Health, Well-Being, and Aging (SABE) study was carried out in urban metropolitan areas in cities of seven countries, including São Paulo in Brazil (Lebrão and Laurenti 2005). Another important study is the one of the Network for Research on Fragility in Elderly Brazilians (FIBRA), in which a descriptive population-based survey was carried out in seventeen Brazilian cities (Moretto et al. 2012).

Despite these efforts, data are still insufficient and there is a large gap as to the mechanisms involved in functional performance and in the relationship between nutritional status and level of physical activity. Moreover, as Brazil is a country of continental dimensions, more studies are needed to analyze these aspects in elderly people from different Brazilian regions to ensure the development of consistent preventive and curative actions according to local conditions. Thus, this study aimed to analyze the factors associated with the functional performance of elderly people.

2. Material and Methods

Subjects and study design

This is an observational, cross-sectional, and descriptive study with a quantitative approach, part of the research entitled "Assessment of Fragility, Psychosocial and Nutritional Aspects in an Elderly Population". Sample size was calculated considering a 95% confidence level, a tolerable error of 5%, and an expected prevalence of 50%. The number of consultations provided for elderly clients at the clinic of a health unit from January to June 2012 was 321 according to information from the Municipal Health Foundation, resulting in a minimum of 179 elderly people over the age of 65 and of both sexes.

According to recommendations of Ferrucci et al. (2004), the existence of one of the following characteristics prevented the participation in the study: medical record of severe cognitive impairment; permanent or temporary use of a wheelchair; severe sequelae of stroke, with localized loss of strength and aphasia; Parkinson's disease in an advanced stage or unstable; hearing loss or severe vision- impairemente that prevented communication.

Initially, sociodemographic variables sex, age (full years), ethnicity (Caucasian and non-Caucasian), marital status (with or without a partner), education (complete years of choolings), and family income (in minimum wages) were identified by applying a questionnaire created for this study.

Functional performance assessment

Functional performance was assessed through measure of the muscle strength and gait speed. Muscle strength was determined by handgrip strength testing in kg/force (kgf) with a Jamar dynamometer placed in the dominant hand. Measurements followed the recommendations of the American Society of Hand Therapists (Bohannon et al. 2006), with three attempts, and 1-minute interval of rest between attempts. The average value was used in the analysis. Participants whose average was below 1 fifth of the sample were considered to have low strength (Fried et al. 2004). The evaluation of gait speed considered the time in seconds spent to walk a distance of 4.6 meters at their usual pace and on a flat surface, according to recommendations of Guralnik et al. (1994) and Nakano (2007). The procedure was performed three times and the average value was used in the analysis. Participants whose average belonged to the quintile with higher values of time were considered to have slow gait (Fried et al. 2004).

Nutritional status assessment

The overall nutritional status was classified according to the body mass index (BMI), using the cutoff points established by the Pan American Health Organization (2003): underweight: BMI < 23 kg/m^2; normal weight ≥ 23 and < 28 kg/m^2; overweight ≥ 28 and < 30 kg/m^2; and obesity ≥ 30 kg/m^2. Body weight was determined using a Plena portable digital scale with a 100g resolutionand 150 kg capacity, and the elderly participants were weighed barefoot with minimum clothing (Brasil 2011). Knee height was used to estimate height based on the principle that the aging process does not affect the length of long bones of legs, making this measure the most recommended for elderly individuals, because knee height is strongly, reliably and accurately related to total height (Chumlea et al. 1985).

Calf circumference (CC) was measured using an inelastic measuring tape with an accuracy of 1 mm, placed on the largest girth of the left calf of the participant sitted on a chair with a 90-degree flexed leg (Martin et al. 2012). Waist circumference (WC) is used as an indicator of muscle changes in the elderly, being considered the most sensitive anthropometric measure to estimate muscle mass of individuals in this age group. Values lower than 31 cm were considered to indicate muscle mass loss (WHO 1995).

Waist circumference measures were used as a proxy for central adiposity, being considered the best indicator of risk for cardiovascular and metabolic diseases (Lean et al. 1996). It was measured by putting an inelastic measuring tape around the smallest circumference between the last rib and the iliac crest (Brasil 2011). The classification of this parameter was based on cutoff points defined by Lean et al. (1996), where WC is adequate or normal when < 80 cm for women and < 94 cm for men. Waist circumference is also the basis of a classificatio into two levels of action: level 1 or increased risk for obesity-associated comorbidities (WC ≥ 80 and < 88 cm for women and WC ≥ 94 and < 102 cm for men); and Level 2 or very increased risk (≥ 88 ≥ 102 for women and men). In this study, for data analysis purposes, two categories were considered: normal WC when WC values were considered normal or appropriate; and increased WC when WC values were classified into the levels 1 and 2 aforementioned.

The waist-to-hip ratio (WHR) was measured by placing an inelastic measuring tape around the hip on the area of larger diameter (Brasil 2011). This measure was used to calculate both the WHR and the WC. The result was considered normal when WHR < 0.85 for women and WHR < 1.0 for men and increased when WHR ≥ 0.85 for women and WHR ≥ 1.0 for men. The presence of central adiposity is an indicative condition of risk for developing cardiovascular and metabolic diseases (WHO 1995). All anthropometric and circumference measurements were performed three times and the average value was used in the analyses.

Physical activity level assessment

The version of the Minnesota Leisure Activities Questionnaire (Taylor et al. 1978) adapted, translated and validated for use in Brazil by Lustosa et al. (2010) of the FIBRA study was applied to assess the level of physical activity. For this, the frequency and daily duration of physical exercise on weekly basis were identified and household chores were described; then the energy expenditure of each activity (kcal/min) and the weekly caloric expenditure (kcal/week) were calculated (Taylor et al. 1978; Ainsworth et al. 2000). Elderly participants who scored below the first quintile were considered sedentary (Fried et al. 2001).

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences software (SPSS) version 20.0. Descriptive analysis (frequencies, measures of central tendency, and dispersion) were used to characterize the population. First, the Pearson's chi-square ($\chi 2$) test was applied to check the association between the loss of muscle strength and gait speed and socioeconomic variables, nutritional status, and physical activity, and odds ratios (OR) and confidence intervals were calculated. Then, in the case of loss of strength and slow gait, variables with $p < 0.20$ were selected to remain in the final model ($p <0.05$). They were: sex, monthly income, and CP in the case of loss of strength; and sex, age, marital status, and education in the case of slower gait.

Ethical aspects

The study was approved by the Research Ethics Committee (REC) of the Federal University of Piauí, with Certificate of Apresentation for Ethical Appreciation - CAAE 12171213.7.0000.5214, and the participants of the study was confirmed after their signing Informed Consent Terms.

3. Results

Of 179 elderly individuals who participated in this study, 63.7% were women. The mean age was 73.6 ± 5.66 years, and most of them were in the age group for ≤ 74 years (64.3%). Half the sample had a partner (52.5%) and 70.4% were of non-Caucasian ethnicity. There was a predominance of low level of education, where 50.3% of the participants said they had no schooling. It was also observed that 74.9% had family income below twice the minimum wage. Regarding nutritional status, low weight was more frequent (53.6%), the CC measurement showed that the majority of the elderly had no muscle loss (70.4%) and the WC and WHR measures were classified as normal in 59.2 and 64.8% of the elderly, respectively. Around half of the participants were not sedentary (54.2%) (Tables 1 and 2).

In the univariate analysis, the variables sex and CC were associated with low muscle strength ($p < 0.05$). The female sex (OR = 3.09) and the elderly with muscle loss (OR = 2.36) had a higher chance of having low muscle strength, based on CC measures (Table 1).

Table 1. Distribution parameters of low muscle strength in the sample studied according to socioeconomic and demographic characteristics, nutritional status and sedentary lifestyle.

Variable	Distribution in the sample		Low muscle strength			OR	95% CI
	N	%	n	%	p (χ^2)		
Sex							
Male	65	36.3	7	10.7	0.010	1	-
Female	114	63.7	31	27.2		3.09	1.28 - 7.51
Age range (years)							
≤74	108	64.3	22	20.4	0.729	1	-
≥ 75	71	39.7	16	22.5		1.14	0.55 – 2.35
Ethnic group							
Caucasian	53	29.6	11	20.8	0.920	1	-
Non-caucasian	126	70.4	27	21.4		1.04	0.47 – 2.29
Marital status							

With partner	94	52.5	16	17.0	0.148	1	-
Without partner	85	47.5	22	25.9		1.70	0.82 – 3.51
Schooling (years of schooling)							
0	90	50.3	23	25.6		1	-
1 to 9	73	40.8	11	15.1	0.247	0.52	0.23 – 1.15
> 9	16	8.9	4	25.0		0.97	0.28 – 3.31
*Family income (MW)***							
< 2	134	74.9	32	23.9	0.134	1	-
≥ 2	45	25.1	6	13.3		0.49	0.19 – 1.26
BMI							
Low weight	96	53.6	20	20.8		1	-
Eutrophic	67	37.4	14	20.9	0.928	1	0.46 – 2.16
Overweight/Obesity	16	8.9	4	25.0		1.27	0.37 - 4.35
Calf circumference							
No muscle loss	126	70.4	21	16.7	0.021	1	-
Muscle loss	53	29.6	17	32.1		2.36	1.12 – 4.96
Waist circumference							
Normal	106	59.2	22	20.8	0.852	1	-
Increased	73	40.8	16	21.9		1.07	0.52 – 2.22
Waist-to-hip ratio							
Normal	116	64.8	22	19.0	0.315	1	-
Increased	63	35.2	16	25.4		1.45	0.70 – 3.03
Sedentary							
No	90	54.2	15	16.7	0.259	1	-
Yes	76	45.8	18	23.7		1.55	0.72 – 3.34

* p value refers to Pearson's chi-square test
**MW = Minimum Wage (R$ 678.00)

As for the evaluation of gait speed, an association between slow gait and the variables sex, age and marital status ($p < 0.05$) was observed. Elderly females (OR = 3.51), aged ≥ 75 years (OR = 3.01) and without a partner (OR = 1.45) had a higher chance of slow gait (Table 2).

Table 2. Distribution parameters of gait speed in the sample studied according to socioeconomic and demographic characteristics, nutritional status and sedentary lifestyle.

Variable	Distribution in the sample		Gait speed			OR	95% CI
	N	%	N	%	p (χ^2)		
Sex							
Male	65	36.3	6	9.2	0.006	1	-
Female	114	63.7	30	26.3		3.51	1.38 – 8.97
Age range (years)							
≤74	108	60.3	14	13.0	0.003	1	-
≥ 75	71	39.7	22	31.0		3.01	1.42 - 6.41
Ethnic group							
Caucasian	53	29.6	10	18.9	0.788	1	-
Non-caucasian	126	70.4	26	20.6		1.11	0.50 – 2.52
Marital status							
With partner	94	52.5	12	12.8	0.010	1	-
Without partner	85	47.5	24	28.2		1.45	0.65 – 3.20
Schooling (years of schooling)							
0	90	50.3	24	26.7		1	-
1 to 9	73	40.8	11	15.1	0.065	0.49	0.22 – 1.08
> 9	16	8.9	1	6.2		0.18	0.02 – 1.46
*Family income (MW)***							
< 2	134	74.9	26	19.4	0.683	1	-
≥ 2	45	25.1	10	22.2		1.19	0.52 – 2.70
BMI							
Low weight	96	53.6	21	21.9	0.609	1	-

Eutrophic	67	37.4	11	16.4		0.70	0.31 – 1.57
Overweight/Obesity	16	8.9	4	25.0		1.19	0.35 – 4.08
Calf circumference							
No muscle loss	126	70.4	24	19.0	0.584	1	-
Muscle loss	53	29.6	12	22.6		1.24	0.57 – 2.72
Waist circumference							
Normal	106	59.2	22	20.8	0.796	1	-
Increased	73	40.8	14	19.2		0.91	0.43 – 1.91
Waist-to-hip ratio							
Normal	116	64.8	23	19.8	0.898	1	-
Increased	63	35.2	13	20.6		1.05	0.49 – 2.25
Sedentary							
No	90	54.2	14	15.6	0.359	1	-
Yes	76	45.8	16	21.0		1.45	0.65 – 3.20

* p value refers to Pearson's chi-square test
**MW = Minimum Wage (R$ 678.00)

The multivariate analysis of loss of muscle strength showed an association with the variables sex and CC ($p < 0.05$). The chance of losing muscle strength was 2.9 times higher in elderly women and 2.18 times higher in participants with muscle loss (CC) (Table 3).

Table 3. Final multivariate logistic regression model of determinants of loss of muscle strength in the elderly.

Variable	OR	95% CI	p value
Sex			
Male	1	-	
Female	2.90	1.19 – 7.10	0.020
Calf circumference			
No muscle loss	1	-	
Muscle loss	2.18	1.02 – 4.65	0.044

* p value refers to logistic regression.

The analysis of chance of slow gait showed an association with the variables sex and age group ($p < 0.05$). Female elderly individuals were 4.87 times more likely to have slow gait, while elderly individuals aged ≥ 75 years had a 2.94 times greater chance of having slow gait (Table 4).

Table 4. Final multivariable logistic regression model of determinants of gait speed in the elderly.

Variable	OR	95% CI	p value
Sex			
Male	1	-	0.002
Female	4.87	1.77 – 13.36	
Age range (years)			
≤ 74	1	-	0.001
≥ 75	2.94	1.54 – 5.62	

* p value refers to logistic regression.

4. Discussion

The frequency of elderly individuals who had reduced muscle strength was similar to that described in other studies carried out in Brazil (Pinto and Neri 2013; Lenardt et al. 2014). The same was observed for gait speed; slow gait was found to occur with a frequency of 16.9% to in an analysis in seven Brazilian cities (Pinto and Neri 2013) and 24.89% in a study with elderly people from Campinas, São Paulo, Brazil (Bez and Neri 2014).

Physiological changes resulting from aging increase the risk of slow gait, mobility and balance problems, and low grip strength among elderly people (Pinto and Neri 2013). The fact that a fifth of the elderly had loss of strength and slow gait deserves better attention in the planning of health policies geared to this population group, because such conditions make these people more susceptible to falls and fractures and prevent them from performing activities of daily living without assistance, causing a negative effect on quality of life.

In this study, elderly women were at higher chance for losing muscle strength. According to Maltais et al. (2009), this can be explained by the fact that elderly women have less body activity and an endogenous hormonal imbalance resulting from the reduction of estrogen concentrations that cause, among other changes, a decrease in muscle mass and strength.

Regarding the classification of the global nutritional status, it was observed that more than half of the elderly were underweight. A similar situation was seen by Fares et al. (2012) in their research with elderly people in Lafaiete Coutinho, Bahia, but the percentage was lower than that obtained in the present study (28.9%). However, other studies have shown conflicting results in which greater proportions of overweight and obesity were found in the elderly (Soares et al. 2012).

With aging, there is a progressive redistribution of fat and decrease of subcutaneous adipose tissue in the limbs and accumulation of intra-abdominal fat (Ponti et al. 2020). Furthermore, there is a reduction in fat-free mass, daily energy expenditure, and basal metabolic rate (Gómez-Cabello et al. 2012).

The aging process may be related to low weight (Streicher et al. 2018) because of anatomical and physiological changes such as those in the oral cavity, including loss of teeth, poorly adjusted dentures, and decreased salivary secretion. These changes can cause problems for chewing and swallowing and lead the elderly to avoid certain foods. Other changes involve the sensory aspects of taste and smell that can hinder the detection and identification of food flavors, leading the elderly to change their selection of foods (Bez and Neri 2014).

Another aspect observed in this study was the absence of muscle loss in most elderly based on CC measures. Similar results were found in other studies conducted in Brazil (Martin et al. 2012; Soares et al. 2012). It is known that advancing age is related to a progressive reduction in muscle mass and strength and in fatigue resistance, restraining the functional independence. Thus, the absence of compromissed lean mass found can be explained by the fact that most elderly participants are part of a younger age group, with ages varying from 65-74 years, and these changes have not become so evident yet.

Calf circumference is a more sensitive measure of muscle mass loss in the elderly than other circumference and skinfold measures (Hajjar et al. 2003). In this perspective, Chumlea (2006) recommends the CC as a better indicator of overall muscle mass, since more than half of the body's muscle mass is in the legs.

Considering the relationship between functional status and anthropometric measures of the elderly individuals evaluated loss of muscle mass was associated with reduced muscle strength. Similarly, Mendes et al. (2018) observed that the lower CC values were associated with low handgrip strength in a population sample of 1,500 elderly people in Portugal. The reduction in muscle strength is a significant change of aging which apparently occurs at the same time as a reduction in the size and number of muscle fibers and reduction of muscle mass during the late middle age and later years of adult age (Soares et al. 2012).

In the assessment of walking speed, there was a greater chance of slow gait among females and in elderly individuals aged ≥ 75 years. In the study by Lenardt et al. (2019), who evaluated 243 long-lived elderlies registered in Basic Health Units in a capital of the southern region of Brazil, it was also found that walking speed was higher in females, with an average age of 86.24 years. A population-based study in Brazil which evaluated 385 elderly people found that elderly people aged ≥ 75 years were more likely to have a slow gait (OR = 3.81) (Ruggero et al. 2013).

According to Pérez-Zepeda et al. (2016), age had a strong influence on gait speed, and Menz et al. (2003) reported that slower gait in older age groups can be justified by adherence to a more careful gait mode, which is probably a compensatory method for maintaining balance.

Another important aspect observed was that elderly people without a partner were at a higher chance of slow gait. In this sense, Lenardt et al. (2014) emphasize that the absence of a partner can contribute to the removal of social, productive and leisure activities, lower confidence, and greater susceptibility to functional deficiencies. In addition, not having a partner can result in paternalistic attitudes in the families of elderly people, affecting their independence and autonomy.

On the other hand, in this study, there was no association between slow gait and anthropometric variables. This can be explained by the fact that the largest number of participants in this study were in the youngest age group, 65 to 74 years, and did not present muscle loss and neither overweight/obesity.

In this study, around half of the elderly were considered active (54.2%), but there was no association between physical activity and functional performance variables. Regarding the possible relationship between physical activity, bone mineral density, muscle strength and functional capacity in the elderly, Daly et al. (2008) found that being physically active did not influence the reduction in gait speed and grip strength.

A possible justification for lack of association between the variables of functional performance and physical activity may be the fact that the research activities listed in the questionnaire may not promote changes in the musculoskeletal system detectable by the handgrip test and gait speed assessment in a short time.

Some limitations of this study include: 1. the cross-sectional design, which makes it impossible to establish a causal relationship; 2. the use of functional performance tests, which provide an indirect measure of muscle strength and gait speed parameters; and 3. a sample composed of elderly people who were able to go to the geriatric outpatient clinic, a situation that may have contributed to the exclusion of individuals with functional impairment.

Despite these aspects, this work is important because the knowledge about the aging of the Brazilian population and about characteristics of the elderly population is very important, for the need of definition and implementation of policies to ensure active aging and to help elderly people to face the challenges generated by new demographic pattern in Brazil.

5. Conclusions

In this study, elderly women and elderly individuals with loss of muscle mass had a higher chance of loss of muscle strength. In addition, female participants with an age range greater than or equal to 75 years were more likely to have slower gait. Thus, considering the importance of these parameters for healthy aging and the lack of publications investigating associations in elderly people in Teresina and the Northeast of Brazil, it is necessary to conduct more studies on the subject. Investigations that include home visits to collect information are recommended, in order to make it possible to reach elderly people with lower functional performance and those who are not able to seek care in hospitals or health centers.

Authors' Contributions: Muniz, V.R.C.: conception, design, acquisition, interpretation of data and drafting the work. Meneses, C.C.C.F.: conception, design, acquisition, interpretation of data and drafting the work. Carvalho, C.M.R.G.: conception, design and critical review of the work. Oliveira, A.S.S.: analysis, interpretation of data, critical review of the work and final approval of the version to be published. da Paz, S.M.R.S: analysis, interpretation of data and critical review of the work. Carvalho, M.D.F.: interpretation of data and critical review of the work. Martins, M.P.S.C.: acquisition, interpretation of data and drafting the work. Sousa, D.M.: acquisition, interpretation of data and drafting the work. Sales, A.L.C.C.: acquisition, interpretation of data and drafting the work. Sá, G.G.M.: analysis, interpretation of data and critical review of the work. Carvalho, V.B.L.: acquisition, interpretation of data and drafting the work. Lima, G.M.: acquisition, interpretation of data and drafting the work. Martins, M.C.C.: conception, design, critical review of the work and final approval of the version to be published.

Conflicts of Interest: The authors declare no conflicts of interest.

Ethics Approval: Ethical approval for this study was obtained from Research Ethics Committee (REC) of the Federal University of Piauí, with Certificate of Apresentation for Ethical Appreciation - CAAE 12171213.7.0000.5214.

Acknowledgments: This research received no external funding.

References

AINSWORTH, B.E., et al. Compendium of physical activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise*. 2000, **32**(9 Suppl.), S498-504. https://doi.org/10.1097/00005768-200009001-00009

BEZ, J.P.O. and NERI, A.L. Gait speed, grip strength and self-rated health among the elderly: data from the FIBRA Campinas network, São Paulo, Brazil. *Ciência & Saúde Coletiva*. 2014, **19**(8), 3343-3353. http://dx.doi.org/10.1590/1413-81232014198.09592013

BOHANNON, R.W., et al. Reference values for adult grip strength measured with a Jamar dynamometer: a descriptive meta-analysis. *Physiotherapy*. 2006, **92**(1), 11-15. http://dx.doi.org/10.1016/j.physio.2005.05.003

BRASIL. Ministério da Saúde (BR), Secretaria de Atenção à Saúde, Departamento de Atenção Básica. *Guidelines for collection and analysis of anthropometric data in health services*: technical standard system of food and nutrition surveillance – SISVAN. Brasília (DF): Ministério da Saúde; 2011. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/orientacoes_coleta_analise_dados_antropometricos.pdf

CHUMLEA, W.C., ROCHE, A.F. and STEINBAUGH, M.L. Estimating stature from knee height for persons 60 to 90 years of age. *Journal of the American Geriatrics Society*. 1985, **33**(2), 116-120. https://doi.org/10.1111/j.1532-5415.1985.tb02276.x

CHUMLEA, W.C. Is the MNA valid in different populations and across practice settings? *The Journal of Nutrition, Health & Aging.* 2006, **10**(6), 524-7.

DALY, R.M., et al. Association between changes in habitual physical activity and changes in bone density, muscle strength, and functional performance in elderly men and women. *Journal of the American Geriatrics Society*. 2008, **56**(12), 2252-2260. https://doi.org/10.1111/j.1532-5415.2008.02039.x

FARES, D., et al. Factors associated with nutritional status of the elderly in two regions of Brazil. *Revista da Associação Médica Brasileira*. 2012, **58**(4), 434-441. http://dx.doi.org/10.1590/S0104-42302012000400013

FERRUCCI, L., et al. Designing randomized, controlled trials aimed at preventing or delaying functional decline and disability in frail, older persons: a consensus report. *Journal of the American Geriatrics Society*. 2004, **52**(4), 625-634. http://dx.doi.org/10.1111/j.1532-5415.2004.52174.x

FRIED, L., et al. Untangling the concepts of disability, frailty and comorbidity: implications for improved targeting and care. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*. 2004, **59**(3), 255-263. https://doi.org/10.1093/gerona/59.3.m255

FRIED, L.P., et al. Frailty in older adults: evidence for phenotype. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences.* 2001, **56**(3), 164-56. https://doi.org/10.1093/gerona/56.3.m146

GÓMEZ-CABELLO, A., et al. Aging and body composition: the sarcopenic obesity in Spain. *Nutrición hospitalaria*. 2012, **27**(1), 22-30. https://doi.org/10.1590/S0212-16112012000100004

GURALNIK, J.M., et al. A short physical performance battery assessing lower extremity function: association with self reported disability and prediction of mortality and nursing home admission. *Journal of gerontology*. 1994, **49**(2), 85-94. https://doi.org/10.1093/geronj/49.2.m85

HAJJAR, R.R., KAMEL, H.K. and DENSON, K. Malnutrition in aging. *The Internet Journal of Geriatrics and Gerontology*. 2003, **1**(1).

INSTITUTE OF GEOGRAPHY AND STATISTICS. *Projeções da população: Brasil e unidades da federação*: revisão 2018 / IBGE, Coordenação de População e Indicadores Sociais. 2th. Rio de Janeiro: IBGE, 2018. Available from: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101597.pdf

LEAN, M.E., HAN, T.S. and MORRISON, C.E. Waist circumference as a measure for indicating need for weight management. *BMJ (Clinical research ed.)*. 1996, **311**(6998), 158-161. https://doi.org/10.1136/bmj.311.6998.158

LEBRÃO, M.L. and LAURENTI, R. Health, well-being and aging: the SABE study in São Paulo, Brazil. *Revista Brasileira de Epidemiologia*. 2005, **8**(2), 127-141. http://dx.doi.org/10.1590/S1415-790X2005000200005

LENARDT, M.H., et al. Factors Associated With Loss of Handgrip Strength in Long-Lived Elderly. *Revista da Escola de Enfermagem da USP*. 2014, **48**(6), 1006-12. http://dx.doi.org/10.1590/S0080-623420140000700007

LENARDT, M.H., et al. Gait speed and occurrence of falls in the long-lived elderly. *Revista Mineira de Enfermagem*. 2019, **23**(e-1190). http://www.dx.doi.org/10.5935/1415-2762.20190038

LUSTOSA, L., et al. *Translation, cross-cultural adaptation, and analysis of the psychometric properties of the Minnesota Physical Activity and Leisure Questionnaire*. Belo Horizonte (MG): UFMG, 2010.

MALTAIS, M.L., DESROCHES, J. and DIONNE, I.J. Changes in muscle mass and strength after menopause. *Journal of Musculoskeletal & Neuronal Interactions*. 2009, **9**(4), 186-197.

MARTIN, F.G., NEBULONI, C.C. and NAJAS, M.S. Correlation between nutritional status and hand grip strength in elderly. *Revista Brasileira de Geriatria e Gerontologia*. 2012, **15**(3), 493-504. https://doi.org/10.1590/S1809-98232012000300010

MENDES, J., et al. Association of Anthropometric and Nutrition Status Indicators with Hand Grip Strength and Gait Speed in Older Adults. *Journal of Parenteral and Enteral Nutrition*. 2018, **43**(3), 347-356. https://doi.org/10.1002/jpen.1424

MENZ, H.B., LORD, S.R. and FITZPATRICK, R.C. Age-related Differences in Walking Stability. *Age and ageing*. 2003, **32**(2), 137-142. http://doi.org/10.1093/ageing/32.2.137

MORETTO, M.C., et al. Relação entre estado nutricional e fragilidade em idosos brasileiros. *Revista da Sociedade Brasileira de Clínica Médica*. 2012, **10**(4), 267-271.

NAKANO, M.M. *Versão brasileira da Short Physical Performance Battery SPPB: adaptação cultural e estudo da confiabilidade*. 2007. 63 f. Dissertação de Mestrado. Campinas: Universidade Estadual de Campinas, 2007.

OSOBA, M.Y., et al. Balance and gait in the elderly: A contemporary review. *Laryngoscope Investigative Otolaryngology*. 2019, **4**(1), 143-153. http://doi.org/10.1002/lio2.252.

PAN AMERICAN HEALTH ORGANIZATION. *Chronic-degenerative illnesses and obesity: world-wide strategy on healthful feeding, physical activity and health*. Brasília: OPAS, 2003. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/doenca_cronico_degenerativas_obesidade_estrategia_mundial_alimentacao_atividade_fisica.pdf

PAPA, E.V., DONG, X. and HASSAN, M. Resistance training for activity limitations in older adults with skeletal muscle function deficits: a systematic review. *Clinical Interventions in Aging*. 2017, **12**, 955-961. http://doi.org/10.2147/CIA.S104674

PÉREZ-ZEPEDA, M.U., et al. Risk factors for slow gait speed: a nested case-control secondary analysis of the Mexican Health and Aging Study. *The Journal of Frailty & Aging*. 2015, **4**(3), 139-143. http://doi.org/10.14283/jfa.2015.63

PINTO, J.M. and NERI, A.L. Chronic diseases, functional ability, social involvement and satisfaction in community-dwelling elderly: the Fibra study. *Ciência & Saúde Coletiva*, 2013, **18**(12), 3449-3460. http://doi.org/10.1590/S1413-81232013001200002

PIRKER, W. and KATZENSCHLAGER, R. Gait disorders in adults and the elderly: A clinical guide. *Wiener klinische Wochenschrift*. 2017, **129**(3-4), 81-95. http://doi.org/10.1007/s00508-016-1096-4

PONTI, F., et al. Aging and Imaging Assessment of Body Composition: From Fat to Facts. *Frontiers in endocrinology*. 2020, **10**, 861. http://doi.org/10.3389/fendo.2019.00861

RAJU, M.S.V.K. Population Ageing and the Elderly. *Indian journal of psychiatry*. 2018, **60**(Suppl 3), S295. http://doi.org/10.4103/0019-5545.224466

RUGGERO, C.R., et al. Gait speed correlates in a multiracial population of community-dwelling older adults living in Brazil: a cross-sectional population-based study. *BMC Public Health*, 2013, **13**, 182. http://doi.org/10.1186/1471-2458-13-182.

SEENE, T. and KAASIK, P. Muscle weakness in the elderly: role of sarcopenia, dynapenia, and possibilities for rehabilitation. *European Review of Aging and Physical Activity*. 2012, **9**, 109–117. https://doi.org/10.1007/s11556-012-0102-8

SOARES, L.D.A., et al. Análise do Desempenho Motor associado ao Estado Nutricional de Idosos cadastrados no Programa Saúde da Família, no município de Vitória de Santo Antão-PE. *Ciência & Saúde Coletiva*. 2012, **17**(5), 1297-1304. http://doi.org/10.1590/S1413-81232012000500023

STREICHER, M., et al. Determinants of Incident Malnutrition in Community-Dwelling Older Adults: A MaNuEL Multicohort Meta-Analysis. *Journal of the American Geriatrics Society*. 2018, **66**(12), 2335-2343. http://doi.org/10.1111/jgs.15553

TAYLOR, H.L., et al. A questionnaire for the assessment of leisure time physical activities. *Journal of Chronic Diseases*. 1978, **31**(12), 741-755. https://doi.org/10.1016/0021-9681(78)90058-9

VOLAKLIS, K.A., HALLE, M. and MEISINGER, C. Muscular strength as a strong predictor of mortality: A narrative review. *European Journal of Internal Medicine*., 2015, **26**(5), 303-10. http://doi.org/10.1016/j.ejim.2015.04.013

WORLD HEALTH ORGANIZATION. *Global strategy and action plan on ageing and health*. Geneva: World Health Organization, 2017.

WORLD HEALTH ORGANIZATION. *Physical status: the use and interpretation of anthropometry*. Geneva (SWZ): WHO, 1995.

Received: 1 July 2020 | **Accepted:** 31 October 2021 | **Published:** 12 August 2022