REVISTA O MUNDO DA SAÚDE

Influence of Body Composition on Functional Capacity of Elderly Women with Incidence of Falls

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Abstract

Functional capacity is an important predictor of quality of life and can be affected by changes in body composition in the elderly, resulting from the aging process itself, with loss of bone mass, muscle mass, and changes in the level of body fat. It is important to analyze the influence of these changes on the decrease of strength and, consequently, its relationship with the incidence of falls, an important factor of functional capacity. The objective of this study was to verify the relationship between body composition and functional capacity in community-dwelling elderly women over 65 years old with or without incidence of falls. This is a cross-sectional and analytical study, sample composed of 77 elderly women divided into two groups, according to the history of falls among fallers (n = 23, mean age 73.6 ± 5.15 years) and non-fallers (n = 54, mean age 71.24 ± 4.92 years). Data were collected age, weight, height, functional capacity through the Sit and Stand Test (SST), as well as body composition, anthropometric measurements, skinfolds, and bone diameters were considered. Later, the comparative study between the faller and non-faller groups in relation to body composition with functional capacity was performed by the T-Student and Mann-Whitney tests. The correlation between the variables body composition and functional capacity and BMI was verified by the Pearson and Spearman tests, adopting the value of ($p \leq 0.05$) as significance. A significant difference was identified between the values of functional capacity and bone weight in the group of elderly women with an incidence of falls when compared to the non-faller group ($p = 0.002$). A weak positive relationship was observed between functional capacity and lean mass weight ($r = 0.232$, $p = 0.021$), and functional capacity and bone weight ($r = 0.343$, $p = 0.001$) in the elderly women in this study. Among the elderly, aged over 65 years old and with an incidence of falls, bone weight had an influence on functional capacity. The variables of body composition, weight, lean mass, and bone weight are related to functional capacity in community-dwelling elderly women aged over 65 years.

Keywords: Elderly Health. Body composition. Functional Physical Performance. Risk Groups. Accidents from Falls.

INTRODUCTION

Functional capacity is the potential that an individual has to lead their life independently according to their decisions and daily demands[1] and has been considered an important factor of quality of life, especially in the elderly[2].

The obesity epidemic and the growing population aging are factors that can result in functional limitations and physical disability in the elderly[3]. The natural decline of physiological functions, including loss of bone mass and muscle mass, decrease in lean mass, increase in fat mass, and decrease in muscle strength cause changes in body composition[4]. Thus, assessing changes in the body composition of individuals is an important indicator of possible health risks, such as changes in functional capacity[5,6].

Body composition can be verified by lean

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muscle mass or fat mass, through measuring skinfolds[7]. Other measures such as bone mineral density (BMD), which defines the resistance of the skeletal system to the loads imposed daily[8], body mass index (BMI)[9,10], free fat mass (FFM), body fat mass (BFM)[11,12], and the percentage of body fat (%BF)[8] can also be included. These factors are important indicators to the changes in the level of body fat associated with loss of bone mass are key components that lead to a greater propensity to develop frailty, fractures, and falls, which leads to functional disability[11].

In women, these factors are even more accentuated because the hormonal change with aging modifies the BMD, which is added to other factors of change in body composition, which results in the loss of muscle strength, bone fragility, and changes in balance, which influence the falling factor[12,13,14].

A fall is an unexpected event in which the individual descends to the ground or another lower level[15]. In the United States, falls are the leading cause of injury death in adults over age 65 and the most common cause of non-fatal injuries and hospital admissions for traumatic injuries and are considered a public health problem. Preventing falls is a way to reduce mortality, as well as the significant use of health services and avoid the loss of independence[16].

Thus, when considering the risk of falling as an important factor of functional capacity, a parameter used is the activity of sitting and standing[17,18]. This activity evaluates the indirect measure of strength of the lower limbs, as it involves the activation of multiple muscles and requires the change of weight from the gluteus region and posterior thighs to the base of the feet and, therefore, evaluates the functional capacity and can be associated with the prevention of falls in elderly populations[19].

More recent studies have investigated this relationship between body composition, muscle capacity, and functional capacity. It has been identified that sarcopenic obesity is associated with increased rates of falls over a two-years period in elderly men and may also be associated with a higher risk of fractures[20]; however, this relationship in elderly women has been investigated less.

Therefore, in view of the changes in body composition that occur in elderly women, it is necessary to study its influence on muscle strength, a predictor of functional capacity with an important impact on the risk of falls. Thus, the objective was to verify the relationship between body composition and functional capacity in community-dwelling elderly women aged 65 and over with or without incidence of falls.

METHODOLOGY

This is a cross-sectional and analytical study carried out from January/2016 to December/2017, at the Laboratório do Movimento Dr. Cláudio de Almeida Borges (LAMOV) from the State University of Goias (UEG), approved by the Research Ethics Committee of the Federal University of Goias under number 33089614.4.0000.5083, opinion 3646405. The participants agreed and signed the Informed Consent Form (ICF).

The sample size calculation for this study considered the variable functional capacity according to Santos *et al.*[18]: 95% confidence interval; significance level of 0.05 (type I error); 95% power (type II error); and an effect size of 0.15, resulting in a minimum sample of 74 elderly women. The calculation was performed by the GPower software version 3.1.9.4

considering a loss of 10%. In the end, there were 77 elderly women, divided into two groups, fallers (n = 23) and non-fallers (n = 54).

The intentional probabilistic sample was composed of elderly women from the community, aged 65 years or older, enrolled in the Open University program for the Elderly of the State University of Goias (UNATI – UEG), considered regularly active, from the metropolitan region of Goiania, GO.

Elderly women who had partial or total prostheses (or endoprostheses) of the lower limbs and/or acute crises of vertigo syndromes close to the evaluation date and/or with a score lower than 13 were not included in the study, considering the influence of education in the Mini-Mental State Exam (MMSE)[21].

An anamnesis form was applied to obtain data on age, weight, height, Body Mass Index (BMI), and its classification Low Weight (< 22 kg/m²), Eutrophic (between 22 kg/m² and 27 kg/m²), and Overweight (> 27 kg/m²)[19]. History of falls through the patient's report from the last 12 months. The history of falls made it possible to divide the sample into two groups: fallers and non-fallers.

The Chair Sit and Stand Test (SST) was performed using a protocol similar to that of Lucena[22], using a chair without armrests. The elderly women were instructed to sit on the chair, leaning their backs on the support and their feet shoulder-width apart, resting on the floor. Their upper limbs were crossed at wrists and against the chest. A start signal was then given to rise to an upright position (fully standing) and then return to the starting position (sitting). The elderly women were encouraged to complete the maximum number of repetitions in a time interval of 30 seconds while the evaluator counted the number of repetitions, the unit for this measurement[23,24]. Scores equal to or less than 9 repetitions were classified as altered functional capacity and above these values as preserved functional capacity[19,25].

Body composition measurements were obtained by a single evaluator, trained to perform the technique, obtaining measurements of body fat percentage, percentage of fat-free mass, body fat weight, lean mass weight, and bone weight. The skinfold measurement collection was performed with a Cescorf® adipometer, measured in millimeters, according to the protocol by Ribeiro[26], and performed on the participants' hemibody by a single, previously trained evaluator. Three measurements were performed in a rotational system and the arithmetic mean was adopted as the final value[26]. Bone weight estimation was calculated from wrist and femur diameters, obtained with a caliper (Lafayette Instrument Company®, model 01290) and measured in centimeters[27].

After obtaining the anthropometric measurements and skinfolds, body composition calculations were performed using the Sotware Physical Test version 4.8 from the triceps, subscapular, biceps, iliac crest, axillary, abdominal, medial thigh, and calf skinfolds.

Data analysis

Data normality analysis was performed using the Shapiro-Wilk test. The comparative study between the faller and non-faller groups in relation to body composition with functional capacity was performed using the T-Student and Mann-Whitney tests with a test of homogeneity of variance. The correlations between the variables body composition and functional capacity and BMI were verified by the Pearson and Spearman tests.

A strong positive correlation was defined as values between 0.70 and 1.0; moderate, 0.30 to 0.70; weak, between 0 and 0.30; and a strong negative correlation for values between -0.70 to -1; moderate, 0.30 to -0.70; and weak 0 to -0.30[28]. The p-value ≤ 0.05 was adopted as significant.

RESULTS

The groups were homogeneous in terms of age. Among the fallers (n = 23) the mean was 73.6 ± 5.15 years and among the non-fallers (n = 54) it was 71.24 ± 4.92 years old. Mean BMI values showed that the faller group was classified as eutrophic (BMI = 25.99 Kg/m^2), while the non-faller group was classified as overweight (BMI = 27.16 Kg/m^2)[29] (Table 1).

In the comparison between body composition measures considering fallers and non-fallers, the percentile of body fat and the percentile of fat-free mass showed a statistically significant difference (Table 1).

In the group of elderly fallers, the values of body fat percentile and body fat weight were lower for elderly women with altered functional capacity compared to elderly women with preserved functional capacity. Elderly women with altered functional capacity and incidence of falls present values of body fat percentage, body fat weight, and lean mass weight lower than elderly women with altered functional capacity without incidence of falls (Table 2).

A significant difference was identified between the values of functional capacity and bone weight in the group of elderly women with incidence of falls when compared to the group of elderly women who did not fall. There was no significant difference between the values of body composition and functional capacity in the group of elderly women who did not fall in relation to the group of elderly women with an incidence of falls (Table 2).

Table 3 presents the correlation measures between the body composition variables in relation to the functional capacity of the total group. There was a weak positive correlation between functional capacity and lean mass weight, and functional capacity and bone weight.

The BMI measurement correlated with the variables of body composition of the elderly women showing a strong and positive correlation with the variables body fat weight (r = 0.891, p = 0.000) and lean mass weight (r = 0.776, p = 0.000), a moderate and positive correlation with body fat percentile (r = 0.602, p = 0.000), a moderate and negative correlation with fat-free mass percentile (r = -0.602, p = 0.000), and a weak and negative correlation with bone weight.

Table 1 - Description and analysis of variables age, weight, height, body mass index, sit and stand test, body fat percentage, fat-free mass percentage, body fat weight, lean mass weight, and bone weight, comparing the faller and non-faller groups. Goiania, GO, 2017.

Variables	Mean (SD)		P-value
	Faller (n=23)	Non-Faller (n=54)	
Age (years)	73.6 (5.15)	71.24 (4.92)	0.069[a]
Weight (Kg)	63.77 (10.24)	64.89 (12.1)	0.680[b]
Height (meters)	1.57 (0.06)	1.54 (0.06)	0.144[b]
BMI (Kg/m^2)	25.99 (4.69)	27.16 (5.08)	0.350[a]
SST (final average value)	10.57 (2.96)	11.43 (2.53)	0.061[b]
% BF	35.95 (5.13)	38.79 (4.88)	0.029[a*]
% FFM	64.04 (5.13)	61.20 (4.88)	0.029[a*]
Body Fat Weight (Kg)	23.10 (5.87)	25.52 (6.95)	0.111[b]
Lean Mass Weight (Kg)	30.81 (5.39)	29.99 (5.85)	0.410[b]
Bone Weight (Kg)	9.85 (1.41)	9.37 (1.72)	0.088[b]

SD = Standard Deviation; BMI = Body Mass Index; SST = Sit and Stand Test; BF = Body Fat; FFM = Fat Free Mass; a = T-Student test; b = Mann-Whitney; * ($p<0.05$).

Table 2 - Description and analysis of body composition variables in the group of non-falling and falling elderly women in relation to the condition of functional capacity. Goiania, GO, 2017.

	Faller			Non-Faller		
Body Composition Variables	Altered Functional Capacity (n=8)	Preserved Functional Capacity (n=15)	P Value	Altered Functional Capacity (n=8)	Preserved Functional Capacity (n=46)	P Value
	Mean (SD)			Mean (SD)		
% BF	34.40 (3.47)	36.77 (5.76)	0.302[a]	39.97 (5.20)	38.59 (4.86)	0.465[a]
% FFM	65.59 (3.47)	63.22 (5.76)	0.302[a]	60.02 (5.20)	61.40 (4.86)	0.465[a]
BF weight	22.12 (3.89)	23.62 (6.76)	0.776[b]	28.98 (7.18)	24.92 (6.81)	0.150[b]
LM weight	31.23 (5.69)	30.59 (5.41)	0.728[b]	33.22 (6.59)	29.43 (5.60)	0.106[b]
Bone weight	10.94 (0.77)	9.27 (1.35)	0.002[b*]	9.66 (0.87)	9.32 (1.83)	0.368[b]

SD = Standard Deviation; BF = Body Fat; FFM = Fat Free Mass; MM = Lean Mass; a = T-Student Test; b = Mann-Whitney; * ($p<0.05$).

Table 3 - Measurements of correlations between the body composition variables of the entire group of women in relation to their functional capacity. Goiania, GO, 2017.

Correlations	Correlation Coefficient	P-value
Functional capacity x % Body Fat[a]	-0.025	0.416
Functional capacity x % Fat-free massa[a]	0.025	0.416
Functional capacity x Body fat weight[b]	-0.120	0.148
Functional capacity x Lean mass weight[b]	0.232	0.021
Functional capacity x Bone weight[b]	0.343	0.001

a = Pearson's correlation; b = Spearman correlation.

DISCUSSION

The present study compared and correlated body composition and functional capacity in elderly women with or without incidence of falls. The event of a fall marked the difference between the groups, associated with the factors of body fat percentage and fat-free mass with regards to body composition in this study. The study identified statistical significance in the analysis of the risk of falls in relation to FFM. However, when the groups under analysis are stratified in terms of functional capacity, the reduction in the number of people in each subgroup may have influenced the absence of this same statistical evidence.

Functional capacity was related to bone weight, corroborating the study by Falsarella[30] who showed an association of bone weight with a great impact on functional capacity. Elderly people who have a history of falling have a higher risk of recurrent falls, fractures, and functional disability[31].

The bone weight of the elderly fallers in the study showed a statistically significant difference when considering the change in functional capacity. This indicates that body composition analysis, a simple and inexpensive method compared to instrumented exams such as bone densitometry, can help in preventive diagnostic measures. According to Nanes and Kallen[32], decreased bone mass predisposes to frailty, one of the most prevalent diseases in the elderly population, and a greater risk of fractures[30].

Functional capacity was related to lean

mass weight. It is noteworthy that studies on the independent contribution of lean mass to the future risk of functional frailty and risk of fractures are scarce[33]. Recently, the predictive value of low lean mass was examined for the first time in a large homogeneous group of 65-year-olds, with a sample of 913 individuals, 80% of which were women from the community, demonstrating that low lean mass is associated with greater risk of fractures[34].

The BMI of the elderly women in the study was not related to bone weight, a body composition variable that was related to functional capacity in the study. This indicates that BMI should not be used as the only way to assess and monitor the nutritional status of elderly women, but rather body composition variables should be used as possible influencers of the physical performance of the elderly[35]. The BMI was not sufficient to discriminate the presence of a risk in relation to the body composition of elderly women with a history of falls.

Anthropometry and skinfolds assess the body composition of the entire physical body structure, and the sit-and-stand test verifies the functional capacity and strength of the lower limbs. An association with a specific measurement of fat-free mass with another method of assessing body composition is suggested in order to verify changes in functional capacity associated with the decline in FFM of the lower limbs, which is a limitation of our study[36].

The study addressed heterogeneous groups of elderly women and a single method (anthropometry) was used to determine body composition. The study population is small and limited to women aged 65 and over, with irregular groups regarding the fall factor. In clinical practice, anthropometry is easily applicable in the routine of physical assessment, whether in the clinic, in bedside assessment situations, or in community environments.

It is suggested that future studies record data on bone fragility, forms of treatment adopted for these disorders such as hormone or calcium replacement, respectively, associating this information to the context of body composition assessments together with the evaluation of functional capacity.

CONCLUSION

In elderly women aged over 65 years with an incidence of falls, the bone weight measurement was more significant when the influence on functional capacity was evaluated. The variables of body composition, lean mass weight, and bone weight are related to the functional capacity of elderly women from the community aged 65 years and over. It is considered healthy to carry out an assessment of body composition, observing bone weight and its influence on functional capacity and on the recurrence of falls in women who already have this relevant event.

Author statement CRediT

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