Functional autonomy, bone mineral density and risk of falls in older women with two distinct body composition profiles

Autonomía funcional, densidad mineral ósea y riesgo de caídas en mujeres mayores con dos perfiles de composición corporal distintos

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Abstract

Objetive: Evaluate the functional autonomy, bone mineral density and risk of falling in older women of two different body composition profiles.
Methods: The study was carried out as a correlational study with a quantitative analytical approach. The older women participants (n=114) were submitted to a diagnostic evaluation, consisting of: Functional Autonomy (FA) assessment GDLAM protocol; Bone Mineral Density (BMD) and Body Composition (BC) - tested by bone densitometry by means of dual X-ray emission (DXA) and the Risk of falls was used the Falls Risk Assessment Battery (BARQ).
Results: 114 older women were evaluated ($\bar{X}$= 66.7 ± 6.27 years), distributed into two groups according to Body Mass Index (BMI), being normal body composition group NBC (n=39; up to 24.9 kg/m2) and overweight and obese (OO) (n=75; ≥ 25 kg/m²). The overall group studied is in overweight nutritional status ($\bar{X}$ =27.23 ± 4.5 kg/m2). For FA, the studied group obtained a predominance of the classification "regular" preceded by "good", a total of 63.2% of the participants, with the best result for the group NBC presenting GDLAM index (GI) ($\bar{X}$ = 29.45 ± 4.14). The Mann-Whitney test showed a significant result only with the standing up from prone position (RPP) test for the obese and overweight (OO) group when compared to the NBC group (*Δ*% = 12,81; p=0.027). For BMD a significant result was found for the femoral neck region (BMDNF) (Δ% = 5,88; p=0.047) and significant correlation of the 10-meter walk test (C10m) with the Index of Fall Risk (IRQ) (rho = -0.191; p=0.042).
Conclusions: The results allow us to conclude that older women participating in the study, from the OO, present better results in the prone position elevation test (RPP) and in the femoral neck BMD, probably due to the higher body mass, since the BMI does not differentiate fat mass from lean mass

Keywords

Activities of daily living; autonomy; bone density; older health; risk factors.

Resumen

Objetivo: Avaliar a autonomia funcional, a densidade mineral óssea e o risco de queda em mulheres idosas com dois perfis diferentes de composição corporal.
Métodos: O estudo foi realizado como um estudo correlacional com uma abordagem analítica quantitativa. As mulheres idosas participantes (n=114) foram submetidas a uma avaliação diagnóstica, que consistiu em: Avaliação da Autonomia Funcional (AF) protocolo GDLAM; Densidade Mineral Óssea (DMO) e Composição Corporal (CC) - testada por densitometria óssea por meio de dupla emissão de raios X (DXA) e o Risco de quedas foi utilizado o Falls Risk Assessment Battery (BARQ).
Resultados: Foram avaliadas 114 mulheres idosas ($\bar{X}$= 66,7 ± 6,27 anos), distribuídas em dois grupos de acordo com o Índice de Massa Corporal (IMC), sendo grupo de composição corporal normal NBC (n=39; até 24,9 kg/m2) e sobrepeso e obesidade (OO) (n=75; ≥ 25 kg/m2). O grupo geral estudado está em estado nutricional de sobrepeso ($\bar{X}$ =27,23 ± 4,5 kg/m2). Para a AF, o grupo estudado obteve uma predominância da classificação "regular" precedida de "boa", num total de 63,2% dos participantes, com o melhor resultado para o grupo NBC apresentando índice GDLAM (GI) ($\bar{X}$ = 29,45 ± 4,14). O teste de Mann-Whitney mostrou um resultado significativo apenas com o teste de levantar da posição prona (RPP) para o grupo obeso e com sobrepeso (OO) quando comparado ao grupo NBC (Δ% = 12,81; p=0,027). Para a DMO, foi encontrado um resultado significativo para a região do colo do fêmur (BMDNF) (Δ% = 5,88; p=0,047) e uma correlação significativa do teste de caminhada de 10 metros (C10m) com o Índice de Risco de Queda (IRQ) (rho = -0,191; p=0,042).
Conclusões: Os resultados permitem concluir que as mulheres idosas participantes do estudo, da OO, apresentam melhores resultados no teste de elevação da posição prona (RPP) e na DMO do colo do fêmur, provavelmente devido à maior massa corporal, uma vez que o IMC não diferencia massa gorda de massa magra.

Palabras clave

Atividades da vida diária; autonomia; densidade óssea; fatores de risco; saúde do idoso.

Introduction

Over the last decades, a change in the world population age range has been observed, as the older people has been growing and occupying large proportions in several countries1. Demographic data are changing globally, making the population more aged, with the last 50 years, in which the population over 65 years old tripled, possibly reaching 25% of the world population by the year 20502.

This population aging process brings about changes in society due to physiological changes. Functional autonomy (FA), bone mineral density (BMD), falls and body composition (BC) in the older people are factors that change over time, the first depending on factors intrinsic to older people, such as the loss of independence, decreasing conditions to perform activities of daily living; however, an active life provides the maintenance of dependence, and it is this condition of life that contributes positively or negatively to the well-being of the older people3.

In view of physiologicals changes that occur with the aging process, body mass and body composition require attention4. With increasing age, a decrease in fat-free mass and an increase in the percentage of body fat are observed, these changes being more accentuated in women. According to Reinders et al.5, older people with a high fat mass index, who reach different levels of obesity, waist circumference measurements above normal, can determine that they are considered frail. For Junior, Scartoni, Machado Bocali & Yazigi6, one of the systems most affected by ageing is the neuromuscular system, which determines the ability to exert strength, endurance and power, considered to be key components in quality locomotion.

In this aspect, sarcopenia, which causes age-related decline in physical function, affects the cross-sectional area of muscle fibers, compromises gait speed, balance, coordination, bone density, and quality of life. Thus, the maintenance of muscle mass must be considered of great importance, minimizing the risks caused by fragility and maintaining the quality of functional autonomy7. For Kuo et al.8, the loss of functional autonomy can also increase dependence for performing activities of daily living (ADL), contributing to a loss in quality of life.

Bone mass loss is also a relevant factor during aging and a problem, since older people with osteoporosis and osteopenia may be affected by traumas caused by falls, with a higher risk of fractures9. Osteoporosis is a disease characterized by a decrease in bone mineral density (BMD) and deterioration of bone tissue microarchitecture, which induces fragility and thus contributes to an increased risk of fractures. This osteometabolic disease affects mainly older people with a higher incidence in women, especially in the post-menopausal period10. Bone metabolism is influenced by genetics, hormone replacement, medication use, sunlight exposure deficiency and vitamin D insufficiency, body composition, smoking, alcoholism, physical activity, and educational level11.

According to Barker and Eickmeyer12, falls in older people are a major concern, since hip fractures worsen health, affecting the condition of independence and are associated with high rates of morbidity and mortality. Ren et al.13 reports that most falls are result of the complex relationship between intrinsic and extrinsic factors, and it is impossible to dissociate them in practice. Studies by Stevens e Konda14; Ferrer et al.15 relate the occurrence of bone fractures as an indicator of osteoporosis, which may over-value the protective effect of physical activity for bone metabolism. However, the authors of the cited studies state that some activities can decrease the occurrence of bone fractures, not by improving BMD, but by reducing falls. However, falls and age-related injuries are a critical, and growing, factor, becoming a public health problem, as they stand out as the main cause of unintentional injuries and deaths of older people aged 65 years and older16.

Thus, the study sought to analyze the relationship between functional autonomy, bone mineral density and the risk of falls in older women with two distinct profiles of body composition.

Method

Study design and participants

The study was developed in a comparative and correlational form with a quantitative analytical approach. Older women aged 60 years or older, treated at the Basic Health Unit in South Zone of Aracaju were study´s participated. After the explanatory meeting held at the Tiradentes´ University about the purpose of the study and evaluation methods used, the volunteers signed the free and informed consent form.

Sample size was estimated using the G*Power 3.1 software17, with the following information: T-Student test for independent samples or Mann-Whitney test; Cohen's effect size (d) = 0.55; α error = 0.05 two-tailed; test power = 0.80 and allocation ratio = 1. The calculated sample was 106 participants. As inclusion criteria, older women volunteers should be at least 60 years old, be in good physical and health conditions, as evidenced by a medical certificate, to perform physical exertion activities proposed in the evaluation protocols. As exclusion criteria, the volunteers could not fail to answer any of the questionnaires or fail to perform at least one of the tests proposed in the evaluation.

After analyzing selection/inclusion criteria, 114 older women were recruited to participate in the study, and information was obtained from the participants themselves that they had an inactive lifestyle and did not regularly practice physical exercises.

Research Ethics

All the principles of Law No. 14,874, of May 28, 202418 as well as the Helsinki Declaration19, have been adhered to. All participants gave their individual consent. In addition, the project was approved by the Ethics Committee of Tiradentes University, with Certificate of Submission for Ethical Appraisal No. 26524719.4.0000.5371.

Data collection procedures

Functional autonomy was assessed through the protocol of the Latin American Development Group for Maturity (GDLAM battery)20, 21. This protocol, consisting of 5 tests: walking 10 meters, getting up from a sitting position, getting up from a prone position, putting on and taking off a shirt, and getting up from a chair and moving around the house, which simulate the activities of daily living. The tests were performed in timed intervals to determine the GDLAM index.

Bone mineral density and body composition were assessed by dual-energy X-ray absorptiometry (DXA)22 using a GoldSeal Certified Lunar Prodigy Advance device from General Electric Company© (USA). To determine body composition, the BMI classification for older people of the Kyoto-Kameoka study was considered23.

To assess the risk of falls, Fall Risk Assessment Battery (BARQ in Portuguese)24 was used, which analyzes intrinsic, extrinsic, and behavioral factors that are considered aggravating for the situation of falls, such as the use of medications, history of falls, environment, balance, and mobility,

The BARQ aims to estimate the index of risk of falls presented in scores, and results categorized into quartiles, from 25% to 25%, considering that the higher the value of the Risk of Falls Index - RFI, the lower the risk of an older people to suffer a fall.

After the tests, the group of older women was subdivided into two subgroups, being the normal body composition group - NBC (n=39) and the group of overweight or obese older women - OO (n=75) using as cutoff point the BMI up to 24.9 kg/m2 and BMI≥25 kg/m2 respectively.

Statistical Procedures

All statistical analyses were performed in IBM SPSS Statistics Program (Inc., Chicago, IL, USA). Data were analyzed descriptively and presented as mean, standard deviation, and minimum and maximum values. For categorical variables, absolute and relative frequencies were used to represent the results. Analysis of the normality distribution of the sample data was done using the Shapiro-Wilk or Kolmogorov-Smirnov test, when appropriate. For comparisons between groups subdivided by the body composition variable of the sample, the Mann-Whitney test was used. Spearman's correlation (rho) test was used to analyze the possible associations between the study variables. The p value < 0.05 was used for statistical significance.

Results

Sample group studied characterization is presented in table 1. It can be observed that in the 114 older women were evaluated ($\bar{X}$ = 66.7 ± 6.27 years), the body mass index (BMI) of the group, according to the WHO classification for older people, is in a nutritional status of overweight $\bar{X}$ = 27.23 ± 4.55 kg/m2

Table 1. Sample group studied characterization, Aracaju/Brazil (2020)

	Average	SD	Minimum	Maximum	p-valor (KS)
Age (years)	66.74	6.27	60.00	85.00	<0.001*
Body Mass (kg)	66.78	10.39	40.70	104.00	0.162
Height (m)	1.57	0.09	1.38	1.78	0.067
BMI (kg/m^2)	27.23	4.55	19.22	43.85	0.007
W10m (s)	7.86	2.01	4.75	14.64	<0.001*
RSP (s)	12.01	2.87	5.88	21.18	0.087
RPP (s)	4.44	1.39	2.03	8.36	0.009
GCMH (s)	46.18	6.92	29.18	60.50	0.081
PTS (s)	12.16	3.22	5.09	20.39	0.167
GI (scores)	29.78	4.64	18.90	41.33	0.118
LumBMD (g/cm^2)	0.94	0.17	0.00	1.35	0.029
BMDFN (g/cm^2)	0.88	0.12	0.61	1.19	0.200
BMDTF (g/cm^2)	0.94	0.14	0.61	1.26	0.200
BMDF (g/cm^2)	0.75	0.13	0.18	1.02	0.019
TScoreLum(SD)	-1.93	1.15	-4.00	1.30	0.200
TScoreFN(SD)	-1.16	0.88	-3.20	1.10	0.024
TScoreFA(SD)	-1.29	1.20	-5.40	1.70	0.200
RFI(scores)	17.85	3.14	7.20	25.46	0.200

Legend: SD: Standard Deviation; p-Value (KS): Kolmogorov-Smirnov Test; BMI: Body Mass Index; W10m: 10-meter walk test; RSP: Rise from a sitting position test: RPP: raising from prone position test: GCMH: getting up from a chair and moving around the house test; PTS: putting on and taking off the shirt test; GI: GDLAM Index; LumBMD: Lumbar Bone Mineral Density; BMDFN: Bone Mineral Density Femoral Neck; BMDTF: Bone Mineral Density Total Femur; BMDF: Bone Mineral Density Forearm; T-SCORELum: T-score lumbar; T-SCOREFN: T-Score femoral neck; T-SCOREFA: T-score forearm; RFI: Risk of Falls Index.

The group of older women participating in the study showed a predominance of middle-age women, aged between 60 and 64 years, preceded by older women aged between 65 and 69 years, making up approximately 70%, and older women, aged 70 years or more, comprised about 30% of the sample group studied.

According to the standard of functional autonomy evaluation of the GDLAM battery, in function of the averages of the evaluated group, a "weak" classification was obtained for the tests of W10m, RSP and GCMH. These tests need strength of the lower limbs in function of displacement and change of position dynamically; for the tests of PTS and RPP a better result occurred, being classified as "regular". However, the GI of the evaluated group was classified as "weak".

Table 2 shows the results of functional autonomy for the sample group, formed according to body composition, showing statistically that the W10m, RSP and GCMH tests were favorable for the NBC group, while the OO group obtained better results in the RPPT and PTS tests. The GI results found between the NBC and OBS groups did not show statistically significant results, however the NBC group obtained better GI. It is worth mentioning that the results obtained in the tests that make up the protocol that analyzed functional autonomy, only the RPPT showed a statistically significant value.

Table 2. Functional Autonomy between groups NBC e OO, Aracaju/Brazil (2020)

	NBC (n=39)		OO (n=75)			
	Mean	SD	Mean	SD	Δ%	p-valor
W10M (s)	7.47	1.80	8.07	2.09	8.03	0.116
RSP (s)	11.61	2.54	12.22	3.02	5.25	0.464
RPP (s)	4.84	1.55	4.22	1.25	-12.81	0.027*
PTS (s)	12.57	3.19	11.94	3.24	-5.01	0.585
GCMH (s)	44.80	6.29	46.90	7.16	4.69	0.146
GI (escores)	29.45	4.14	29.95	4.90	1.70	0.548

Legend: * p<0.05. W10m: 10-meter walk test; RSP: Rise from a sitting position test; RPP: raising from prone position test; PTS: putting on and taking off the shirt test; GCMH: getting up from a chair and moving around the house test; GI: GDLAM Index. Δ%: percentual difference.

The results regarding BMD (g/cm2) and T-score, expressing the state at the temporal moment of the analysis, in general, the analyzed group presents a level of osteopenia (T-score -1 to -2.5), although a variation of participants classified in normal level (T-Score up to -1) and severe osteoporosis (T-score < -2.5 with previous fractures) was registered. For Bone Mass it was observed that the forearm region obtained the lowest index, while the lumbar region presented the highest bone mass index among the bone sites studied.

Because the body region is subjected to bear much of the body weight, it can thus stimulate bone cells responsible for bone remodeling, providing a decrease or delay in the loss of bone mass.

Table 3 presents the results of the variable bone mineral density between the groups according to body composition. The study shows that for L1-L2 and forearm of the NBC group the results were better than for the OBS group. For the femoral neck site the values found present statistically significant values between the NBC and OBS groups, indicating a better BMD level for the OO group; however, the T-Score analysis for the bone sites studied indicates that the group studied has osteopenia.

Table 3. Bone Mineral Density Results between NBC e OO groups, Aracaju/Brazil (2020

	NBC (n=39)		OO (n=75)			
	Mean	SD	Mean	SD	Δ%	p-valor
LumBMD (g/cm²)	0.95	0.16	0.94	0.17	-1.05	0.663
BMDFN(g/cm²)	0.85	0.13	0.90	0.12	5.88	0.047*
BMDTF(g/cm²)	0.91	0.14	0.96	0.14	5.49	0.101
BMDF(g/cm²)	0.76	0.11	0.75	0.14	-1.32	0.846
TScoreLum (SD)	-1.95	1.32	-1.92	1.06	-1.54	0.554
TScoreFN (SD)	-1.37	0.93	-1.05	0.84	-23.36	0.065
TScoreFA (SD)	-1.37	1.26	-1.26	1.18	-8.03	0.774

Legend: * $p<0.05$. SD: Standard Deviation; LumBMD: Lumbar Bone Mineral Density; BMDFN: Bone Mineral Density Femoral Neck; BMDTF: Bone Mineral Density Total of Femur; BMDF: Bone Mineral Density of Forearm; T-SCORELum: T-score lumbar; T-ScoreFN: T-Score femoral neck; T-ScoreFA: T-score forearm; Δ%: percentual difference.

Table 4 presents the results about the risk of falls among the groups, noting that both groups have maximum risk for falls, however the OBS group presented a lower result, although with a statistically non-significant difference.

Table 4. Risk of Falls between the NBC and OO groups, Aracaju/Brazil (2020)

	NBC (n=39)		OBS (n=75)			
	Mean	SD	Mean	SD	Δ%	p-value
RFI	18.05	3.49	17.74	2.95	-1.72	0.962

RFI: Fall of Risk Index; SD: Standard Deviation. Δ%: percentual difference.

Table 5. Correlation between Functional Autonomy, Bone Mineral Density and Risk of Fall

		Age	BodyMass	BMI	W10m	RSP	RPP	GCMH	PTS	GI	LumBMD	BMDFN	BMDTF	BMDF	TScoreLum	TScoreFN	TScoreFA
Body-Mass	rho	-0,126															
	p-value	0,180															
BMI	rho	-0,052	,710**														
	p-value	0,581	0,000														
W10m	rho	0,010	0,103	0,232*													
	p-value	0,917	0,275	0,013													
RSP	rho	-0,038	0,044	0,096	,530**												
	p-value	0,686	0,641	0,312	0,000												
RPP	rho	0,126	-0,097	-0,086	,241**	,340**											
	p-value	0,183	0,302	0,364	0,010	0,000											
GCMH	rho	0,137	0,078	0,149	,634**	,576**	,373**										
	p-value	0,146	0,408	0,114	0,000	0,000	0,000										
PTS	rho	,301**	-0,023	-0,022	,199*	,207*	,495**	,289**									
	p-value	0,001	0,804	0,816	0,034	0,027	0,000	0,002									
GI	rho	0,154	0,034	,723**	,671**	,740**	,612**	,815**	,655**								
	p-value	0,103	0,723	0,000	0,000	0,000	0,000	0,000	0,000								
LumBMD	rho	-0,100	0,161	0,075	0,004	0,002	0,000	0,009	-0,040	-0,028							
	p-value	0,290	0,086	0,428	0,964	0,985	0,998	0,924	0,671	0,765							
BMDFN	rho	-,314**	,230*	0,157	-0,023	-0,015	-0,115	0,023	-,189*	-0,098	,582**						
	p-value	0,001	0,014	0,095	0,807	0,876	0,225	0,810	0,044	0,298	0,000						
BMDTF	rho	-,338**	0,174	0,113	-0,063	-0,039	-0,073	-0,005	-0,112	-0,084	,639**	,890**					
	p-value	0,000	0,065	0,231	0,507	0,679	0,437	0,955	0,237	0,376	0,000	0,000					
BMDF	rho	-,329**	,207*	0,034	-0,073	0,039	-0,021	-0,058	-0,095	-0,054	,479**	,557**	,617**				
	p-value	0,000	0,027	0,717	0,440	0,683	0,825	0,543	0,317	0,565	0,000	0,000	0,000				
TScore-Lum	rho	-0,092	0,162	0,079	0,006	0,031	0,041	0,034	-0,037	-0,005	,961**	,597**	,634**	,478**			
	valor-p	0,330	0,085	0,402	0,949	0,740	0,663	0,720	0,692	0,958	0,000	0,000	0,000	0,000			
TScoreFN	rho	-,308**	,224*	0,142	-0,010	-0,008	-0,100	0,033	-0,177	-0,083	,589**	,996**	,896**	,554**	,605**		
	valor-p	0,001	0,016	0,133	0,914	0,936	0,288	0,728	0,059	0,381	0,000	0,000	0,000	0,000	0,000		
TScoreFA	rho	-,349**	,224*	0,045	-0,088	0,043	-0,013	-0,063	-0,104	-0,060	,498**	,593**	,652**	,989**	,505**	,590**	
	valor-p	0,000	0,017	0,635	0,354	0,651	0,892	0,507	0,271	0,525	0,000	0,000	0,000	0,000	0,000	0,000	
RFI	rho	-,308**	-0,049	-0,056	-,191*	-0,034	-0,073	-0,064	-0,126	-0,101	0,031	0,075	0,135	0,116	0,013	0,076	0,126
	valor-p	0,001	0,602	0,553	0,042	0,719	0,437	0,498	0,181	0,284	0,742	0,430	0,151	0,217	0,888	0,419	0,182

To identify the possible correlations between the variables functional autonomy, bone mineral density, and risk of falls the Spearman correlation test was used, presenting the coefficient of correlation (rho) and p-value. In table 5, it is observed that the BMI has a statistically significant relationship with the C10m test and with the IG. Once the C10m test aims to identify the gait speed, thus exploring the dynamic strength of the lower limbs, the result points out that the higher the body composition, the longer it will take to perform the test. As for the GI, the result indicates that the higher the body composition, the lower the functional autonomy, reflecting negatively on the independence of the older women.

For BMD, among analyzed sites, significant relationships were found between BMD and age; for this relationship, it is understood that even greater the age, lower the bone mineral density at femoral neck. As for BMD and height, results indicate that greater these variables are, greater the BMD at the femoral neck. The BMDTF showed a relationship with age, that older the age, lower the BMD, and taller the height, higher the bone mineral density. In the forearm region, BMD also showed a significant relationship with age, body mass, and height, respectively. The results show that older the age, lower the BMD; however, higher the body mass and height, lower the bone mineral density in analyzed bone site.

For risk of falls correlation, the results showed a statistically significant relation between age and the W10m test, which is one of functional autonomy test components, showing that even older the patient is and the longer he/she has to walk, the higher is the r

Discussion

The present study aimed evaluate the functional autonomy, bone mineral density, and risk of falls of older women with two different body composition profiles. However, for the older women studied ($\bar{X}$ = 66.74 ± 6.27 years) it was observed that only for the RPP test the group with the highest BMI had the best execution time. This occurred, probably, because for the movement of getting up from the floor uses with greater emphasis the stabilizing muscles of the spine and the flexor and extensor muscles of the hip and lower limbs, and due to the greater weight they have greater motor freedom for this movement[25].

In the study by de Campos, Lourenço and Molina[26], less strength was observed in obese women with concomitant reduced lean body mass and osteopenia. The association of these 3 variables also implied slower walking speed, worse balance, and a 2-fold greater chance of frailty, thus causing a greater risk of loss of independence. The age-related loss of lean body mass poses a health risk to the older people throughout aging, as observed in a study of 3633 participants, only 2% of whom had probable or confirmed sarcopenia and a reduced probability of having low appendicular lean mass, low handgrip strength, and slow gait time[7]. These results corroborate those of the present study, when it was observed that people with a higher BMI will have a longer walking time, as seen in the W10m test, given that the overload on joints and muscles during locomotion requires greater energy expenditure and biomechanical exploration due to the possibility of lower cardiorespiratory fitness and muscle strength, which influences mobility.

A study carried out with a group of physically trained older women and untrained older women, stated that individuals with greater lean mass generally have a more active lifestyle, with more adequate nutrition and habits that can have a direct impact on bone health[27]. Muscle strength also leads to better muscle contraction, in turn impacting specific bone sites to produce specific, stimulating deformations in bone cells that are anatomically related to these muscles, explaining the piezoelectric effect in increasing bone mass. This study shows that the relationship between body composition and bone mineral density is complex and depends on anatomical location. Although obesity may be associated with higher BMD in certain regions, such as the femoral neck, this does not imply better overall bone health, especially when the T-Score indicates a risk of osteopenia.

The findings in the present study, with respect to body composition and BMD, were seen that people with higher BMI have better bone mineral density in the total femur and hip region, since the greater muscular effort stimulates an increase in bone mass.

The study by Santos et al.[28] with 128 older people aged 80 to 95 years showed significant, but negative, correlations between the variables body composition and BMD of the femur, spine and whole body. Fat mass showed significant correlations with BMD of the total proximal femur, spine, and whole body, respectively, while lean mass showed correlations of 0.55, 0.52, and 0.67 ($p \leq 0.001$) and ALM (Appendicular Lean Mass) of 0.53, 0.42, 0.62 ($p \leq 0.001$), respectively. These results justify the relationship between BMD and BMI in the present study, which observed better rates for the femoral neck region of people with higher BMI.

A recent systematic review showed that obese older people have a higher risk of suffering a fall, however it did not show an association with fall-related injuries or fractures[29].

According to Marcos-Pardo et al[30], weight and body composition variations, have important implications for the health and functional capacity in older population. Muscle mass decreases with age and is gradually replaced by fat mass, where these changes, when associated with aging, can result in an increase in BMI of 1.5 - 2.5 kg/m^2 in men and women, even when body weight remains constant. This variation provides destability in the older people, and sometimes loss of independence, leaving them vulnerable. Although this study did not show a relationship between falls and body composition, this result can be explained by the physiological decline that occurs with ageing, which has a direct impact on functional mobility.

Body composition changes, increased percentage of intramuscular fat and decreased lean mass due to apoptosis or disuse, result in loss of muscle strength, a fundamental component for maintaining the independence and functional autonomy of the older people, since it allows them to perform the ADLs more effectively and with less risk of injuries and falls[31]. However, this study suggests that body composition is not a single determinant of functional autonomy and that it may differ according to the type of activity required.

A study developed with chinese older women, in an age range between 60 and 63 years, identified the association of obesity with osteopenia and reduced lean mass[32]. These results corroborate the present study, since most of the older women studied belonged to a group of young older women in overweight or obese nutritional status and with compromised functional autonomy and low bone mass index.

In a 2024 systematic review, prepared by Pleticosic-Ramírez et al[33], the influence of body composition was identified, analyzing the effects of fat mass and lean mass on bone mass. However, 42% of the studies analyzed lean mass and agreed that it had a positive influence on bone mass; however, regarding fat mass, there were divergences, because 15% of the articles concluded that fat mass had a positive impact only in females, 15% concluded that fat mass had a negative influence both in males and females, and 12% of the articles indicated that fat mass had a positive impact in both genders.

The study by Lee et al.[34] analyzed the association between fall risk, previous fall events, physical fitness, and gait speeds in 148 older women in South Korea, divided into high and low fall risk groups based on the Berg Balance Scale (BBS). The results showed that participants with BBS scores above the average had 18.2% fewer falls and better performance in physical fitness tests and gait speeds, reinforcing the relationship between good physical fitness and a lower risk of falls.

The study by Jayakody et al.[35] examined the association between falls and longitudinal changes in gait domains and the onset of clinical gait abnormalities in 428 community-dwelling older adults, with a mean age of 77.8 years. The results showed that multiple falls in the first year of follow-up were associated with an accelerated decline in pace ($p < 0.05$) and an increase in gait variability and rhythm ($p < 0.01$), while a single fall was associated only with a faster increase in variability ($p < 0.05$). However, neither single nor multiple falls were associated with the risk of developing clinical gait abnormalities during the study period.

The risk of falls was related to the TUG test applied to 100 older people individuals aged 60 to 80 years, to verify the mobility of the older people in walking 10 meters. A relationship between the risk of falling and the TUG test was observed, and it was identified that for the individuals who fell the result was $\bar{X} = 13.35 \pm 4.57$ seconds and for those who did not fall $\bar{X} = 11.71 \pm 3.61$ seconds ($p<0.001$)[32]. This result corroborates the present study, in a way that the execution of the walk in a longer time generates a higher risk of falls[36].

The results of the present study show a statistically significant relationship for GDLAM, Body Composition and LPDV test and for DMOCF with better results for the group of overweight or obese older women, which can be justified by body weight stimulating bone remodeling conducted by osteocytes, minimizing bone mass loss and muscle mass of the lower limbs[37].

As a limitation of the study, the composition of the sample was exclusively female, limiting the applicability of the results to the male population. From this perspective, research is needed on the participation of men and people be-longing to different population groups[38, 39].

This study's primary focus was on the association between BMD and fall risk in older women, necessitating a streamlined approach to assessing body composition. While DXA provides a more comprehensive assessment, we opted to utilize the widely used and clinically relevant BMI to avoid introducing confounding factors that could obscure the primary relationship under investigation. Furthermore, while acknowledging the potential influence of confounding variables such as chronic diseases, medication use, and nutritional deficiencies on BMD and fall risk, we did not control for these factors in this analysis[40]. Including these variables would have significantly broadened the scope of the study, potentially obscuring the primary findings. Future research should address these limitations to provide a more nuanced understanding of the complex interplay between BMD, body composition, and fall risk in older women.

Conclusions

The study indicates that the prone position elevation test (PRT), a component that assesses muscle strength, motor coordination and balance, showed better performance in the obese group (OBS) compared to the normal weight group (NBC). As for bone mineral density (BMD), there was a significant positive correlation only for the femoral neck, where the OBS group showed higher values than the NBC group, possibly due to the greater weight support and impact in this region. With regard to the risk of falls, body composition was not a determining factor for the incidence of falls in the elderly participants. However, there was a correlation with the 10-meter walk test (W10m), indicating that an increase in body composition is associated with a slower gait.

The study highlights the need for public policies that encourage regular physical activity among the elderly, with a focus on strength training programs at least twice a week. These programs are key to improving muscle mass, functional capacity and reducing the risk of falls, which in turn contributes to better health and quality of life, as well as minimizing dependence on medication and medical care.

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