ORIGINAL ARTICLE

Are the age and the body mass index related with sarcopenia diagnosis criteria in elderly women?

A idade e o índice de massa corporal estão relacionados com os critérios de diagnóstico de sarcopenia em mulheres idosas?

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ABSTRACT

Aging brings changes in the body composition of the elderly, characterized by reduced muscle mass and bone density, increased redistribution of body fat and decreased body mass. These changes are associated with the lack of healthy habits, such as regular exercise and good nutrition, and can lead to a probable diagnosis of sarcopenia. **Objective:** To evaluate the relationship between the age and body composition of active community-dwelling and institutionalized elderly women with the diagnostic criteria for sarcopenia. **Method:** 132 elderly women, aged ≥70 years, without dementia and/or depressive features were selected. After determining body mass index (BMI) they were classified into three groups (n= 13 underweight <22 kg/m^2 n= 43 eutrophic from 22 to 27 kg/m2 and n= 76 overweight >27 kg/m^2). Total muscle mass index (TMMI) by predictive equation, and handgrip strength (HGS) by dynamometry were also evaluated. **Results:** It was observed that with advancing age there is a reduction in BMI, as well as a decrease in TMMI and HGS in the underweight group. There was also a very strong positive correlation between the BMI and the TMMI in the overweight group, showing that the higher the BMI, the higher the TMMI. **Conclusion:** Age and BMI are related to the diagnostic criteria of sarcopenia. Thus, a thorough evaluation of body composition, nutritional status and muscle strength is extremely important in the elderly.

Keywords: Health of the Elderly, Geriatric Assessment, Sarcopenia

RESUMO

O envelhecimento traz modificações na composição corporal do idoso, caracterizadas pela redução da massa muscular e densidade óssea, aumento da redistribuição de gordura corporal, e diminuição de massa corporal. Essas alterações estão associadas à falta de hábitos saudáveis, como exercício físico regular e boa alimentação, podendo levar a um provável diagnóstico de Sarcopenia. **Objetivo:** Observar a relação da idade e composição corporal de idosas comunitárias ativas e institucionalizadas com os critérios diagnósticos da Sarcopenia. **Método:** Foram selecionadas 132 idosas, com idade ≥70 anos, sem traços demenciais e/ou depressivos. Após a determinação do índice de massa corporal (IMC) foram classificadas em três grupos (n= 13 com baixo peso <22 kg/m^2, n= 43 eutróficas de 22 a 27 kg/m^2, e n= 76 com sobrepeso >27 kg/m^2). Foram avaliados ainda, o índice de massa muscular total (IMMT) por equação preditiva, e a força de preensão manual (FPM) por dinamometria. **Resultados:** Foi observado que com o avançar da idade ocorre redução do IMC, assim como diminuição do IMMT e FPM no grupo baixo peso. Também houve uma correlação positiva muito forte entre o IMC e o IMMT no sobrepeso, mostrando que quanto maior o IMC, maior será o IMMT. **Conclusão:** Idade e IMC estão relacionados com os critérios diagnósticos da Sarcopenia. Assim, é de extrema importância a avaliação minuciosa da composição corporal, estado nutricional e da força muscular em idosos.

Palavras-chaves: Saúde do Idoso, Avaliação Geriátrica, Sarcopenia

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INTRODUCTION

The aging process can cause changes in body composition, characterized by a reduction in muscle mass and bone density, as well as an increase and redistribution of body fat to the trunk and viscera.[1,2] Furthermore, the literature shows that after 70 years of age there is a decrease in body mass,[3] associated with sex, decrease in body water and muscle mass.[4]

These aging-related changes associated with the lack of healthy habits, such as regular exercise and good nutrition, may lead to a probable diagnosis of sarcopenia, or even frailty,[5-7] considering that the reduction in the level of physical activity has already been related to advancing age[8] and, the latter, to the incidence of frailty.[9]

Frailty, in turn, is recognized as a syndrome with numerous causes that result in reduced physiological reserves, increasing the vulnerability of the elderly.[5-7] Sarcopenia, currently recognized by the International Classification of Diseases as a muscle disease,10 is characterized by reduced muscle strength, muscle quality and quantity, and low physical performance, being highly related to aging.[5,10,11]

In the presence of these conditions, the elderly have a high risk of falls, hospitalizations, functional disability and, in more severe cases, even death.[5,12] Therefore, a broad evaluation must be performed to detect and prevent health complications in these individuals.[13]

One of the best-known anthropometric indicators, already well documented for screening and monitoring the elderly at health risk, is the BMI,[14] which is easily applied[15] and also allows the analysis of physical variations of individuals, facilitating their nutritional classification in grades, with a good correlation with morbidity and mortality indicators.[16]

OBJECTIVE

Based on this rationale, the purpose of this study was to analyze the relationship of age and body composition of active and institutionalized community-dwelling elderly women with the diagnostic criteria of Sarcopenia. Therefore, we would have two factors that provided, in a simple and objective way, a more complete evaluation for the detection of this pathology.

METHOD

This is a descriptive correlational study, involving elderly women from Bethesda and Betânia long-term care institutions (LTCI) and active community elderly women from Joinville, Santa Catarina, Brazil. The research project was approved by the Ethics Committee on Human Research of the Luteran Institute and Ielusc College under number 3.275.654. To participate in the study, the elderly women signed an Informed Consent Form.

Study participants

Initially, 137 elderly women were screened, 45 of whom were institutionalized and 92 of whom were active community members, aged ≥70 years, selected intentionally. After the initial screening, where they were evaluated by the Mini Mental State Examination and the Geriatric Depression Scale, five of the institutionalized participants were not part of the study, according to exclusion criteria (two with dementia traits, two with impairments secondary to stroke, and one parkinsonian). Thus, 132 elderly women without depressive traits and/or cognitive impairment participated in the study.

It is worth mentioning that the 40 institutionalized women included in the study were diagnosed with the Frailty Syndrome Elderly (FSE), presenting frailty characteristics, according to the criteria already established.[17]

Of these, all had lived for at least three years in the institutions, received the same nutritional guidelines and general health care, such as regular use of medication, monitoring of vital signs, and were independent for their activities of daily living.

Measurement Instruments and Evaluation Procedures

The evaluations began with a registration form containing personal identification data, a brief anamnesis, and a list of twelve pathologies and/or associated dysfunctions (hypertension, diabetes mellitus, stroke, parkinsonism, cardiopathy, pneumopathy, nephropathy, obesity, rheumatic disease, visual, auditory, and/or vestibular deficits), medications in use, and associated treatments.

As initial screening instruments, the Mini Mental State Examination was used, considering cut-off scores according to the level of education[18,19] and the Geriatric Depression Scale to track the elderly with a depressive profile.[20]

The International Physical Activity Questionnaire - Short Form was used to classify the level of physical activity (low, moderate, and high).[20]

Muscle strength was assessed by dynamometry. A TAKEI® handgrip dynamometer was used to assess handgrip strength (HGS). It was measured according to the recommendations of the American Association of Hand Therapists.[21] The equipment was calibrated before data collection. After two measurements of maximum isometric contraction (3 to 5 seconds), the best measurement was recorded.

To assess muscle mass a predictive equation[22] was used, establishing the Total Muscle Mass Index (TMMI), which ranges from 5.9 to 9.5 $kg.m^{-2}$, calculated by the formula below, where the Total Muscle Mass Index is expressed by TMMI ($kg.m^{-2}$)= $TMMI/E^2$.

Total Muscle Mass (TMM)= 0.244.WC + 7.80.H1 - 0.098.A + 6.6.G + Et - 3.3

Where BW= body weight, in kg; H1= height, in meters; A= age, in years; G= gender (female= 0 and male= 1; Et= ethnicity (Caucasian= 0, Asian= -1.2; Afro-descendant = 1.4).

A digital scale with 50g resolution was also used to measure body mass (Model 2096PP, Toledo®, BR), a stadiometer with 1 mm resolution to measure height (Model ES2020, Manufacturer American Medical do Brasil Ltda, Sanny®, BR).

After determining the BMI, the elderly women were classified into three groups: Low weight <22 kg/m^2; Eutrophic 22 to 27 kg/m^2; and Overweight >27 kg/m^2.

This classification of nutritional status based on BMI was proposed by the Nutrition Screening Initiative, considering the changes in body composition inherent to aging. These cut points were adopted for the elderly in Brazil, according to

recommendations of the Food and Nutritional Surveillance System. This classification seems to be more appropriate for the elderly population than the classic general classification recommended by the WHO.[23]

Data tabulation and analysis was performed in GraphPad Prism 6® software. Descriptive statistical data such as means and standard deviations were obtained. To verify the differences between the groups classified by BMI the Student's t test was applied with a 95% significance level ($p<0.05$).

To compare the differences between the groups ANOVA was used, and to verify the relationship between age and the other variables in the three groups a correlation matrix (Pearson's test) was used. A with a significance level of 95% ($p<0.05$) was considered.

RESULTS

The study had the participation of 132 elderly women, without depressive traits and/or cognitive impairment. The 40 institutionalized women were classified as sedentary, and the community-dwelling elderly women were classified as irregularly active (two free active exercise sessions totaling 120 minutes per week), according to the International Physical Activity Questionnaire.

The participants were divided into three groups according to BMI classification, since there was no difference between the institutionalized and community elderly women (p 0.179), although a difference was observed in relation to age, BMI and HGS ($p<0.001$). Thus, Group 1 was composed of underweight elderly women <22 kg/m^2 (n= 13); Group 2 eutrophic 22 to 27 kg/m^2 (n= 43); and Group 3 overweight >27 kg/m^2 (n= 76).

Next, the results found in the study by BMI classification are presented, as described in the methodology. Table 1 shows the descriptive statistics data (means and standard deviations) for each controlled variable. These were also analyzed for possible differences between groups, based on the eutrophic group (BMI between 22 and 27 kg/m^2).

Table 1. Summary of results and differences between the groups

Variable	Group 1 (n=13) M (SD)	Group 2 (n=43) M (SD)	Group 3 (n=76) M (SD)	p
Age	78.0 (10.2)	71.7 (8.1)	72.2 (8.4)	NS
BMI	19.9 (1.1)	25.1 (1.4)	31.3 (8.4)	0.000*
TMMI	5.3 (0.5)	6.8 (0.6)	8.4 (1.0)	0.000*
HGS	20.7 (5.6)	23.5 (7.3)	22.5 (6.0)	NS

Group 1 (BMI <22 kg/m2); Group 2 (BMI 22 to 27 kg/m2); Group 3 (BMI >27 kg/m2); N, Number of elderly women; M, Mean; SD, Standard deviation; Age, in years; BMI, Body Mass Index (kg/m2); TMMI, Total Muscle Mass Index (5.9 to 9.5 kg.m-2); HGS, Handgrip Strength (kgf); p significant difference by ANOVA (p<0.01)*

The first interesting aspect to be observed in Table 1 is that the BMI decreases as age advances, although the age difference between the groups was not significant, this fact draws attention. Also, it can be seen that the groups have statistically significant differences in mean BMI and TMMI. Of the 132 women participating in the study, most are overweight (57.5%), and as for the BMI, only the underweight group (BMI 5.3 kg.m^{-2}) had rates below the normative values (5.9 to 9.5 kg.m^{-2}). The best mean HGS is from the eutrophic group, being 11.9% higher than the underweight group and 4.3% higher than the overweight group.

Table 2. Correlation analysis of Age and BMI versus TMMI and HGS

		Group 1 (n=13)		Group 2 (n= 43)		Group 3 (n= 76)	
		TMMI	HGS	TMMI	HGS	TMMI	HGS
Age	r	-0.89	-0.74	-0.56	-0.43	-0.47	-0.54
	p	0.000*	0.004*	0.000*	0.003*	0.000*	0.000*
BMI	r	0.23	-0.13	0.51	0.05	0.85	0.20
	p	0.452	0.684	0.000*	0.749	0.000*	0.081

*Group 1 (BMI <22 kg/m^2); Group 2 (BMI 22 to 27 kg/m^2); Group 3 (BMI >27 kg/m^2); N, Number of elderly women; Age, in years; BMI, Body Mass Index (kg/m^2); TMMI, Total Muscle Mass Index (5.9 to 9.5 kg.m^{-2}); HGS, Handgrip Strength (kgf); * significant correlation (p<0.05)*

Table 2 shows that there was a strong negative correlation between age and TMMI and HGS (r -0.89; p<0.000 and r -0.74; p 0.004, respectively) in Group 1, i.e., as age advances there is a reduction of both indexes in underweight elderly women.

There was also a very strong positive correlation between BMI and TMMI (r 0.85; p<0.000) in Group 3, showing that the higher the BMI, the higher the TMMI. At least in part, this can be explained because the TMMI obtained by the predictive equation adopted in this study also uses variables such as weight and height, which are the basis for calculating the BMI, although this equation uses other variables in its composition.[22]

DISCUSSION

It is known that as age advances, changes in body composition can occur, such as fat tissue redistribution and muscle mass reduction. Thus, these changes can lead to mobility impairment, increased risk of falls, recurrent hospitalizations, functional disability, institutionalization, and even death.[24]

When analyzing the results found in this research, it was verified that with advancing age there is a reduction in BMI.

According to Vieira et al.[25] there is a significant reduction in BMI with advancing age and this is explained by physiological changes resulting from aging. Such as, reduced sense of smell and vision, reduced taste buds, chewing difficulties, use of ill-fitting dental prostheses, and these, are factors that contribute to malnutrition in the elderly. Morphological alterations of the stomach and difficulties in absorbing nutrients, as well as the slowing of gastric emptying, with a consequent increase in satiety time, are additional factors in the development of malnutrition.[25]

This finding also corroborates the study of Carneiro et al.[9] where they report that the reduction in BMI predominates in longevous elderly and is highly related to sarcopenia. The study by Sampaio et al.[26] brings that BMI is influenced by sarcopenia during the aging process, as it is a disease that is characterized by the loss of muscle mass accompanied by the reduction of muscle strength. Other factors related to sarcopenia are elderly who do not have a marital life, low income, low education, and

loneliness, consequently associated with low availability of food, and thus malnutrition.[5]

Still regarding BMI, a predominance of overweight elderly women (57.5%) was found. The deposition of fat mass in women occurs later, after menopause, especially due to the fall in estrogen levels, causing an accumulation of fat that ends up reflecting on BMI values.[23]

These facts impair their functional mobility, being an important predictor for sarcopenia.[3,27] Oliveira et al.[28] state in their findings that elderly people who practice physical activities with light to moderate intensity, such as walking, have a lower tendency to present sarcopenia. The study by Cruz-Jentoft et al.[10] states in their results that a training program for the elderly is more beneficial when compared to low intensity exercises, such as domestic activities.

Despite these divergences regarding the intensity of the exercise, it should be noted that the loss of muscle mass is more pronounced in sedentary individuals, with a reduction of up to 50%.[29] Thus, it is clear that it is important to maintain weight at levels close to normality and practice regular physical activity, regardless of the type, in order to prevent and/or delay possible complications arising from aging.

Another interesting result was the strong negative correlation of age with the HGS, a measurement that reflects the patient's overall strength because it has a good correlation with large muscle groups.[30] It was observed that with advancing age, this index decreases. This finding corroborates another study, which found in underweight/undernourished elderly people a worse performance in muscle strength tests.[31]

Advancing age dramatically affects muscle strength levels. There is a relationship between the loss of muscle mass and the reduction in muscle strength.[30] Such negative effects on muscle mass and strength are, at least in part, explained by the fall in hormone levels, and also by neural factors such as the degeneration of motor units.[25] It is worth remembering that currently, the reduction in muscle strength is the most disabling aspect in the characterization of sarcopenia, since it reflects dramatically on the functional performance of the elderly.[10]

CONCLUSION

Considering that sarcopenia is a disease that affects a large part of the elderly population and is related to serious negative outcomes, one must strongly consider the recommendations of the latest European Consensus for the diagnosis of sarcopenia, which indicates as a key procedure a thorough assessment of muscle strength and mass for its detection, and thus plan the best treatment strategy to minimize or reverse the condition.

The results found in this research, instigate the belief that age and BMI are related with sarcopenia diagnosis criteria in elderly women, a fact that corroborates our hypothesis. Thus, we have two more important factors to consider in the assessment for detecting sarcopenia in elderly women, which are simple, easy to apply and objective.

Therefore, throughout life, special attention must be given to weight control and to encouraging healthy living habits such as regular physical activity and a balanced diet. Such recommendations should be recommended by all professionals involved in the management of the elderly.

Further research on this topic is needed, covering a greater number of elderly women, as well as older men.

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