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Regional Differences in the Diagnosis of Sarcopenia in Older People in Brazil

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Abstract

Introduction: Sarcopenia is a prevalent condition, and that is strongly associated with morbimortality outcomes. The optimal way to diagnose sarcopenia is currently a matter of debate. Despite evidence suggesting differences in body composition and physical performance of individuals from different regions, the diagnosis of sarcopenia in Brazil is still conducted using cutoff values established by international consensus. Therefore, the objective of this study was to establish cutoff values for appendicular muscle mass and muscle strength in a population of elderly outpatients with cardiovascular diseases from the city of São Paulo, using this data to compare populations with sarcopenia diagnosed in Brazil with individuals diagnosed using the European consensus values.

Materials and Methods: This was a cross-sectional analysis including 502 older individuals from the SARCOS-Brazil study. All subjects underwent densitometry to assess muscle mass and measure strength using a manual dynamometer. The cutoff values for the SARCOS-Brazil criteria were obtained from the 25th percentile of each variable.

Results and Discussion: There was no difference in the prevalence of muscle weakness using the two methods (180 patients, 35.9% of the sample). However, a difference was observed concerning low muscle mass. According to the European criteria, a total of 215 older individuals (42.8%) had low muscle mass and 123 (24.5%) according to the SARCOS-Brazil criteria. The prevalence of sarcopenia was 20.3% according to European criteria versus 13.7% according to the SARCOS-Brazil criteria. The kappa coefficient was 0.79.

Conclusion: This study suggests that weakness and muscle mass can, in isolation, predict variables related to past vulnerability outcomes, as well as highlights the possibility of using regional cutoff values for the diagnosis of sarcopenia.

Keywords: Sarcopenia; Aging; Muscle mass; Muscle strength

Abbreviations

CVA: Cerebrovascular Accident; DM: Diabetes Mellitus; DLP: Dyslipidemia; COPD: Chronic Obstructive Pulmonary Disease; CKD: Non-Dialytic Chronic Kidney Disease; DXA: X-Ray Dual Emission Densitometry; SAH: Systemic Arterial Hypertension; CHF: Congestive Heart Failure; IMC: Body Mass Index; MEEM: Mini-Mental Status Examination; ASFFM Appendicular Skeletal Fat-Free Mass

Introduction

Sarcopenia is defined as a decrease of physical ability associated with loss of muscle mass due to aging. The prevalence varies according to country, ethnicity, diagnostic criteria, and population (community, hospital environment, or permanent residency). The incidence ranges between 2.5 to 27.2% in women and 3.1 to 20.4% in men older than 65 [1]. In Brazil, it is estimated that 17% of people older than 60 years are sarcopenic [2].

The importance of sarcopenia is related to the risk of fractures and falls [3-5] and the development of cardiovascular diseases [6,7] frailty [8], reduction in the quality of life [9], increasing hospitalization [10], and death [11-13]. However, the diversity of the diagnostic criteria and cutoff values adopted for low muscle mass and weakness have limited the standardization of universal criteria for sarcopenia and reduced the adoption of preventive policies against the progression of unwanted outcomes.

The differences among diagnostic methods have generated a growing instability in determining those variables and values that would be more appropriate for sex, age range, ethnicity, and country of origin. The European Working Group on Sarcopenia in Older People - EWGSOP II [14] suggested muscular mass and physical performance measures to identify sarcopenia. The American Group Foundation for the National Institutes of Health – FNIH [15] indicated that physical performance measures only would be sufficient to describe individuals with physical vulnerability. Nevertheless, there is a significant difference between values of cutoff adopted for these criteria according to sex, ethnicity [16,17], and country of origin [18-20].

Significant differences in body composition and physical

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performance have been shown in terms of ethnicity. A cross-sectional study conducted in 2012 in Boston, USA, found that Hispanic people present on average lower muscle mass than White and Black people, in addition to low grip strength [21]. Despite this evidence, international consensus determining cutoff values are based on regional population studies stratified by sex, and there is no stratification by ethnicity.

This issue related to cutoff values is even more relevant in Brazil. This is because there are significant numbers of individuals of African descent and other ethnic groups and varied eating habits, physical exercise practices, sun exposure, and smoking, among others, that may modulate the quality of muscle mass [22]. Despite this heterogeneity, there are no data on muscle mass and physical performance in Brazilians that can be used to diagnose sarcopenia. This situation limits the understanding of related outcomes, given that the values used are based on criteria for American and European populations.

Objectives

The objective of this study was to evaluate cutoff values for appendicular muscle mass and strength in an older outpatient population with cardiovascular diseases from the city of São Paulo, SP (SARCOS-Brazil criteria) and to investigate whether low muscle mass, muscle weakness and sarcopenia, either by the European consensus (EWGSOP II) or by SARCOS-Brazil, were associated with past vulnerability variables.

Materials and Methods

Design

This was a cross-sectional analysis of the Sarcopenia and Osteoporosis Study in Older Individuals with Cardiovascular Diseases (SARCOS), a prospective study concerning the association of sarcopenia and osteoporosis as a common pathway for functional loss and weakness among ambulatory elderly patients.

Sample

The sample included 502 older adults of both sexes and any ethnicity among outpatients from the cardiogeriatrics department of the Federal University of São Paulo, SP, Brazil. Exclusion criteria were nationality other than Brazilian, unstable medical conditions, any type of cancer within the previous five years, chronic renal failure requiring dialysis, Parkinson's disease, any severe infectious disease requiring hospitalization in the previous month, moderate or severe dementia according to the Mini-Mental Status Examination, and the use of an auxiliary gait device.

After providing informed written consent, individuals underwent a physical examination, physical performance test, bone density measurement, and total body test. The Ethical and Research Committee of the institution where the study was conducted provided approval (CEP/UNIFESP nº682659).

Variables of interest

Demographic characteristics: We evaluated the following demographic characteristics: age, sex, marital status (single, married, separated, divorced, widow or widower), personal income, body mass index (BMI), and ethnicity. The characterization of ethnicity was self-identified as White, Black, or Asian.

Cardiovascular and chronic diseases: We evaluated the following cardiovascular diseases: Systemic Arterial Hypertension (SAH), Diabetes Mellitus (DM), Congestive Heart Failure (CHF), previous Cerebral Vascular Accident (CVA) (more than 6 months prior), and Dyslipidemia (DLP). We considered the following chronic diseases: Chronic Kidney Disease (CKD) not requiring dialysis, Chronic Obstructive Pulmonary Disease (COPD), and past cancer history. All information on diseases was obtained from medical records.

Lifestyle: At the outset of the study, we gathered information on lifestyle in terms of current or former smoking habits, total cigarette packs per year, and current or former consumption of alcohol.

Measures of body composition: All subjects underwent dual-energy x-ray absorptiometry (DXA) (GE Lunar; DPX-MD 73477, GE Medical Systems, Madison, WI, EUA) to measure parameters of total body composition and regional muscle mass (left arm and leg, right and left arm, and trunk) in kilograms and percentage. The appendicular skeletal muscle mass was obtained by summing the muscle mass of arms and legs (kilograms) divided by squared height (m), resulting in Appendicular Skeletal Fat-Free Mass (ASFFM). The BMI was calculated as weight (kilograms) divided by the squared height (m). The total body fat percentage was calculated as the sum of the fat of arms, legs, trunk, and pelvis. In our laboratory, *in vivo* precision (variation coefficient, CV%) was based on repetitive screening of ten individuals with repositioning of 1.3% for fat mass and 0.8% for fat-free mass.

Strength measures: Strength pressure of the upper limb was measured using a manual dynamometer (Jamar; TEC; Clifton, NJ, USA) determined by three consecutive measures and recording considered maximum value.

Sarcopenia diagnosis:

Sarcopenia according to the European criteria: Sarcopenia was diagnosed according to the recommendation of EWGSOP II (14), in which individuals with pressure strength equivalent or inferior to 27 kilograms for men and 16 kilograms for women and ASFFM < 7.0 kilograms/m2 for men and < 6.0 kilograms/m2 for women were considered sarcopenic. In this situation, cutoff values are the same for all ethnicities, according to the consensus opinion.

Sarcopenia according to the 25th percentile of the sample: We determined parameters of ASFFM and muscular strength for the Brazilian population with percentiles 25 of the sample for each of the variables [21,23]. The flowchart for diagnosis according to SARCOS-Brazil criteria followed those used by EWGSOP II, i.e., weakness associated with low ASFFM.

Variables of previous vulnerability: Patients with low muscle mass and muscular weakness and who had sarcopenia according to one of the criteria (SARCOS-Brazil and EWGSOP II) were analyzed concerning two variables of previous vulnerability: falls and hospitalizations.

Statistical analysis

Clinical features were expressed as total numbers and percentages for qualitative variables. We included standard deviations for normally distributed quantitative data and median + interquartile interval for non-normally distributed data. The agreement between

Table 1: Characteristics of the population (n=502).

Variable	n (%)
Age (years)	78.4 ± 7.1
Women (n)	277 (55.2)
Ethnicity (n)	
White	339 (67.5)
Black	145 (28.9)
Asian	18 (3.6)
Marital Status (n)	
Single	38 (7.6)
Married	234 (46.9)
Separated	21 (4.2)
Divorced	24 (4.8)
Widow or widower	182 (36.5)
Personal income (minimal salaries)	1.0 (1.0)
Body mass index (kilograms/m^2)	26.8 ± 4.6
Former smoking (n)	249 (49.7)
Former drinker (n)	74 (14.7)
Systemic arterial hypertension (n)	465 (92.8)
Diabetes (n)	203 (40.6)
Dyslipidemia (n)	239 (69.7)
Congestive heart failure (n)	158 (31.5)
Chronic renal disease (n)	88 (17.6)
Obstructive chronic pulmonary disease (n)	48 (9.6)
Previous stroke (n)	63 (12.5)
Previous cancer (n)	66 (13.1)

*Age variables and body mass index are expressed on means ± standard deviation.
*Personal income variable is expressed in means and interquartile interval.
*Other variables expressed in the number of cases and percentages.

SARCOS-Brazil and EWGSOP II criteria for sarcopenia diagnosis were analyzed using contingency tables and kappa coefficient. Sarcopenic groups according to each criterion were analyzed concerning previous vulnerability using multiple logistic regression controlling for confounding variables. The variables included in multivariate models were selected based on the association found in simple logistic regression. Data analysis was performed using SPSS (22.0, Chicago, EUA).

Results

Of 502 older adults, 277 (55.2%) were women, and the mean age was 78.4 ± 7.1 years (Table 1). Concerning ethnicity, 339 (67.5%) were White, 145 (28.9%) were Black, and 18 (3.6%) were Asian. Most participants were married (46.9%) with a mean personal income of 1.6 ± 1.5 times the minimum salary. The mean body mass index was 26.8 ± 4.6 kilograms/m^2. The patients had several comorbidities, most frequently DM (40.6%), SAH (92.8%), DLP (69.7%), CHF (31.5%), COPD (9.6%), CVA (12.5%), and history cancer (13.1%).

Due to the similarity of cutoff points between SARCOS-Brazil and European criteria concerning muscular strength (26 kilograms for men and 16 kilograms for women *vs.* 27 kilograms for men and 16 kilograms for women, respectively), there was no difference in the prevalence of muscular strength using the two methods (108 patients, 35.9%). However, concerning low muscle mass, there was a difference. There were 215 older adults (42.8%) with low muscle mass diagnosed by European criteria and 123 (24.5%) diagnosed using SARCOS-Brazil criteria. Differences between them gave rise to a third group of individuals with low ASFFM according to the European criteria but not according to SARCOS-Brazil, resulting in divergence in the number of individuals diagnosed with sarcopenia: 20.3% by European criteria versus 13.7% by SARCOS-Brazil criteria, i.e., a difference of 6.6%. The kappa coefficient for sarcopenia was 0.79, indicating satisfactory concordance despite the divergence (Table 2).

Sarcopenia characteristics according to each of the criteria are displayed in Table 3. Sarcopenia patients by SARCOS-Brazil criteria were older and had a higher prevalence of DLP, COPD, CVA, and previous cancer. Sarcopenic individuals diagnosed using the European criteria presented higher numbers of former smokers, former drinkers, diabetic, hypertensives, cases of heart failure, and chronic renal diseases.

We then determined whether low muscle mass, muscle weakness, and sarcopenia, either by the European criteria or by the SARCOS-Brazil, were associated with previous vulnerability variables, including falls and hospitalizations (Table 4). Muscle weakness was associated with a greater chance of falls in the previous 6 months (OR 1.49; p-value = 0.024). There was a tendency of association with hospitalizations in the previous 12 months (OR 1.39; p-value = 0.073). Low muscle mass was associated with hospitalizations in the previous 12 months only when considering the European criteria, with borderline statistical significance (OR 1.52; p-value = 0.054). There was an association between sarcopenia and falls in the previous 6 months when the SARCOS-Brazil criteria were used (adjusted OR 1.77; p-value 0.040), but not by the European criteria (adjusted OR 1.31; p-value = 0.278). However, the European criteria showed a greater association with hospitalizations in the previous 12 months (adjusted OR 1.73; p-value = 0.047), while the SARCOS-Brazil criteria did not (adjusted OR 0.93; p-value = 0.830).

Discussion

To the best of our knowledge, the present study is the first to use regional and non-international values to define sarcopenia. The main contributions of this study are as follows: I - Similarity of cutoff points for muscular weakness and low muscular mass of the isolated form concerning variable of previous vulnerability; II - Importance of weakness and low muscle mass in the isolated form concerning

Table 2: Prevalence of individuals with low muscle mass, weakness, and sarcopenia according to SARCOS-Brazil criteria and European criteria (n=502).

		European criteria		
	SARCOS-Brazil criteria	Yes	No	Kappa
Low muscle mass (%)	Yes	123 (24.5%)	-	
	No	92 (18.3%)	287 (57.2%)	0.61
Muscular weakness (%)	Yes	180 (35.9%)	-	
	No	-	322 (64.1%)	1
Sarcopenia (%)	Yes	69 (13.7%)	-	
	No	33 (6.6%)	400 (79.7%)	0.79

Table 3: Clinical features of a group of sarcopenic patients according to SARCOS-Brazil and European criteria.

Variables	Sarcopenic according to SARCOS-Brazil criteria (n=69)	Sarcopenic according to European criteria (n=102)
Age (years)	82.9 ± 6.9	80.9 ± 7.1
Women (n)	38 (55.1)	90 (57.0)
Ethnicity (n)		
White	12 (17.4)	32 (20.3)
Black	6 (8.7)	9 (5.7)
Asian	51 (73.9)	117 (74.1)
Marital status (n)		
Single	5 (7.4)	16 (10.3)
Married	26 (38.2)	63 (40.4)
Separated	2 (2.9)	3 (1.9)
Divorced	1 (1.5)	4 (2.6)
Widow or widower	34 (50.0)	70 (44.9)
Personal income (Minimum salaries)	1.0 (1.0)	1.0 (0.5)
Body Mass Index (kilograms/m^2)	29 (42.0)	77 (49.0)
Former smoking (n)	9 (13.0)	25 (15.8)
Former drinker (n)	22.4 ± 3.1	24.0 ± 3.8
Systemic arterial hypertension (n)	24 (34.8)	57 (36.3)
Diabetes (n)	64 (92.8)	150 (94.9)
Dyslipidemia (n)	52 (75.4)	111 (70.3)
Congestive heart failure (n)	19 (27.5)	47 (29.7)
Chronic renal disease (n)	12 (17.4)	31 (19.7)
Obstructive chronic pulmonary Diseases (n)	6 (8.7)	13 (8.2)
Previous stroke (n)	16 (23.2)	30 (19.0)
Previous cancer (n)	12 (17.4)	27 (17.1)

*Age variables and body mass index are expressed on means ± standard deviation.
*Personal income variable is expressed in means and interquartile interval.
*Other variables expressed in the number of cases and percentages.

variable of previous vulnerability; and III - Importance of using or not using different concepts for values of regional cutoff values to determine sarcopenia.

The differences between the values obtained by the SARCOS-Brazil and those found in the European consensus for low muscle mass, despite similar strength, suggest that the Brazilian population may have higher strength and lower muscle mass. This can be due to the genetic influence of African descendants in our population that is associated with greater values of strength than Caucasian populations [24]. Another factor would be the use of angiotensin-converting enzyme inhibitors widely used by this population because they were recruited from the cardiogeriatrics department; this medication may help preserve muscle strength and physical performance in the elderly [25]. Finally, unknown variables might lead to weakness of the association between muscle mass and strength, including the amount of body fat, physical inactivity, and others [26,27]. From an epidemiological point of view, it is crucial to determine how weakness, low muscle mass, and the association between the two impact the diagnosis of sarcopenia. In this study, we did not analyze prospective endpoints, which limits our conclusions.

Nevertheless, when analyzing the association with clinical vulnerability variables, we observed that both appear critical to identifying older individuals with previous vulnerabilities. Muscular weakness was significantly associated with falls within the previous 6 months (p-value = 0.024), whereas low muscle mass was borderline significantly associated with a more significant number of hospitalizations in the previous 12 months (p-value = 0.054). This result contradicts findings previously reported in 2019 when no association was found between low muscle mass and relevant outcomes such as loss of mobility, mortality, hip fracture, or limitation in basic activities of daily living, while low muscle strength was associated with all of them [28]. This finding suggests that low muscle mass can be an essential variable, depending on region or country.

Finally, our findings highlight the importance of considering regional values when diagnosing sarcopenia. Regional differences aid the identification of phenotypes, and endpoints may be diverse. Nevertheless, the consensus among researchers is paramount, and the determination of the phenotype of sarcopenia will enable us to define the best diagnostic criteria, and therefore determine optimal cutoff values for each population.

Some essential features of this study limit the generalization of our findings. First, the sample was from the cardiogeriatrics department of a single institution. For this reason, participants presented a higher prevalence of cardiovascular disease than the general population and did not necessarily represent the clinical and epidemiological characteristics of the entire Brazilian population. Second, because this was a cross-sectional cohort study, we could not evaluate clinical outcomes and results in the medium and long term, complicating any understanding that would improve variables to define sarcopenia.

Table 4: Association of weakness, low muscle mass, and sarcopenia with past vulnerability variables.

	Falls within the previous 6 months		Hospitalizations in the previous 12 months	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Muscle weakness (European and SARCOS-Brazil criteria)	1.49 (1.05-2.11)	0.024	1.39 (0.97-2.00)	0.073
Low muscle mass European criteria	1.14 (0.76-1.70)	0.52	1.52 (0.99-2.32)	0.054
Low muscle mass SARCOS-Brazil criteria	1.27 (0.81-1.99)	0.293	0.77 (0.46-1.28)	0.31
Sarcopenia European criteria	1.31 (0.80-2.14)*	0.278*	1.73 (1.01-2.97)*	0.047*
Sarcopenia SARCOS-Brazil criteria	1.77 (1.03-3.08)*	0.040*	0.93 (0.47-1.82)*	0.830*

OR: odds ratio. CI: confidence interval.
*For fall within the previous 6 months, logistic regression was adjusted to DRC, EVA, and sex. For hospitalization in the previous 12 months, it was adjusted by DM, DLP, and age.

Finally, we did not evaluate some clinical variables that are critical sarcopenic patients, including nutrition, physical activity, cognitive diseases, and inflammatory markers, among others.

Nevertheless, our study has important implications for clinical practice and future research. By identifying differences in regional cutoff values, our findings should encourage population studies to define these cutoff values for each location. Furthermore, we corroborated the current consensus regarding the importance of muscle mass and weakness to diagnose sarcopenia and identify individuals with previous vulnerability.

Conclusions

The cutoff points values for muscular mass differed from those in European consensus, whereas muscular strength was the same. According to SARCOS-Brazil criteria, Sarcopenia had the highest association with falls during the previous 6 months, whereas by European criteria, it was associated with hospitalization in the previous 12 months. The results suggest that weakness and muscle mass can, in isolation, predict variables related to past vulnerability outcomes and highlight the possibility of using regional cutoff values to diagnose sarcopenia.

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