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Sarcopenia in Brazilian rural and urban elderly women: Is there any difference?

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ABSTRACT

Objectives: There are many studies concerning sarcopenia prevalence from all over the world. However, to our knowledge, only two compared urban and rural sarcopenia and to date, none have been conducted in the Americas. The aim of this study was to evaluate the prevalence of sarcopenia in a convenience sample of women ≥60 y of age who underwent bone densitometry and live in urban and rural areas of southern Brazil.

Methods: This was a cross-sectional study comprising 205 women ≥60 y of age who had undergone bone densitometry. *Sarcopenia* was defined according to the criteria recommended by the European Working Group on Sarcopenia in Older People. The diagnosis combined the evaluation of muscle mass (assessed by dual-energy x-ray absorptiometry), muscle strength (measured using a manual digital dynamometer), and muscular performance (evaluated by the 4-m walking speed test). Sociodemographic data, smoking status, chronic conditions, number of falls and fractures in the past year, and level of physical activity also were collected.

Results: Sarcopenia was present in 2.4% of the total sample. Urban and rural populations significantly differed in terms of schooling ($P < 0.001$), occupation ($P = 0.010$), socioeconomic status ($P = 0.001$), and smoking status ($P = 0.006$). The environment in which the women lived was independently associated with sarcopenia (odds ratio, 9.561; 95% confidence interval, 1.021–89.523; $P = 0.048$). The prevalence of sarcopenia was significantly higher in the urban women than in the rural group (5.7 versus 0.7%, respectively; $P = 0.047$). After multivariate analysis, the environment of the women's residence remained independently associated with sarcopenia.

Conclusion: Urban elderly women are more vulnerable to sarcopenia than rural elderly women.

Introduction

Sarcopenia was initially defined as an age-related loss of muscle mass [1]. Recent definitions have incorporated elements of strength and physical performance, as well as muscle mass in the identification criteria [2] and causes other than aging in its etiology.

One of the most accepted current definitions of sarcopenia was proposed by the European Working Group on Sarcopenia in Older People (EWGSOP), which defined sarcopenia as a syndrome characterized by the progressive and generalized loss of skeletal muscle mass and strength [3]. The EWGSOP also suggested that the potential for falls, fractures, and fragility [4–6] observed in sarcopenic individuals lead to physical disability, poor quality of life, and increased mortality [3,7].

A large disparity in the prevalence of sarcopenia is found in the literature, varying from 1% to 29% among the different populations studied [8]. This variability can be due to the lack of unanimity in the diagnostic criteria, in which different techniques were used to evaluate muscle mass [9,10], to different ethnicities, different social contexts, both cultural and lifestyle, as well as the variation in the age of the studied population [11].

According to a recent meta-analysis that evaluated 31 studies on sarcopenia in Brazil, the mean prevalence of sarcopenia in the elderly population was 17%. From the studies evaluated, 75% were carried out in urban areas of Brazil, with no data on the rural

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population [12]. Although Brazil is highly urbanized, with 84.7% of the population living in cities, 26.6% of individuals ≥65 y of age live rural areas [13].

To better understand this population, which often is disregarded in epidemiologic studies based on the hypothesis that their health indicators and lifestyle may be different from urban elders, it is important to study sarcopenia and the factors that influence its development considering the aging Brazilian population and the health problems associated with the aging process. Therefore, the aim of this study was to evaluate the prevalence of sarcopenia using EWGSOP recommended methods in a convenience sample of women ≥60 y of age who underwent bone densitometry and live in the urban and rural areas of the south region of Brazil.

Materials and methods

This was a cross-sectional study of women (≥60 y of age) who underwent bone densitometry by medic indication for evaluation of bone mineral density or to diagnosis or for follow-up of osteoporosis treatment at a specialized diagnostic imaging clinic in the northwest region of Rio Grande do Sul (a state in the south of Brazil), between July 2016 and April 2017. This study is part of a larger project that was approved by the Research Ethics Committee of the Universidade Federal de Santa Maria. All the precepts of Resolution no. 466/12 of the Brazilian National Health Council were followed, and all participants signed an informed consent.

The participants' place of residence was classified as "urban" or "rural" according to the setting in which they lived. Each woman provided her complete address and was classified as "urban" or "rural" according to the environmental context of her place of residence. Those in an urban area lived in central regions, whereas women in rural regions lived outside the city limits, in the country area that surrounds the evaluated city. Sociodemographic data (age, ethnicity, marital status, schooling, and occupation), smoking status, chronic conditions (dyslipidemia, diabetes mellitus, systemic arterial hypertension, coronary artery disease, rheumatoid arthritis, and cancer), and the number of falls and bone fractures in the past year were collected through a standardized questionnaire. Furthermore, socioeconomic status was evaluated through a questionnaire of the Brazilian Association of Research Companies (in Portuguese, Associação Brasileira de Empresas de Pesquisa - ABEP) [14], which considers the possession of certain consumer goods, the head of the household's schooling, the presence of a maid, and access to public services. According to this scale, individuals in category A are considered the wealthiest, and those in category E, the poorest.

The participants' physical activity status was classified through the International Physical Activity Questionnaire (IPAQ) [15]. Time spent in intensive activities was multiplied by 2, and the women who reported <150 min of physical activity per week were considered inactive [16].

Anthropometric parameters evaluated were weight, height, and body mass index (BMI). Weight was measured with a calibrated anthropometric scale with the women standing barefoot and wearing only a hospital gown. Height was measured with the anthropometric scale's metal stadiometer. Participants stood in the upright position, with their arms loose on the sides of the body and heels together. BMI was calculated through the Quetelét equation, dividing weight (kg) by the squared height (m^2). BMI was then classified by the World Health Organization (WHO) reference [17] as underweight: <18.5 kg/m^2, normal weight: 18.5 to 24.9 kg/m^2, overweight: 25 to 29.9 kg/m^2, obesity: ≥30 kg/m^2.

Sarcopenia definition

According to EWGSOP recommendations, sarcopenia was diagnosed combining the evaluation of muscle mass, strength, and muscular performance [3].

Muscle mass was assessed by dual-energy x-ray absorptiometry (GE Lunar DPX-NT 150951; General Electric Healthcare, Madison, WI, USA), and the appendicular skeletal muscle mass was estimated through the following equation:

$$\left[\sum_{\text{lower+upper limbs muscle mass}}(kg)/\text{m}^2\right]$$

Values <5.62 kg/m^2 were considered "low muscle mass," according to a previous study with a similar Brazilian population [18].

Muscle strength was measured using a manual digital dynamometer (EH101; Camry, Guangdong, China).The women sat comfortably in a chair, with the forearm resting relaxed on the chair's arm, flexed at 90 degrees, and wrapping the evaluated hand around the device's handle [19]. The interviewer provided verbal stimuli to encourage the participants to perform the maximum strength possible for each repetition of the exam. Three measurements were performed for each hand alternately, and the highest value found among the six measures was used. Values <20 kg were considered "low muscle strength" [20].

To evaluate muscular performance, the 4-m walking speed test was applied. The interviewer, using a digital stopwatch, recorded the time it took for the women to walk a previously established distance of 4 m. The test was conducted twice, and the lowest value of the two measurements was considered and converted into walking speed. Values <0.8 m/s were considered "loss of muscle performance" [20].

Considering the three aforementioned tests, the women were further classified as "no sarcopenia," "presarcopenic" (low muscle mass, but adequate manual strength and walking speed), "sarcopenic" (low muscle mass and low muscle strength or low walking speed), and "severe sarcopenic" (low muscle mass, low muscle strength, and low walking speed). For analytical purposes, those classified as presarcopenic were included in the group "no sarcopenia" and the sarcopenic and severe sarcopenic participants were grouped in the "sarcopenia" category.

Statistical analysis

Data were analyzed using the SPSS version 21 (SPSS Inc.; Chicago, IL, USA). The normal distribution of the age, weight, and height variables were verified using the Kolmogorov–Smirnoff test and the measure shows a normal distribution. Descriptive analysis was performed through measures of frequency, central tendency, and dispersion. The association between the categorical variables was verified through Pearson's χ^2 test and Fischer's exact test. Variables with $P < 0.2$ in the bivariate analysis were kept for multivariate analysis using the backward stepwise method of the logistic regression model. The confidence level of 95% ($\alpha = 5\%$) was considered in all the analyses.

Results

Of the 207 invited women, only 2 refused to participate in the study. Therefore, 205 women were evaluated. The mean age was 67.3 ± 5.9 y (ranging from 60 to 88 y). The majority of the sample was composed of women who were rural inhabitants (65.9%), as all who lived in a rural area were engaged in agriculture. The majority of the sample was 60 to 69 y of age (66.3%), white (71.2%), had 4 to 8 y of schooling (47.3%), lived with a partner (61.5%), was retired (92.2%), and belonged to socioeconomic class C (61%). Additionally, the women were physically active (52.7%), non-smokers (73.2%), overweight (39.5%), and had no history of falls (62%) or fractures (85.9%) in the past year. The prevalence of sarcopenia found in the general sample was 2.4%.

The chronic conditions most frequently reported by the women were hypertension (63.4%), dyslipidemia (40%), diabetes mellitus (17.1%), rheumatoid arthritis (12.7%), coronary artery disease (11.7 %), and cancer (11.7%). All of the women were postmenopausal, and none were taking estrogen-containing hormone therapy. The sociodemographic characteristics and associated factors according to the place of residence of the participants are shown in Table 1. There was a significant difference between the urban and rural populations in terms of schooling ($P < 0.001$), occupation ($P = 0.01$), socioeconomic status ($P < 0.001$), and smoking status ($P = 0.006$). A significant association could not be found between their place of residence and the other variables evaluated. Furthermore, no significant association was found between their place of residence and the chronic conditions evaluated.

The sociodemographic characteristics and associated factors, according to the sarcopenia status, are shown in Table 2. Their place of residence was significantly associated with sarcopenia ($P = 0.047$), and higher sarcopenia prevalence was found among the women who lived in urban areas (5.7%) than in those who lived in rural areas (0.7%). None of the other evaluated variables had a significant association with sarcopenia.

The variables that presented $P < 0.2$ in the bivariate analysis (residence, skin color, and smoking status) were included in the multivariate logistic regression model, along with marital status, schooling, occupation, socioeconomic status, and smoking status as possible confounding factors. The environment in which the women lived was independently associated with sarcopenia, with a greater chance of the women who lived in an urban area to present sarcopenia (Table 3).

Table 1
Sociodemographic characteristics and associated factors, according to the place of residence of the participants (N = 205)

Variables	n (%)	Residence		*P*-value
		Urban (n = 70) n (%)	Rural (n = 135) n (%)	
Age (y)				
60–69	136 (66.3)	44 (62.9)	92 (68.1)	0.622*
70–79	60 (29.3)	22 (31.4)	38 (28.1)	
≥80	9 (4.4)	4 (5.7)	5 (3.7)	
Skin color				
White	146 (71.2)	53 (75.7)	93 (68.9)	0.306†
Non-white	59 (28.8)	17 (24.3)	42 (31.1)	
Marital status				
With companion	126 (61.5)	38 (54.3)	88 (65.2)	0.128†
Without companion	79 (38.5)	32 (45.7)	47 (34.8)	
Schooling (y)				
<4	77 (37.6)	22 (31.4)	55 (40.7)	<0.001†
4–8	97 (47.3)	26 (37.1)	71 (52.6)	
>8	31 (15.1)	22 (31.4)	9 (6.7)	
Occupation				
Working	8 (3.9)	6 (8.6)	2 (1.5)	0.010*
Housewife	8 (3.9)	5 (7.1)	3 (2.2)	
Retired	189 (92.2)	59 (84.3)	130 (96.3)	
Socioeconomic status‡				
A/B	30 (14.6)	24 (34.3)	6 (4.4)	<0.001†
C	125 (61.0)	36 (51.4)	89 (65.9)	
D/E	50 (24.4)	10 (14.3)	40 (29.6)	
Physical activity§				
Active	108 (52.7)	36 (51.4)	72 (53.3)	0.796†
Inactive	97 (47.3)	34 (48.6)	63 (46.7)	
Smoking status				
Never smoked	150 (73.2)	42 (60.6)	108 (80.0)	0.006†
Previous smoker	40 (19.5)	19 (27.1)	21 (15.6)	
Current smoker	15 (7.3)	9 (12.9)	6 (4.4)	
Weight in kg (mean ± SD)		68.08 ±11.59	66.54 ±12.43	0.393‖
Height in m (mean ± SD)		1.56 ± 0.06	1.56 ± 0.06	0.716‖
BMI¶				
Eutrophic	64 (31.2)	22 (31.4)	42 (31.1)	0.978†
Overweight	81 (39.5)	27 (38.6)	54 (40.0)	
Obese	60 (29.3)	21 (30.0)	39 (28.9)	
Number of falls (past year)				
0	127 (62.0)	44 (62.9)	83 (61.5)	0.967†
1	53 (25.9)	18 (25.7)	35 (25.9)	
≥2	25 (12.2)	8 (11.4)	17 (12.6)	
Number of fractures (past year)				
0	176 (85.9)	61 (87.1)	115 (85.2)	0.976†
1	28 (13.7)	9 (12.9)	19 (14.1)	
≥2	1 (0.5)	0	1 (0.7)	

BMI, body mass index
*Fischer's exact test.
†Pearson's χ^2 test.
‡Individuals in category A are considered the wealthiest, those in category E, the poorest.
§Referred physical activity time >150 min/wk.
‖*t* test.
¶BMI: normal weight 18.5–24.9 kg/m^2, overweight 25–29.9 kg/m^2, obesity ≥30 kg/m^2.

Discussion

To the best of our knowledge, this is the first study in the Americas to compare the prevalence of sarcopenia in women ≥60 y of age living in urban and rural areas. The results of the present study demonstrated that, using the recommendations proposed by the EWGSOP, 2.4% of the total sample tested presented sarcopenia, with the highest prevalence in urban women (5.7%) than in those who live in rural areas (0.7%). After multivariate analysis, their place of residence was independently associated with sarcopenia, with greater odds of the disease in the urban elderly (odds ratio [OR], 9.561; 95% confidence interval [CI], 1.021–89.523).

There are many studies concerning sarcopenia prevalence from all over the world. However, only two that compare urban and rural sarcopenia have been found. One of them was conducted with the population of Thailand, in which 435 individuals living in urban areas and 397 in rural areas were evaluated and classified sarcopenic through a skeletal muscle index. Those findings are similar to the ones presented in the present study: The urban population presented a higher prevalence of sarcopenia whn compared with the rural population both in men (OR, 2.01; 95% CI, 1.14–3.53) and women (OR, 1.69; 95% CI, 1.31–2.17) [21].

The other study was conducted in China and it evaluated 329 elderly residents in urban areas and 283 in rural areas. The sarcopenia prevalence was 7% in urban elderly and 13.1% in rural elderly [22], which differs from the results found in the present study and even from the results expected from the authors of that study. However, they stated that the rural population presented a higher risk for malnutrition, which may have been responsible for the low muscle mass and muscular strength found in the rural population. Moreover, a different sarcopenia definition was adopted (International Working Group on Sarcopenia [IWGS]), which used different

Table 2
Sociodemographic characteristics and associated factors, according to the diagnosis of sarcopenia in elderly women (N = 205)

Variables	N	Sarcopenia		*P*-value
		No (n = 200) n (%)	Yes (n = 5) n (%)	
Residence area				
Urban	70	66 (64.3)	4 (5.7)	0.047*
Rural	135	134 (99.3)	1 (0.7)	
Age (y)				
60–69	136	133 (97.8)	3 (2.2)	0.715*
70–79	60	58 (96.7)	2 (3.3)	
≥80	9	9 (100)	0	
Skin color				
White	146	144 (98.6)	2 (1.4)	0.145*
Non-white	59	56 (94.9)	3 (5.1)	
Marital status				
With companion	126	124 (98.4)	2 (1.6)	0.376*
Without companion	79	76 (96.2)	3 (3.8)	
Schooling (y)				
<4	77	74 (96.1)	3 (3.9)	0.580*
4–8	97	95 (97.9)	2 (2.1)	
>8	31	31 (100)	0	
Occupation				
Working	8	8 (100)	0	1.000*
Housewife	8	8 (100)	0	
Retired	189	124 (97.4)	5 (2.6)	
Socioeconomic status				
A/B	30	29 (96.7)	1 (3.3)	0.530*
C	125	121 (96.8)	4 (3.2)	
D/E	50	50 (100)	0	
Physical activity†				
Active	108	105 (97.2)	3 (2.8)	1.000*
Inactive	97	95 (97.9)	2 (2.1)	
Smoking status				
Never smoked	150	148 (98.7)	2 (1.3)	0.096*
Previous smoker	40	37 (92.5)	3 (7.5)	
Current smoker	15	15 (100)	0	
Weight in kg (mean ± SD)		67.21 ±12.14	61.54 ±12.44	0.304‡
Height in m (mean ± SD)		1.56 ± 0.06	1.57 ± 0.06	0.766‡
BMI§				
Eutrophic	64	61 (95.3)	3 (4.7)	0.276*
Overweight	81	79 (97.5)	2 (2.5)	
Obese	60	60 (100)	0	
Number of falls (past year)				
0	127	125 (98.4)	2 (1.6)	0.221*
1	53	50 (94.3)	3 (5.7)	
≥2	25	25 (100)	0	
Number of fractures (past year)				
0	176	172 (97.7)	4 (2.3)	0.537*
1	28	27 (96.4)	1 (3.6)	
≥2	1	1 (100)	0	

BMI, body mass index
*Fischer's exact test.
†Referred physical activity time >150 min/wk.
‡*t* test.
§BMI: normal weight 18.5–24.9 kg/m^2, overweight 25–29.9 kg/m^2, obesity ≥ 30 kg/m^2.

Table 3
Sarcopenia-associated factors derived from logistic regression (backward stepwise selection method)

Variables	β	*P*-value	OR (95% CI)
Residence	2.26	0.048	9.561 (1.021–89.523)
Skin color	−1.57	0.097	0.208 (0.032–1.331)
Constant	−4.10	<0.001	0.017

Binary logistic regression test. Adjusted for residence, skin color, smoking status, marital status, schooling, occupation, and socioeconomic status

parameters for diagnosing sarcopenia. Muscle mass was estimated through calf circumference only, which may be a less accurate measurement of muscle mass and also may have compromised the results.

Two other studies approached sarcopenia prevalence in the rural environment only. The first evaluated 549 Taiwanese elderly [23] using EWGSOP-proposed criteria. Body composition was evaluated by bioelectrical impedance analysis, and muscle mass was estimated through Janssen's equation [24]. Sarcopenia prevalence was 7.1%, and severe sarcopenia was 5.6%. The other study evaluated a sample of the Peruvian rural population and included 222 elderly. IWGS' sarcopenia criteria were adopted, and bioelectrical impedance analysis was the chosen method for muscle mass evaluation. Sarcopenia was present in 17.6% [25] of the sample, which is a considerably higher prevalence than found in the present study's population.

In the present study, urban women were 9.5 times more likely to present sarcopenia compared with rural women. It is important to point out that the rural area where the women live in the present study is an exclusively agricultural area, and most of them reported working throughout their lives in agriculture. The manual labor associated with this activity usually requires strength, which may have influenced their current muscle mass and function [22] and, therefore, reduced their risk for developing sarcopenia [25].

Tramontano et al., in the study carried out with the Peruvian Andes rural population, observed that the higher prevalence of sarcopenia was found between the elderly who were not farmers [25]. Sampaio et al., evaluating elderly women from urban and rural areas of Japan, found that the muscle mass in the upper limbs of women who lived in rural areas was greater than their urban counterparts, probably because of the daily routine of agricultural work that usually requires manual strength [26]. Pongchaiyakul et al. also observed a higher muscle mass in the rural population, composed mostly by farmers who work daily in activities that require long hours of physically heavy work [27].

The higher sarcopenia prevalence in the urban area also may be associated with other factors, such as a more sedentary lifestyle, less sun exposure, and a lower-quality diet that is rich in fats and refined carbohydrates, and has a low fiber content [28].

The differences observed between the rural and urban women are relatively similar with other findings from other studies. The women living in the rural region presented less schooling and lower income [29–31] than their urban counterparts. Also, rural women were more often retired, whereas urban women were still working. Less schooling may be related to the difficulty in accessing schools usually observed in the rural context compared with the urban scenario [32]. The lower income observed in the rural areas in this study may, perhaps, be explained by the payment of only one minimum wage [33] by the Brazilian National Social Security Institute (INSS), as a warranty against labor impairment, called rural retirement [31]. Moreover, the income difference between the two analyzed groups may also be a long-term consequence of the higher level of schooling associated with urban-living elderly [31].

There are some limitations that should be considered when reviewing the presented results. The ability to extract causal inferences was limited by the fact that this was a cross-sectional study. It was also restricted to apparently healthy people who could go to the clinic for bone densitometry, which may eliminate from the sample older people in limiting clinical conditions and, therefore, underestimate the sarcopenia prevalence in the analyzed population. The fact that the bone densitometry exams were requested by a doctor indicates that the participants had some level of access to clinical care, which may have somehow biased the sample for women with better conditions than those who do not receive any medical attention at all. Finally, we did not have information regarding serum levels of vitamin D.

Despite the aforementioned limitations, we strongly believe that the results depicted by the present study positively contribute to the current knowledge on sarcopenia. The effect of the environment in which the patient is inserted may be an important factor for the development of the disease, and there are few studies approaching the topic in the literature. The present results offer some new insights of determinants and associated factors concerning sarcopenia in different lifestyles and environments. Hopefully, these findings can contribute to at least part of the variability of sarcopenia prevalence found between countries.

Conclusion

In a sample of elderly women from southern Brazil, 2.4% had sarcopenia according to EWGSOP's criteria. After multivariate analysis, the place of residence was independently associated with sarcopenia, with greater odds of sarcopenia in women living in urban areas than their rural counterparts.

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