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## Trabajo Original

Nutrición en el anciano

### Factors associated with sarcopenia in institutionalized elderly

*Factores asociados con la presencia de sarcopenia en ancianos institucionalizados*

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### Abstract

**Introduction:** The sarcopenia is a negative aspect for the health of the elderly, increased the risk for disease and mortality. Additionally can contribute greatly to functional reducing capacity and quality of life.

**Objective:** To identify the prevalence and factors associated with sarcopenia in institutionalized elderly.

**Methods:** This is a cross-sectional study, conducted with 216 elderly people, aged  $\geq 60$  years, of both sexes, residents in long-term care facilities in Salvador-Bahia, Brazil. To identify sarcopenia was used the skeletal muscle Index. Covariates were considered: gender, age, time of institutionalization, type of institution, body mass index and functional capacity. The Association between sarcopenia and covariates was evaluated using the Poisson regression model with robust variance.

**Results:** The prevalence of sarcopenia in the elderly was 72.2% and this condition was associated with male sex (PR = 1,33; CI 95% = 1,08-1,65), thinness (PR = 1,29; CI 95% = 1,16-1,43) and obesity (PR = 0,37; CI 95% = 0,23-0,61).

**Conclusion:** The prevalence of sarcopenia was high among the elderly living in long-term institutions, especially among men. Elderly with thinness showed greater impairment of muscle reserves, while the state of obesity was protective.

#### Key words:

Sarcopenia. Elderly. Institutionalization.

### Resumen

**Introducción:** la sarcopenia es un aspecto negativo para la salud de las personas mayores, aumenta el riesgo de enfermedad y mortalidad. Además puede contribuir en gran medida a la reducción de la capacidad funcional y calidad de vida.

**Objetivo:** identificar la prevalencia y los factores asociados con la sarcopenia en los ancianos institucionalizados.

**Métodos:** se trata de un estudio transversal, realizado con 216 personas de edad avanzada ( $\geq 60$  años), de ambos sexos, residentes en centros de atención a largo plazo en Salvador-Bahia, Brasil. Para identificar la sarcopenia se utilizó el índice musculoesquelético. Se consideraron covariables: género, edad, tiempo de institucionalización, tipo de institución, índice de masa corporal y la capacidad funcional. La asociación entre la sarcopenia y covariables se evaluó utilizando el modelo de regresión de Poisson con varianza robusta.

**Resultados:** la prevalencia de la sarcopenia en los ancianos fue de 72,2% y esta condición se asocia con el sexo masculino (RP = 1,33; IC del 95% = 1,08-1,65), la delgadez (RP = 1,29; IC del 95 % = 1,16-1,43) y la obesidad (RP = 0,37; IC del 95% = 0,23-0,61).

**Conclusión:** la prevalencia de la sarcopenia fue alta entre los ancianos que viven en instituciones de larga duración, especialmente entre los hombres. Los ancianos con delgadez mostraron un mayor deterioro en las reservas musculares, mientras que los obesos mostraban una mayor protección muscular.

#### Palabras clave:

Sarcopenia. Anciano. Institucionalización.

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## INTRODUCTION

Sarcopenia is a complex and serious geriatric syndrome in the life of the elderly triggering functional impairment and increasing the risk of falls, fractures and dependence. It has the potential to reduce quality of life leading to higher spending on health and increased mortality (1,2). Its prevalence can reach 5-13% in the elderly between 60-70 years and 11-50% in those over 80 years old depending on the criteria used for diagnosis (1). In Brazil in 2006, a prevalence of 15.4% was found among the elderly population living in São Paulo (3).

Currently sarcopenia can be diagnosed taking into account the reduction of muscle mass and function including the evaluation of strength and physical fitness (1,4). However, some studies have shown that the isolated use of the skeletal muscle mass (SMM) is an appropriate parameter in the identification of sarcopenia (5-8).

The evaluation of SMM can be carried out using methods such as computerized tomography, magnetic resonance imaging and dual-energy X-ray absorptiometry (2). However, the high cost and the use of radiation in such methods have limited their applicability in clinical practice (9). Therefore, bioelectrical impedance is increasingly used to evaluate sarcopenia due to its low cost, ease of use and absence of radiation as well as being a method that has been validated for the diagnosis of this syndrome (10). Given the consequences of sarcopenia and lack of research in the Brazilian population, especially those who are institutionalized, this study assesses the prevalence and factors associated with sarcopenia in long-term care facilities (LTCF) in the city of Salvador Bahia, Brazil.

## METHODS

### STUDY DESIGN

This cross-sectional study is part of a larger project entitled "Multidimensional evaluation of the elderly living in long-term care facilities in Salvador, Bahia", developed by the Aging-Related Research and Intervention Center (CEIAE) at the Nutrition School the Federal University of Bahia (ENUFBA).

### SAMPLE

The sample of the larger study was performed in three stages. In the first stage, was identified a total of 29 LTCFs which were located in 10 Health Districts of the 12 existing in the urban area. In the second stage, the number of elderly subjects by Health District that would participate in the study was determined. This number was proportional to the total elderly population living in each Health District, thus ensuring 80% power in representing the institutionalized elderly of the city. At a significance level of 5%, this number totaled 412 elderly subjects of both genders. In the third stage, LTCFs and elderly subjects were selected by simple random sampling. The final sample information available

bioelectrical impedance and anthropometric measures was 216 elderly evaluated.

### ELIGIBILITY CRITERIA

Those eligible to participate in the study were individuals of both sexes, aged over 60 years living in LTCF (public, philanthropic and private) located in the urban area of Salvador and who agreed to participate in the research.

Non-eligibility criteria for the examination of bioelectrical impedance were: limb amputation, presence of edema and/or ascites, cardiac defibrillator or pacemaker use and inability of weight measurement (11). Those who were unable to move and/or position themselves for gauging the anthropometric measures did not participate.

### DATA COLLECTION

Data collection took place from November 2012 to October 2013 by a multidisciplinary team who had been previously trained to use standardized techniques.

### VARIABLES

#### Outcome

Sarcopenia was identified according to the SMI (SMM (kg) / height (m<sup>2</sup>) (6). The whole body SMM was estimated using the equation proposed by Janssen et al. (10) where SMM (kg) = [(height in centimeters<sup>2</sup>/resistance of the bioelectrical impedance in ohms × 0.401) + (sex × 3.825) + (-0.071 × age in years)] + 5,102. For this calculation, the values considered were 1 and 0 for male and female, respectively.

The resistance measurement was carried out by a tetrapolar body composition analyzer Biodynamics (BF-450 model). The pretest care protocol used was that proposed by Kyle et al. (11): fasting for at least four hours prior to emptying of the bladder, alcohol abstention for 48 hours before the test and no intensive physical activity in the last eight hours.

SMI was classified by the following cut-off points proposed by Janssen et al. (6): severe sarcopenia ≤ 8.5 kg/m<sup>2</sup>, moderate sarcopenia 8.51-10.75 kg/m<sup>2</sup>, normal muscle ≥ 10.76 kg/m<sup>2</sup> for men and severe sarcopenia ≤ 5.75 kg/m<sup>2</sup>, moderate sarcopenia 5.76- 6.75 kg/m<sup>2</sup>, normal muscle ≥ 6.76 kg/m<sup>2</sup> for women.

#### Covariates

Covariates measured were sex, age, time at the institutionalization, type of institution, body mass index (BMI) and functional capacity.

The BMI was classified according to the Nutrition Screening Initiative (12). Weight and height were obtained according to standards established by Jelliffe (13).

For the assessment of functional capacity the 'Activities of Daily Living' scale proposed by Mahoney and Barthel (14) was used and the cutoff points proposed by Azeredo and Matos (15) were adopted.

## STATISTICAL ANALYSIS

The Kolmogorov-Smirnov test was used to analyze the data normality. Descriptive statistics were used (mean, standard deviation, median, interquartile range and percentile values), the Mann-Whitney tests, t student and Chi square Pearson test.

To investigate the relationship between sarcopenia and covariates, we used the Poisson regression model with robust variance, estimating the prevalence ratios and their respective confidence intervals at 95%. We opted for the multilevel modeling because of a possible clustering effect relating to the aggregation of individuals in institutions. Regression models were constructed by stepwise backward.

A 5% significance level was adopted for all analyses, which were carried out with the aid of the software STATA version 10.0 (STATA Corp, College Station, TX).

## ETHICAL ASPECTS

This project was approved by the Ethics Committee at ENUFBA (protocol number 11/2012). Prior authorization was sought from the LTCF and the elderly participants gave their informed consent using a signature or fingerprint. At the end of the study, the results from the evaluations were presented to the LTCFs in a report.

## RESULTS

The population characteristics are shown in table I. It can be observed in table II that the average values of SMM and SMI were

higher for males in all age groups. Comparing gender and age group, the average values of the SMI and SMM were lower in women who were 80 and older and men aged between 70 and 79 years. It is noteworthy that 75% of elderly men of all the age groups analyzed had some degree of sarcopenia (SMI < 10.76 kg/m<sup>2</sup>) (Table II).

Most of the elderly people presented sarcopenia (72.2%) with the highest percentages observed among men (87.7%), in elderly people 60-69 years (77.3%), those who had been institutionalized for one to five years (75.8%). Those who resided in philanthropic LTCF (76.4%) showed thinness (92.4%) and moderate dependence (89%). Sarcopenia was associated only with sex ( $p = 0.006$ ) and BMI ( $p < 0.001$ ) (Table III).

The gross prevalence ratio also showed a statistically significant association between sarcopenia and BMI with a prevalence of sarcopenia which was 28% higher among elderly people with thinness (PR = 1.28, 95% CI: 1.14 to 1.43) compared to normal and 31% higher in men (PR = 1.31, 95% CI: 1.08 to 1.60) when compared to women. For these elderly people overweight and obesity were demonstrated to be sarcopenia protection factors (Table III).

In table IV multivariate Poisson model can be seen. This considers the possible cluster effect due to the aggregation of the elderly in LTCF. In model 1, adjusted for all variables, only males (PR = 1.34, 95% CI: 1.10 to 1.65), thinness (PR = 1.38, 95% CI: 1.19 to 1.60) and obesity (PR = 0.38, 95% CI: 0.20 to 0.73) were significantly associated with sarcopenia.

In model 2, the same variables remained significantly associated with sarcopenia, adjusted for other variables in the model, with prevalences of 33% and 29% higher from sarcopenia, respectively, in the men (OR = 1.33, 95% CI: 1.08 to 1.65) compared to females, and thinness (PR = 1.29, 95% CI: 1.16 to 1.43) compared to normal weight. On the other hand, obese elderly people had a 63% lower prevalence of sarcopenia (PR = 0.37, 95% CI: 0.23 to 0.61) compared to those with adequate nutritional status, revealing obesity to be a protective factor for sarcopenia.

**Table I. Characteristics of institutionalized elderly according to sex. Salvador Bahia**

Variables	Female (n = 159)	Male (n = 57)	p-value*
Age (years)	81.68 (8.40)	72.35 (8.86)	< 0.0001
Weight (kg)	54.7 (45.8-64.9)	61.5 (54.2-73.9)	0.0001
Height (m)	1.53 (1.49-1.57)	1.67 (1.63-1.70)	< 0.0001
Length of institutionalization (years)	6.42 (8.85)	4.23 (8.76)	0.1197
SMI (kg/m <sup>2</sup> )	6.24 (5.59-7.04)	8.64 (8.09-9.73)	< 0.0001
SMM (kg)	15.16 (3.33)	25.19 (4.65)	< 0.0001
BMI (kg/m <sup>2</sup> )	23.78 (5.19)	22.82 (4.06)	0.2108
Score in the Barthel Scale	95 (70-100)	95 (85-100)	0.5719

SMI: Skeletal muscle index; SMM: Skeletal muscle mass; BMI: Body mass index. Weight (kg), height (m), SMI (kg/m<sup>2</sup>) and the Barthel Scale Score are expressed as median (interquartile range). The other variables are expressed as mean (standard deviation). \*Mann-Whitney test and t student test.

**Table II.** Mean values, standard deviations, percentiles of the SMM and SMI of institutionalized elderly according to sex and age group. Salvador Bahia

Variables				Percentil				
	Mean	SD	n	10	25	50	75	90
<i>SMM (kg)</i>								
<i>Female</i>								
60-69 years	16.68	3.39	18	12.95	14.67	16.41	18.60	20.97
70-79 years	16.82	2.86	34	13.69	14.54	16.32	18.88	20.68
≥ 80 years	14.39	3.21	107	11.03	12.15	14.06	15.93	18.21
<i>Male</i>								
60-69 years	25.49	5.42	26	20.57	21.31	24.31	26.63	32.24
70-79 years	24.71	4.17	17	20.32	21.34	23.84	25.58	30.99
≥ 80 years	25.23	3.84	14	20.57	21.29	25.01	28.77	39.61
<i>SMI (kg/m<sup>2</sup>)</i>								
<i>Female</i>								
60-69 anos	6.65	1.11	18	5.38	5.84	6.47	7.21	8.17
70-79 years	6.95	1.03	34	5.77	6.12	6.81	7.75	8.05
≥ 80 years	6.24	1.18	107	4.88	5.43	6.12	6.86	7.77
<i>Male</i>								
60-69 years	8.91	1.44	26	7.62	8.09	8.66	9.05	10.41
70-79 years	8.83	1.23	17	7.62	7.86	8.56	9.70	10.91
≥ 80 years	9.07	1.40	14	7.30	8.25	8.78	10.09	10.99

SD: standard deviation; SMM: skeletal muscle mass; SMI: skeletal muscle index.

## DISCUSSION

The prevalence of sarcopenia in this population was high (72.2%) and higher than that found in studies of institutionalized elderly in other countries (16,17). This is probably a result of the different methods used in the studies and the different living conditions of such populations.

This result highlights the vulnerability of the elderly because sarcopenia can affect the quality of life, functional capacity, health and morbidity of this population (2).

More than half of the elderly men of all age groups showed SMI values below the recommended, or had some degree of sarcopenia. The findings of a higher prevalence of sarcopenia in men (87.7%), corroborate those of other studies with institutionalized elderly (18,19). Bahat et al. (18) who investigated elderly men in LTCF in Turkey reported a prevalence similar to that found in our study (85%).

Although the present study did not find an association between sarcopenia and type of institution, the high prevalence of sarcopenia found in philanthropic institutions justifies more research on the impact of the characteristics of these LTCF on the nutritional status of the elderly. The work of Camarano et al. (20) shows that most of the expenses of running Brazilian LTCF are on staff costs (52.5%) and only 14.1% is spent on food. Perhaps this is one

reason for the impairment of the nutritional status these elderly people.

Malnutrition implies loss of muscle and fat and this is a major problem in the institutionalized elderly population (21) and this may explain the higher prevalence of sarcopenia found in the elderly with thinness in this study. Similar results have been found by other authors (16,17,22). On the other hand, the protective effect of obesity for sarcopenia, despite being considered a risk factor for comorbidities in the case of the elderly, has been linked to a lower risk of death, complications during hospitalization and the development of sarcopenia (8,23).

Physical inactivity, insulin resistance, chronic diseases, hormonal changes, inflammation and nutritional deficiencies (protein, calories, vitamin D and antioxidants) stand out as major causes of sarcopenia in the elderly (24). Therefore, better research on these factors may help to understand this reality.

The severity of the clinical and nutritional status, and functional impairment made it impossible to gauge the weight of many elderly people living in the LTCF investigated and that may have caused an underestimation of the prevalence of sarcopenia found. Although SMI has been used for the diagnosis of sarcopenia in this study, further research is required into the sensitivity of the isolated use of this index for this purpose.

**Table III.** Prevalence, gross prevalence ratio and confidence intervals at 95% for association between sarcopenia and covariates in institutionalized elderly in Salvador Bahia

Covariables	n /N	%	PR <sup>†</sup>	95% CI	p-value
<i>Sex*</i>					
Female	106/159	66.7	1	-	-
Male	50/57	87.7	1.31	1.08-1.60	0.006
<i>Age group</i>					
60-69 years	34/44	77.3	1	-	-
70-79 years	31/51	60.8	0.78	0.60-1.02	0.076
≥ 80 years	91/121	75.2	0.97	0.82-1.15	0.756
<i>Length of institutionalization</i>					
< 1.0 year	36/52	69.2	1	-	-
1.0-5.0 year (s)	72/95	75.8	1.09	0.87-1.36	0.421
5.1-10.0 years	21/28	75	1.08	0.81-1.44	0.589
> 10.0 years	21/33	63.6	0.91	0.76-1.11	0.385
<i>Type of institution</i>					
Private	81/115	70.4	1	-	-
Public	20/29	69	0.97	0.87-1.09	0.703
Philanthropic	55/72	76.4	1.08	0.89-1.31	0.409
<i>BMI*</i>					
Eutrophic	58/80	72.5	1	-	-
Thinness	79/85	92.4	1.28	1.14-1.43	0.000
Overweight	13/28	46.4	0.64	0.41-0.99	0.049
Obesity	6/23	26.1	0.35	0.22-0.56	0.000
<i>Functional capacity</i>					
Independence	40/58	69	1	-	-
Mild dependence	36/45	80	1.16	0.96-1.39	0.118
Moderate dependence	40/52	89	1.11	0.84-1.46	0.432
Severe dependence	21/31	67.7	0.98	0.72-1.33	0.908
Total dependence	7/10	70	1.01	0.60-1.70	0.955

PR: prevalence ratio; CI: confidence interval; BMI: body mass index. \*Statistically significant association by the Chi-square test (gender: p-value = 0.002; BMI: p-value = 0.001). †Poisson regression model with gross prevalence ratio for association between sarcopenia and other variables.

## CONCLUSION

The prevalence of sarcopenia was high among elderly residents in LTCF, especially among males. Elderly people with thinness

showed greater impairment of their muscle reserves while obesity was shown to be a protective factor for the development of sarcopenia.

**Table IV.** Poisson regression model with adjusted prevalence ratio for association between sarcopenia and covariates in institutionalized elderly. Salvador Bahia

Covariables	Model 1		Model 2	
	PR <sub>aj</sub>	95% CI	PR <sub>aj</sub>	95% CI
<i>Sex</i>				
Female	1	-	-	-
Male	1.34	1.10-1.65	1.33	1.08-1.65
<i>Age group</i>				
60-69 years	1	-	-	-
70-79 years	0.99	0.80-1.23	0.91	0.75-1.11
≥ 80 years	1.19	0.99-1.42	1.17	0.98-1.40
<i>Length of institutionalization</i>				
< 1.0 year	1	-	-	-
1.0-5.0 year (s)	1.10	0.89-1.36	-	-
5.1-10.0 years	0.95	0.79-1.13	-	-
> 10.0 years	1.10	0.92-1.31	-	-
<i>Type of institution</i>				
Private	1	-	-	-
Public	0.94	0.82-1.09	-	-
Philanthropic	1.02	0.90-1.15	-	-
<i>BMI</i>				
Eutrophic	1	-	1	-
Thinness	1.38	1.19-1.60	1.29	1.16-1.43
Overweight	0.72	0.50-1.03	0.67	0.45-1.00
Obesity	0.38	0.20-0.73	0.37	0.23-0.61
<i>Functional capacity</i>				
Independence	1	-	-	-
Mild dependence	1.02	0.86-1.20	-	-
Moderate dependence	1.00	0.77-1.30	-	-
Severe dependence	0.84	0.60-1.19	-	-
Total dependence	0.89	0.59-1.33	-	-

PR<sub>aj</sub>: adjusted prevalence ratio; CI: confidence interval; BMI: body mass index. Model 1: adjusted by gender, age, length of institutionalization, type of institution, BMI and functional capacity. Model 2: adjusted by gender, age and BMI.

## REFERENCES

- Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis. Age and Ageing 2010;39:412-23.
- Hairi NN, Bulgiba A, Hiong TG, Mudla I. Sarcopenia in older people. Geriatrics 2012;29-40.
- Alexandre TS, Duarte YAO, Santos JLF, Wong R, Lebrão ML. Prevalence and associated factors of sarcopenia among elderly in Brazil: findings from the SABE study. J Nutr Health Aging 2013;5: 1-7.
- Rosenberg IH. Sarcopenia: origins and clinical relevance. Journal of Nutrition 1997;127(Suppl 5):S990-991.
- Bunout D, de la Maza MP, Barrera G, Leiva L, Hirsch S. Association between sarcopenia and mortality in healthy older people. Australas J Ageing 2011;30:89-92.
- Janssen I, Baumgartner RN, Ross R, Rosenberg IH, Roubenoff R. Skeletal muscle cutpoints associated with elevated physical disability risk in older men and women. American Journal of Epidemiology 2004;159:413-21.
- Janssen I, Heymsfield SB, Ross R. Low relative skeletal muscle mass (sarcopenia) in older persons is associated with functional impairment and physical disability. J Am Geriatr Soc 2002;50:889-96.
- Baumgartner RN, Koehler KM, Gallagher D, Romero L, Heymsfield SB, Ross RR, et al. Epidemiology of sarcopenia among the elderly in New Mexico. American Journal of Epidemiology 1998;147:755-63.
- Lima LRA, Rech CR, Petroski EL. Utilização impedância bioelétrica para estimativa da massa muscular esquelética em homens idosos. Archivos Latino-americanos de Nutricion 2008;58:386-391.
- Janssen I, Heymsfield SB, Baumgartner RN, Ross R. Estimation of skeletal muscle mass by bioelectrical impedance analysis. J Appl Physiol 2000;89:465-7.

11. Kyle UG, Bosaeus I, Lorenzo AD, Deurenberg P, Elia M, Gómez, JM. Bioelectrical impedance analysis: utilization in clinical practice. *Clin Nutr* 2004;23(Pt 2):1430-53.
12. Nutrition Screening Initiative. *A Physician's Guide to Nutrition in Chronic Disease Management for Older Adults*. Leawood (KS): American Academy of Family Physicians; 2002.
13. Jelliffe DB. The assessment of the nutritional status of the community (with special reference to field surveys in developing regions of the world). *Monogr Ser World Health Organ* 1966;53:3-271.
14. Mahoney FI, Barthel D. Functional evaluation: The Barthel Index. *Maryland State Medical Journal* 1965;14:56-61.
15. Azeredo Z, Matos E. Degree of dependence in stroke patients. *Rev Fac Med Lisboa* 2003;8:199-204.
16. Landi F, Liperoti R, Fusco D, Mastropaolo S, Quattrociochi D, Proia A, et al. Prevalence and risk factors of sarcopenia among nursing home older residents. *J Gerontol A Biol Sci Med Sci* 2012;67:48-55.
17. Rahman TTA, Farid HM, Elkholy NM, Mortagy AK. Prevalence of sarcopenia among nursinghome older residents in Cairo, Egypt. *Advances in Aging Research* 2014;3:118-23.
18. Bahat G, Saka B, Tufan F, Akin S, Sivrikaya, Yucel N. Prevalence of sarcopenia and its association with functional and nutritional status among male residents in a nursing home in Turkey. *Aging Male* 2010;13:211-4.
19. Pollo SHL, Assis M. Instituições de longa permanência para idosos - ILPIS: desafios e alternativas no município do Rio de Janeiro. *Rev Bras Geriatr Gerontol* 2008;11:1-18.
20. Camarano AA, Kanzo S. As instituições de longa permanência para idosos no Brasil. *Rev Bras Estud Popul* 2010;27:232-5.
21. Hickson M. Malnutrition and ageing. *Postgrad Med J* 2006;82:2-8.
22. Legrant D, Vaes B, Mathei C, Swine C, Degryse JM. The prevalence of sarcopenia in very old individuals according to the European consensus definition: insights from the BELFRAIL study. *Age and Ageing* 2013;42:727-34.
23. Yu R, Wong M, Leung J, Lee J, Auyeung TW, Woo J. Incidence, reversibility, risk factors and the protective effect of high body mass index against sarcopenia in community-dwelling older Chinese adults. *Geriatr Gerontol Int* 2014;Suppl 14:S15-28.
24. Fielding RA, Vella B, Evans WJ, Bhasin S, Morley JE, Newman JE, et al. Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International Working Group on Sarcopenia. *J Am Med Dir Assoc* 2011;12:249-56.