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PREVALENCE OF SARCOPENIA, BODY COMPOSITION AND ENERGY-PROTEIN INTAKE OF ELDERLY FROM AN INTEGRATED CONTINUING CARE UNIT IN BRAZIL

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ABSTRACT

Sarcopenia is characterized by progressive loss of muscle mass and strength or function during the aging process, and has been recognized as a relevant factor for the occurrence of health problems. The objective of this study was to verify the prevalence of sarcopenia, the body composition and the energy-protein intake in hospitalized elderly. The studied elderly were admitted to the Integrated Continuing Care Unit of a Brazilian hospital. Prevalence was determined by the Skeletal Muscle Index, classifying it as absent, grade I or grade II sarcopenia, and food intake was evaluated at 3 times using a 24-h recall. Value $p<0.05$ was considered. The prevalence of sarcopenia was 58.3% at hospital admission, and increased to 62.5% at hospital discharge, being predominant in males and mostly classified as grade I. Energy-protein intake was significantly higher at hospital discharge in relation to admission, as was the amount of protein consumed at lunch. There was a prevalence of sarcopenia in the elderly studied, despite the progressive increase in energy-protein intake during hospitalization, demonstrating the importance of early identification through accessible methods and nutritional interventions.

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INTRODUCTION

Population growth, the increase in preventive health activities, and the quality of life of the elderly population are being largely studied since the number of chronic non-communicable diseases increases with the advancing of age, thus increasing the burden of morbimortality in Brazil (Duncan *et al*., 2012). As the world's population ages, sarcopenia becomes more and more a public health problem in geriatrics. Some estimates by Janssen (2011) suggest that 200 million people around the world will be affected by sarcopenia by the year 2050. Sarcopenia is defined as the progressive loss of muscle mass and strength or function during aging, and has been related as a relevant factor for the occurrence of negative health outcomes at the end of life, such as increased risk of falls, morbidity, disability, dependence, and mortality (Landi *et al*., 2017).

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Studies have indicated that reduction in resting muscle tissue while in the hospital bed or immobilization may be triggered by a slower synthesis of muscle proteins compared to resting metabolic rate (De Boer *et al*., 2007; Glouver *et al*., 2008). For an adequate maintenance of the skeletal muscle mass, a balance between the anabolic and catabolic pathways is required (Fry *et al*., 2011), but when affected, these alter the intracellular signaling pathways involved in muscle homeostasis, being important to soften, reverse and prevent sarcopenia (Ziaaldini *et al*., 2017). Therefore, an adequate intake of energy, macronutrients and micronutrients should be considered as an essential requirement for any successful therapeutic approach in the elderly in terms of risk reduction and treatment of sarcopenia (Landi *et al*., 2017). Scientific evidence suggests that the uptake and/or supplementation of high biological value protein and/or some amino acids may attenuate this process, both by stimulating protein synthesis and by attenuating its degradation (Bauer *et al*., 2013). Despite the economic and demographic impact, sarcopenia is a condition that greatly affects the elderly population and its pathophysiology is not completely elucidated (Cohen *et al*., 2015). In view of the above, the objective of the study was to verify the prevalence of sarcopenia, the body composition and the energy-protein intake, as well as to determine the socioeconomic and clinical profile of elderly hospitalized in an Integrated Continuing Care Unit in Brazil.

MATERIALS AND METHODS

Study design and population

This is a quantitative, prospective and longitudinal study conducted at the Integrated Continuing Care Unit (ICCU) of a Rear Hospital in the city of Campo Grande, Mato Grosso do Sul, Brazil, from May to October 2017. The sample was convenient, consisting of 24 elderly participants hospitalized at ICCU. Patients 60 years of age or older, orally and/or enterally fed, bedridden and non-bedridden, admitted to the ICCU, who consented to participate in the study, were enrolled through the signing of the Free and Informed Consent Term. People under the age of 60, with parenteral feeding, and totally non-communicable were excluded.

Socioeconomic and clinical profile

The variables related to the socioeconomic profile include: personal data, sex, age, race, income, schooling, and length of stay. To determine the clinical aspects, the main medical diagnosis and associated diseases were considered.

Anthropometric evaluation, body composition and nutritional diagnosis

Anthropometric measurements were performed at hospital admission and discharge. To determine the nutritional diagnosis, we considered the anthropometric measures of actual and estimated weight (kg), estimated height (m), Body Mass Index - BMI (kg/m²), arm circumference - AC (cm), calf circumference - CC(cm), triceps skin fold - TSF (mm), arm muscle circumference - AMC (cm), and the application of the Mini Nutritional Assessment - MNA. For anthropometric classification and diagnosis using BMI, cut-off points for the elderly were used according to Lipschitz (1994). CC was classified based on data from the World Health Organization, providing the most sensitive way to measure muscle mass in the elderly by associating measures <31 cm with nutritional deficiency (WHO, 1995). In both periods, the anthropometric measurements were standardized considering the dominant and/or available side for their measurement. AC, TSF and AMC were evaluated according to NHANES III (Third National Health and Nutrition Examination Survey) (Burt; Harris, 1994). Their adequacy was calculated using the formula proposed by Blackburn; Thornton (1979). MNA was applied at each participant's admission and discharge. This instrument was developed to evaluate the risk of malnutrition in the elderly. It is a practical, non-invasive instrument that considers the nutritional status, health status, fragility, and possible diseases that affect the elderly (Garry and Vellas, 1999). Based on the anthropometric parameters and the nutritional evaluation performed by the MNA, the nutritional diagnosis of the elderly was classified as malnutrition (mild, moderate and severe), eutrophy, overweight and/or obesity.

Prevalence of sarcopenia

The equation of Lee *et al*. (2000) was used to estimate skeletal muscle mass (SMM), being an instrument that presented better similarity in the results compared to the gold standard of dual-energy X-ray absorptiometry (DEXA), adopted as a reference in the classification of sarcopenia (Rech *et al*., 2012). After the anthropometric evaluation, weight and height measurements, in addition to sex, age, and ethnicity were used for the calculation of Muscle Mass (MM) through the equation below. MM (kg) = (0.244 x BW) + (7.8 x Ht) + (6.6 x sex) – (0.098 x age) + (r – 3.3). In which, BW = body weight (kg); Ht= height (m); Age (years); Sex = 1 for men and 0 for women; Race (r) =-1.2 for Asians; 1.4 for African American and 0 for Caucasians.

Then, the MM value was used to calculate the Skeletal Muscle Index (SMI), as shown below.

SMI (kg/m²) = MM/height²

To classify sarcopenia, grade I (mild disability) was considered when SMI> 5.75 and ≤6.75 kg/m² for women and> 8.5 and ≤10.75 kg/m² for men; grade II (severe disability) was considered whenSMI ≤ 5.75 kg/m² for women and ≤8.50 kg/m² for men; and the values that did not fit into this classification were considered as absence of sarcopenia, according to Janssen *et al*. (2004).

Assessment of food intake

To assess food intake, the 24-hour recall of 3 alternate days (hospital admission, intermediate period, and hospital discharge) was applied according to the diet offered by the hospital and the patient's acceptance, for 24 hours, monitored by the main researcher of the study and with the assistance of the elderly caregivers, the ICCU team, and the participant. The data were obtained with homemade measures and converted to grams and milliliters for oral diet (breakfast, morning snack, lunch, afternoon snack, dinner, and supper).

For the participants who received enteral diets in 5 fractions, at the times considered for oral meals, except for the afternoon snack, milliliters per day of the standardized diets offered at the institution were used, considering the manufacturer's information on energy and other nutrients. The total energy-protein intake and the daily protein distributed per meal were evaluated. The data were processed using the Brazilian Tables of Food Composition (Unicamp, 2006; Lajolo *et al*., 2000) and the table of measures referred to the foods consumed in Brazil (IBGE, 2011).

Ethical aspects

Study approved by the Ethics Committee in Research with Human Beings of the Federal University of Mato Grosso do Sul under the opinion nº. 1.870.664/2017.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 18.0, considering a 5% significance level (p<0.05). In the descriptive analysis, mean and standard deviation were used for continuous variables, and absolute and relative frequency for categorical variables. We performed the chi-square test for inference of the categorical variables and the Student's t-test for the numerical ones. Analysis of variance (ANOVA), followed by the Tukey test, was used to compare the means of food intake.

RESULTS

Socioeconomic Profile

Twenty-four elderly individuals were analyzed, being 50% female (n=12) and 50% male (n=12), with age ranging from 61 to 93 years, and mean age of 72.8 years, according to Table 1.

Table 1. Characterization of the socioeconomic profile of hospitalized elderly (n=24)

Variables		Frequency (n)	Percentage (%)
Age			
	60 –79	17	70.8
	80 or more	7	29.2
Sex			
	Male	12	50.0
	Female	12	50.0
Race			
	Caucasian	12	50.0
	African American	11	45.8
	Asian	1	4.2
Educational Level			
	Higher Education	1	4.2
	Intermediate T.*	16	66.6
	Illiterate	7	29.2
Income			
	≤1 MW	19	79.1
	> 1 and ≤ 2 MW	5	20.9

MW: minimum wage (R$ 937.00 in season). * Intermediate Teaching: refers to elementary and secondary education.

Clinical Profile

The main diagnosis was stroke, with 79.2% (n=19), followed by pneumonia, with 8.3% (n=2), Guilliain Barre Syndrome, with 8.3% (n=2), and Post-Chikungunya Motor Myeloradiculopathy, with 4.2% (n=1). The main associated diseases were Systemic Arterial Hypertension, affecting 87.5%(n=21) of the elderly; Diabetes Mellitus (45.8%) (n=11); infections (12.5%) (n=3); and other related cardiovascular diseases (29.2%) (n=7). Fifty percent (50%) of the participants had other diseases. Considering the length of stay of the evaluated elderly, a mean of 39.75 ± 10.68 days was obtained, with a minimum of 19 days and a maximum of 60 days of hospitalization, characterizing a considerable period of hospitalization to carry out the evaluations proposed in the present study.

Anthropometry, body composition and nutritional diagnosis

The results of anthropometry and body composition are presented in Table 2. It is noteworthy that there was a significant reduction ($p<0.05$) between hospital admission and discharge for the indicators of weight, BMI, AC and TSF. At admission, the classification of nutritional assessment in relation to BMI showed that 41.7% (n=10) were eutrophic; 37.5% (n=9) had overweight, and 20.8% (n=5) were thin. At hospital discharge, eutrophic patients still accounted for 41.7% (n=10) of the total; 33.3% (n=8) had overweight, and 25% (n=6) were thin, with statistical difference between the periods ($p<0.05$). Regarding the initial MNA results, a score of 17.18 ± 3.59 was obtained, with a trend of improvement at discharge with a final value of 18.41 ± 4.36 points, but with no statistically significant difference (p=0.115). Figure 1 shows the nutritional diagnosis, which involves the interpretation of the values obtained by BMI, anthropometric measurements (CC, AC, TSF, AMC and their adequacy), and the MNA evaluation. In the present study, there was a reduction in the values of weight, BMI, AC, and TSF parameters during hospitalization, although the values of MM (p=0.403) and SMI (p=0.371) were not affected throughout the length of stay among the study participants (n=24). It was also observed that the anthropometric variables of adequacy of AC, TSF, and AMC measures showed eutrophy for the admission and discharge periods.

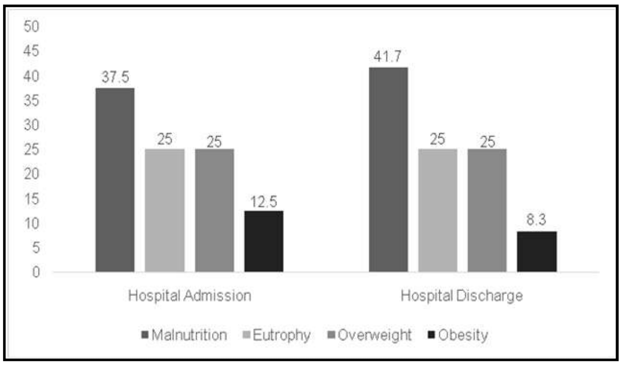

Figure 1. Nutritional diagnosis classification comparing the hospital admission and discharge periods (%) of hospitalized elderly (n=24)

Prevalence of sarcopenia

Table 3 shows the results of the comparison between the sexes in relation to the indicators of sarcopenia during hospitalization, with a statistically significant difference ($p<0.001$) for both MM and SMI in both sexes. When evaluating the classification of sarcopenia in general, the prevalence of sarcopenia was found in 58.3% (n=14) of the elderly; of these, 85.7% (n=12) showed grade I sarcopenia and 14.2% (n=2) were classified as with grade II sarcopenia. At hospital discharge, sarcopenia prevailed in 62.5% (n=15) of the elderly, of which 80% (n=12) had grade I sarcopenia and 20% (n=3) had grade II sarcopenia. In relation to the prevalence of sarcopenia between the sexes (Figure 2), 41.7% of women and 75% of men (p=0.037) presented this condition at hospital admission, while at hospital discharge, the same prevalence of sarcopenia was maintained in women (41.7%), increasing to 83.3% in men, with a statistically significant difference (p=0.004). Stratifying the elderly by age group, at admission, between those aged 60 to 79 years (n=17), 58.8% (n=10) presented grade I sarcopenia, and 41.2% (n=7) had absence of sarcopenia.

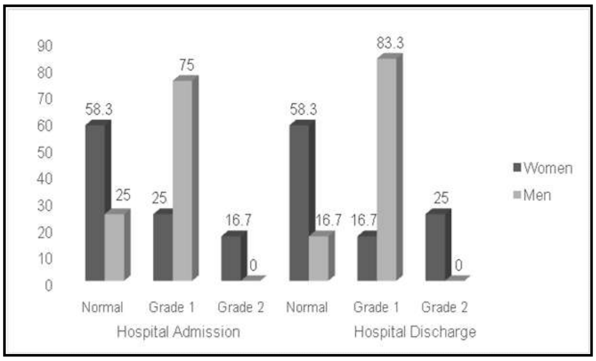

Figure 2. Classification of sarcopenia, according to sex, in relation to the hospital admission and discharge periods (%) of hospitalized elderly (n=24). *p-values for hospital admission (p=0.037) and hospital discharge (p=0.004), with statistically significant difference between the sexes in the classification of sarcopenia in each period evaluated, according to the chi-square test

Table 2. Anthropometric and body composition data of hospitalized elderly (n=24)

Variables	Hospital Admission		HospitalDischarge		p-value
	Mean (min. - max.)	SD	Mean (min. -max.)	SD	
Weight (kg)	66.41 (38.6-94.6)	14.21	64.63 (37.9-90.0)	13.39	0.003*
Height (m)	1.60	0.08	1.60	0.08	-
BMI (kg/m²)	25.54 (15.0-36.6)	4.89	24.87 (14.8-34.8)	4.54	0.005*
CC (cm)	31.94 (25-40)	3.84	31.79 (25-39)	3.83	0.575
AC (cm)	30.62 (24.0 – 36.5)	3.62	29.49 (20.5 – 36.0)	3.90	0.010*
AMC (cm)	25.37 (19.8–30.3)	2.84	25.42 (17.4 – 31.9)	3.86	0.935
TSF (mm)	16.92 (8.5 – 26.5)	6.07	14.82 (8.0 – 25.5)	4.99	0.033*

BMI: Body Mass Index; CC: Calf Circumference; AC: Upper Arm Circumference; AMC: Arm Muscle Circumference; TSF: Triceps Skinfold; SD: Standard Deviation (±). *Values of p<0.05, with statistically significant difference between the hospital admission and discharge periods, according to the Student's t-test for paired samples.

Table 3. Comparison between the sexes in relation to the indicators of sarcopenia during the hospitalization of elderly people (n=24)

Sarcopenia	Women		Men		
	Mean	SD	Mean	SD	p-value*
Hospital Admission					
MM	17.25	4.86	27.44	3.44	0.0001
SMI	7.12	1.64	9.85	1.08	0.0001
Hospital Discharge					
MM	16.42	4.30	27.57	3.68	0.0001
SMI	6.79	1.51	9.90	1.15	0.0001

MM= Muscle Mass (kg); SMI = Skeletal Muscle Index (kg/m²); SD: Standard Deviation.
*p-values, sex comparisons, according to the t-test for independent samples.

Table 4.Comparison of energy-protein dietary intake among hospitalized elderly people (n=24)

Energy-protein intake	Hospital Admission (M ±SD)	Intermediate Period (M ±SD)	Hospital Discharge (M ±SD)	p-value
Energy (Kcal/day)	1359.20 ± 357.01^{b}	1526.67 ± 454.23^{ab}	1663.86 ± 363.39^{a}	0.033*
Protein				
g/day	64.80 ± 27.35^{b}	76.29 ± 30.26^{ab}	85.97 ± 26.92^{a}	0.040*
g/kg/day	1.0 ± 0.40^{b}	-	1.4 ± 0.60^{a}	0.040*

M = mean; SD = Standard deviation. * Value of p defined by the ANOVA test. * Different letters on the same line indicate statistical difference between the periods (p<0.05) by the Tukey test. **p-value defined by t-test for paired samples.

At hospital discharge, the prevalence of grade I (n=10) sarcopenia was maintained, while 5.9% (n=1) presented grade II sarcopenia and the remaining 35.3% (n=6) did not present sarcopenia. For the long-lived elderly group (n=7), with age greater than or equal to 80 years, there was a prevalence of 28.6% for each sarcopenia group (grade I and II), in addition to accounting for 42.8% (n=3) of those who presented no sarcopenia. These results were maintained both at admission and at discharge.

Food intake

The food intake of patients was evaluated at 3 times, hospital admission, intermediate period, and hospital discharge (Table 4), showing a statistically significant difference between the intake and discharge periods for total energy intake, protein in grams and in grams/kg of body weight per day. The feeding route was maintained during hospitalization with 50% (n=12) of the elderly fed orally; only 8.3% were fed with an exclusive enteral diet, and 41.7% started an enteral diet evolving to oral feeding during hospitalization, demonstrating a greater recovery of the oral feeding route. When analyzing the protein intake per meal (Figure 2), the amount of protein differed only for the lunch meal (p=0.001) during hospitalization, with a significantly higher and increasing intake between the periods. The same trend was observed for dinner, but without statistical difference (p=0.088). For breakfast, morning snack, afternoon snack and supper, there was no change in protein intake over the period.

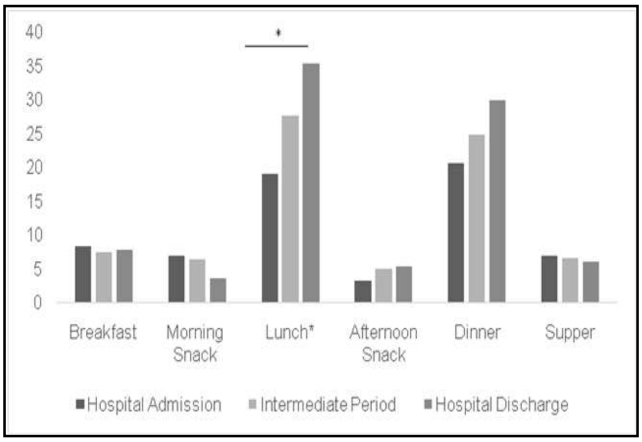

Figure 3. Protein intake (grams) distributed per meal and/or schedule of enteral diet during hospitalization of elderly people (n=24). *Values of p<0.05, according to the ANOVA and post-hoc Tukey test

The energy-protein intake of the elderly increased during the period of hospitalization and could be related to patient recovery, possibly reestablishing the feeding route, often impaired in the stroke condition, the most clinical diagnosis among the study participants.

DISCUSSION

Elderly people aged 60 to 79 years with lower level of schooling and lower income prevailed in the study, which can be correlated with the lower access to health and disease prevention, as well as with the onset of associated chronic diseases such as hypertension and diabetes. The identification of aspects that contribute to the determination of nutritional diagnosis in the elderly involves complex processes, including aging, socioeconomic factors, lifestyle, and pathologies, generally interfering with the nutritional status (Ferreira *et al*., 2014). A study by Gomes, Emery and Weekes (2016) showed higher mortality and worse outcomes related to patients with stroke and impaired nutritional status, mainly due to inadequate food intake. Among the diseases found in that study, pneumonia is also a recurrent disease in the elderly population, since it becomes opportunistic when the immunity of these individuals is more fragile. Stroke and the Guilliain Barré Syndrome are conditions that generate temporary and even permanent sequelae causing disabilities.

They are often related to the loss of autonomy in feeding, especially in hospitalized elderly patients, who are often debilitated by the physiological condition of aging and the psychological issues arising from the disease process. When physical incapacity is present, the patient becomes bedridden, with decreased calf circumference due to impaired movement. In addition, according to Rolland *et al*. (2003), CC correlates positively with muscle mass and the value lower than 31 cm in the elderly has been associated with nutritional deficiency. Moreover, hospitalization in a rehabilitation unit leads to a greater frequency of physiotherapy, which can naturally generate greater energetic expenditure to the individual. A common condition in aging is the progressive loss of lean mass plus a greater centralization of body fat in the elderly. These characteristics may be sufficient to disguise the actual nutritional status of the individual when compared to the BMI values, which would lead to an erroneous diagnosis of eutrophy and may correlate with an important nutritional deficit and a higher risk of developing the fragility syndrome (Melo *et al*., 2017). Two studies showed that sarcopenia was inversely associated with BMI, that is, the elderly with a higher BMI showed a lower risk of sarcopenia than those with lower BMI (Landi *et al*., 2012; Woods *et al*., 2009). The literature highlights that anthropometric measures are considered more accessible tools, which are widely used in clinical practice for the evaluation of the nutritional status of the elderly (Barbosa *et al*., 2005; Cortez *et al*., 2012). In this sense, the improvement of the MNA score may be related to patient rehabilitation at the ICCU, which aims to disable devices such as vesical catheter, feeding catheter, tracheostomy, wheelchair, among others. The prevalence of sarcopenia may be related to the fact that the elderly were referred from a previous hospitalization to the ICCU sector, showing malnutrition from the beginning of the disease process, which can be worsened by a longer length of stay. Research reports that sarcopenia and its reversible character are directly related to musculoskeletal performance and to the potential role of rehabilitation in restoring physical capacity, including feeding in this process (Roubenoff and Hughes, 2000). The results found in relation to the prevalence of sarcopenia between the sexes showed that men presented a higher prevalence of sarcopenia, although the most aggressive degree was verified in women. The same was also found in the study by Gallagher *et al*. (2000), where men presented higher amounts of MM and a higher incidence of sarcopenia when compared to women. A hypothesis raised by Janssen *et al*. (2002) would be that men generally have more muscle mass than women, which provides a greater amount of tissue for accelerated loss associated with hospitalized individuals, who are normally bedridden. Accelerated loss of skeletal muscle may also be related to the aging process, including a decrease in hormonal factors, in both women and men, making it difficult to control.

Thus, aging leads to a greater muscle loss in men, but it seems that in women the consequences are worse and may be related to lower initial muscle mass (Janssen *et al*., 2002). An interesting finding observed in this study was that older elderly patients maintained their sarcopenia profile during hospitalization, with the prevalence of grade II sarcopenia of greater severity compared to young adults. In the last decades, the number of studies that investigated age-related changes in the body composition has increased, but the population aged over 80 years is still little studied. Although these changes are mediated by genetic and physiological factors, environmental factors such as nutrition, disease, and physical activity also exert a strong influence on body composition (Buffa, 2011). Protein intake has been widely studied as a nutritional strategy to attenuate aging-dependent muscle loss and thus maintain quality of life (Wolfe, 2012). One study evidenced that the intake of 25 to 30 g of high-quality protein per meal promoted maximal stimulation of muscle protein synthesis in the elderly, aiming to prevent or delay muscle loss. It was also reported the importance of fractionating protein intake equally in three or more daily meals to stimulate protein synthesis in the elderly (Paddon-Jones; Rasmussen, 2009). According to the study of the PROT-AGE group (represented by several international associations of gerontology and nutrition), it is recommended that healthy elderly should consume between 1.0-1.2g protein/kg body weight/day; however, when associated with strength or aerobic exercise, this intake should be above 1.2 g protein/kg body weight/day (Bauer *et al*., 2013). The Dietary Reference Intakes (DRIs), in turn, recommend a food intake of 0.8 to 1 grams/kg body weight/day of protein for normal individuals (Padovani *et al*., 2006). In the present study, it was verified that the protein intake of the elderly agrees with the values for the period ofhospital admission and exceeds the recommendations for hospital discharge. The energy-protein intake is important for the maintenance of MM, and consequently of sarcopenia. Although there is a greater intake between the periods, there are other metabolic factors -related to aging and less physical mobility caused by hospitalization - that influence the reversion and/or recovery of these indices and of sarcopenia itself. A study by Moraes *et al*. (2008) corroborates these findings, where aging caused a 20% to 30% decrease in muscle mass (sarcopenia) and bone mass (osteopenia), caused by neuroendocrine changes and physical inactivity, which is very present during hospitalization.

Conclusion

The present study was characterized by the predominance of elderly individuals aged between 61 and 69 years, diagnosed with stroke, hospitalized with an average length of stay of approximately 40 days and with nutritional diagnosis of malnutrition. There was a prevalence of sarcopenic elderly with male predominance and classified as grade I, in addition to increased energy-protein intake during the hospitalization period. The use of Lee's equation, combined with a complete and early nutritional assessment, are essential to guide professionals in relation to the elderly hospitalized with sarcopenia in the absence of more accurate imaging methods, aiming to slow the progressive loss of muscle mass, avoiding bad prognoses. The use of this instrument collaborates in the therapy of the most vulnerable elderly, avoiding greater health problems and a longer length of stay with consequent generation of higher public health costs. It is important that other longitudinal, prospective studies of nutritional intervention should be performed to assess the loss of muscle mass in hospitalized elderly.

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