Saúde e Pesquisa
DOI: 10.17765/2176-9206.2023v16n1.e11128

Prevalence of sarcopenia in the elderly and its association with dietary nutrient intake

Prevalência de sarcopenia em idosos e sua associação com a ingestão de nutrientes dietéticos

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ABSTRACT
This study aimed to verify the prevalence of sarcopenia in the elderly and its association with dietary nutrient intake. Quantitative, cross-sectional and analytical study developed with 114 elderly enrolled in a Basic Health Unit located in Mossoró (RN). Data were collected using a sociodemographic questionnaire, dietary survey, nutritional and anthropometric assessment. To determine sarcopenia, tests such as Timed up and go, handgrip and predictive equation of skeletal muscle mass were used. A prevalence of sarcopenia of 26.32% was identified, concomitant with the presence of muscle mass depletion, low weight, increased risk factor with advancing age and inadequate physical performance. It was found that the chance of elderly people aged up to 70 years to present sarcopenia decreased by 73%, compared to those aged over 70 years and that the chances of users with adequate Timed up and go to present the disease decreased by 75% compared to participants who showed inadequate physical performance. It was found that sarcopenic elderly consumed reduced amounts of many micronutrients, such as: vitamin D, E, C, B2, B3, B12, magnesium, selenium and zinc, in addition to having an inadequate diet in terms of energy and protein, compared to non-sarcopenic individuals. It emphasizes the need to expand knowledge about food, prevention and treatment of sarcopenia.

Keywords: Elderly health. Sarcopenia. Nutrients. Food consumption. Primary Health Care.

RESUMO
Este estudo teve o objetivo de verificar a prevalência de sarcopenia em idosos e sua associação com a ingestão de nutrientes dietéticos. Estudo quantitativo, transversal e analítico desenvolvido com 114 idosos adscritos em uma Unidade Básica de Saúde localizada em Mossoró (RN). A coleta foi realizada por meio de um questionário sociodemográfico, inquérito dietético, avaliação nutricional e antropométrica. Para determinação da sarcopenia, utilizou-se testes como o *Timed up and go*, de preensão manual e equação preditiva de massa muscular esquelética. Identificou-se prevalência de sarcopenia de 26,32%, concomitante à presença de depleção de massa muscular, baixo peso, fator de risco aumentado com o avançar da idade e desempenho físico inadequado. Constatou-se que a chance dos idosos com idade até 70 anos apresentar sarcopenia diminuiu em 73%, contraposto aos com idade acima de 70 anos e que as chances dos usuários com *Timed up and go* adequado apresentarem a doença diminui em 75% comparada aos participantes que apresentaram inadequação no desempenho físico. Verificou-se que os idosos sarcopênicos consumiam quantidades reduzidas de muitos micronutrientes, como: vitamina D, E, C, B2, B3, B12, magnésio, selênio e zinco, além de apresentarem dieta inadequada em energia e proteínas, comparados aos não sarcopênicos. Ressalta-se a necessidade da expansão de conhecimentos sobre alimentação, prevenção e tratamento da sarcopenia.

Palavras-chave: Saúde do idoso. Sarcopenia. Nutrientes. Consumo alimentar. Atenção Primária à Saúde.

Received in January 13, 2023
Accepted on February 12, 2023

INTRODUCTION

There is a growing concern about the increase in the number of elderly people in recent decades. According to the projections on the age structure presented in the World Report on Aging and Health of the World Health Organization (WHO), in 2050, 21.5% world population will be made up of individuals over 60 years of age[1]. In Brazil, the demographic transition has happened at an accelerated pace compared to developed countries[2].

That said, it is important to clarify that with human aging, changes occur in physiological systems, mainly related to the musculoskeletal system, conditions that lead to the reduction of functionalities of the elderly, which contribute to the increased risk of morbidities and events of falls[3].

The increase in life expectancy is linked to changes in the individual health profile, in which chronic degenerative diseases and functional disabilities stand out. The diseases that develop as a result of the aging process include sarcopenia[4]. Characterized by the loss of strength and muscle mass in older individuals, sarcopenia affects the functional abilities and quality of life of the elderly, leading to adverse effects, such as: functional dependence, immobility, disability, falls, fractures, institutionalization, morbidity, mortality and increased length of stay[4,5,6,7].

Most of the national and international studies on the prevalence of sarcopenia, involving elderly people in communities, present consistent results, with prevalence between 30% or less of cases[8-11], with recommendations for the need and importance of screening for sarcopenia within Primary Health Care (PHC), in order to prevent, treat early and reduce the risk of disease progression. In recent years, nutritional care has gained ground by playing an important role, both in the prevention and control of sarcopenia[12]. A good diet and adequate nutritional status are associated with healthy aging, with autonomy and independence[13,14]. The benefits of a balanced diet in old age have been recognized for a long time, however, many studies involving its effects on muscle mass, muscle strength and physical function are relatively recent[12].

The elderly population is more prone to dietary restrictions due to economic, psychosocial, and physiological changes, which in most cases leads to poor quality and nutrient-deficient food intake. In this sense, the need was felt to evaluate this public, to diagnose sarcopenia, making it possible, through dietary analysis, to identify nutritional deficiencies that may contribute to the diagnosis of this disease, with a consequence of functional impairment, in particular, so that the elderly, family members, caregivers, health professionals, and the community, in general, become aware and take measures to prevent or delay its effects, based on a balanced diet.

The discussion of this theme becomes relevant as it enables the strengthening of care measures and discoveries of new perspectives in prophylaxis and therapy, with a view to contributing to the promotion of a healthier lifestyle for participants, greater well-being and greater knowledge about food choices. Thus, the study aimed to check the prevalence of sarcopenia in the elderly and its association with dietary nutrient intake.

METHODS

This was a quantitative, cross-sectional, analytical study carried out with elderly people enrolled in a Basic Health Unit (UBS) located in a community in the Ilha de Santa Luzia neighborhood, municipality of Mossoró, state of Rio Grande do Norte. The research was carried out between January and June 2021.

The sample calculation took into account the total elderly population in the municipality,

consisting of 24,238 individuals according to the Brazilian Institute of Geography and Statistics (IBGE) in 2010[15], with a confidence level of 95%, expected error of 5 % and accuracy of 4%, resulting in a sample of 114 elderly people.

There was no revised or updated data on the population of the municipality on the official website of the Municipality of Mossoró, nor on other reliable sources. Thus, the 2010 Census was adopted for sample calculation for the study. The choice of the location was based on the suggestion of the Municipal Health Department, as it is one of the most populous, with a large number of elderly users who have a certain degree of social vulnerability.

As for recruitment, the researcher explained the work to be carried out at the UBS through a meeting called by the researcher at the unit itself, with the participation of the responsible nurses and community health agents (CHA).

The initial objective would be to collect data with the elderly who attended the UBS elderly group, a proposal from the research project of the study, however, due to the COVID-19 pandemic and the impossibility of promoting agglomerations, it was carried out door-to-door home visits to the elderly in the community with the support of CHA of the neighborhood, as they know the territory and its population. All necessary measures to prevent the spread of the Coronavirus have been taken.

Daily, data collection was carried out in each of the homes of the elderly in the neighborhood. At first, the CHA approached, briefly explaining who the researcher was and what her real objective was, then the person responsible for the research clarified the steps of the investigation, carried out the anamnesis, and proposed tests on the elderly in the community.

Individuals aged 60 years or older, with autonomy and the ability to perform the proposed tests, participated in the study. Those who had some cognitive deficit measured by the Mini-Mental State Examination (MMSE)[16] with a score of less than 23 points were excluded, in addition to those who had amputations, severe visual impairment or blindness, presence of chronic disease that favored weight loss and those who used a wheelchair, or some device that assisted in locomotion.

Data were collected using a structured sociodemographic questionnaire; anthropometric and dietary nutritional assessment, test to assess physical performance; muscle strength test, and calculation to determine Skeletal Muscle Mass (MME). Due to the COVID-19 pandemic, data were collected during home visits to the elderly in the community with the support of the neighborhood CHAs. All necessary measures to prevent the spread of the Coronavirus have been taken.

Dietary intake was assessed using a 24-hour recall (R24h). The Table by Pinheiro et al.[17] was used as a reference standard for household food measures for conversion into grams. The amounts in grams were later inserted in the Brazilian Food Composition Table[18], a dietary analysis was carried out for energy, macronutrients, and micronutrients, such as vitamins A, B1, B2, B3, B6, B12, C, D, E, calcium, folic acid, phosphorus, magnesium, iron, zinc, selenium, and sodium.

The assessment of dietary inadequacy was based on the Dietary Reference Intake (DRI) reference values, according to gender and age, prepared by the Committee of the Food and Nutrition Board/Institute of Medicine[19].

The analysis of adequacy and inadequacy of energy intake was performed by calculating the Estimated Energy Requirement (EER) using the equations proposed by the Institute of Medicine for individuals aged 19 years and over. Energy intake was considered adequate when it reached the mean EER of the group, and the prevalence

of inadequacy was calculated by the proportion of individuals in the group who did not reach the reference values[20].

The adequacy of dietary macronutrients in the diet, in relation to the energy percentage, was verified from the values proposed in the intervals of the Acceptable Macronutrient Distribution Ranges (AMDR)[19].

And for the adequacy of micronutrients, DRIs were used, according to gender and age. The values used for reference in the calculations to determine inadequacy were the Estimated Average Requirement (EAR), or adequate intake (AI), in the absence of EAR. Thus, micronutrients with concentrations above the EAR and below the Tolerable Upper Intake Level (UL)[19] were considered adequate.

The anthropometric measurements taken were: weight, height, Body Mass Index (BMI) and calf circumference (CC). With the weight and height measurements, the BMI was calculated, following the specific cutoff points for the elderly proposed by the Ministry of Health[21]. As for calf circumference, the recommendation of the WHO[22] was used, in which values lower than 31 cm indicate loss/depletion of muscle mass.

The diagnosis of sarcopenia was characterized using the criteria of the European Consensus "The European Working Group on Sarcopenia in Older People" (EWGSOP1)[23], on the definition and diagnosis of sarcopenia revised in 2018[4], which considers the onset of sarcopenia when muscle strength is insufficient, associated with insufficient muscle mass, being the physical performance indicator used to categorize the level of sarcopenia.

Skeletal muscle mass (MME) was estimated using the Equation by Lee et al[24]. This formula has a strong agreement with the gold standard, Dual Energy X-Ray Absorptiometry (DEXA), and is indicated as a good parameter to check for sarcopenia[25]. In addition to being an important instrument, it possibly is the only one that can be applied in public health, to the detriment of high-cost instruments, such as magnetic resonance imaging or computed tomography, which still expose subjects to radiation[26].

After measuring the MME, the Muscle Mass Index (MMI) was calculated using the ratio of MME to height squared, evaluated according to Janssen et al.[27], who consider skeletal muscle mass as insufficient when $<10.75 kg/m^2$ for men and <6.75 kg/m² for women.

Muscle strength was assessed using hand dynamometry, using cutoff point values of <27 kg for men and <16 kg for women[4]. Physical performance was analyzed using the Timed Up and Go Test (TUG), considering values for the elderly according to Bischoff et al.[28].

In the present study, Student's t-test, Chi-square and Fisher's exact tests were applied to check the association between categorical variables. The significance level of all statistical tests was 5%.

The research was submitted to the Research Ethics Committee (CEP) of the State University of Rio Grande do Norte (UERN), and approved according to opinion 4,583,238, in accordance with the precepts of Resolution 466/2012 of the National Council of Health.

RESULTS

Considering the collected data, 114 elderly were investigated, of which 76.32% were female and 23.68% were male. There was a predominance of whites (78.07%), incomplete primary education (63.16%), and married marital status (39.47%). Of the elderly assessed, most had an average income between 1 and 3 minimum wages (64.91%). Clinical characteristics and nutritional status are listed in more detail in Table 1.

Table 1. Clinical characteristics and nutritional status of the evaluated elderly, Mossoró, state of Rio Grande do Norte, 2021

Characterization		Absolute frequency	%
Prevalence of Sarcopenia	No	84	73.68
	Yes	30	26.32
Classification of Sarcopenia	No sarcopenia	50	43.86
	Probable sarcopenia	34	29.82
	Sarcopenia	18	15.79
	Severe sarcopenia	12	10.53
BMI Classification	Low weight	19	16.67
	eutrophy	41	35.96
	overweight	54	47.37
CC diagnosis	Adequate	70	61.40
	Muscle mass depletion	44	38.60
Streght Classification	Low strength	64	56.14
	Adequate strength	50	43.86
Mass Classification	Low mass	41	35.96
	Normalized mass	73	64.04
TUG Classification	Low physical performance	24	21.05
	Adequate physical performance	90	78.95
	Total	**114**	**100.00**

Source: Prepared by the authors, 2021. BMI: Body Mass Index; CC: Calf circumference; TUG: *Timed Up and Go Test*

With regard to the diagnosis of sarcopenia, 26.32% elderly had the disease, a result from the combination of the diagnosis of sarcopenia (15.79%) and severe sarcopenia (10.53%). It was possible to observe risk of sarcopenia categorized as pre-sarcopenic (29.82%) and that only 43.86% participants were not at risk of developing the disease. Importantly, analyses were performed according to Cruz-Jentoft et al.[4], being classified as pre-sarcopenia (only loss of muscle strength), sarcopenia (loss of strength accompanied by loss of muscle mass) or severe sarcopenia (loss of strength, mass and physical performance).

When evaluating the nutritional status in a broad way, the diagnosis of overweight stood out in the general classification of BMI. Muscle mass, CC and TUG also had positive repercussions when evaluated taking into account the total sample. Muscle strength, unlike mass, showed low strength results in most of the sample.

In order to check for possible nutritional deficiencies that may contribute to the diagnosis of sarcopenia, statistically significant differences were detected in sarcopenia with inadequate nutritional data for vitamins D, E, C, B2, B3, B12, magnesium, selenium and zinc in both sexes (Table 2).

Table 2. Nutritional variables and occurrence of sarcopenia, Mossoró, state of Rio Grande do Norte, 2021 (Continued)

Variáveis nutricionais	Sarcopenia	Female			Male		
		Mean	Standard deviation	p-value	Mean	Standard deviation	p-value
Vitamin A	**Yes**	1913.72	463.08	**<0.001**	1602.87	666.47	**0.499**
	No	1393.49	685.29		1871.48	950.92	
Vitamin D	**Yes**	8.59	2.91	**<0.001**	8.74	1.45	**0.014**
	No	37.27	9.87		41.66	32.47	
Vitamin E	**Yes**	10.89	4.19	**<0.001**	9.84	4.36	**0.002**
	No	17.43	6.03		25.61	11.45	
Vitamin B1	**Yes**	0.98	0.13	**<0.001**	1.14	0.18	**<0.001**
	No	1.54	0.51		1.77	0.50	
Vitamin B2	**Yes**	0.68	0.14	**<0.001**	0.78	0.20	**<0.001**
	No	1.32	0.31		1.68	0.47	
Vitamin B3	**Yes**	7.25	1.28	**<0.001**	8.81	0.60	**<0.001**
	No	18.25	5.37		21.13	6.54	
Vitamin B6	**Yes**	1.36	0.27	**0.323**	1.20	0.29	**<0.001**
	No	2.01	3.14		2.13	0.45	
Folate	**Yes**	325.83	42.09	**0.014**	339.31	32.56	**0.001**
	No	354.83	58.67		421.71	75.39	
Vitamin B12	**Yes**	0.69	0.37	**<0.001**	0.99	0.47	**<0.001**
	No	2.86	1.28		4.68	2.14	
Vitamin C	**Yes**	42.91	23.47	**<0.001**	37.93	26.17	**<0.001**
	No	101.96	66.30		125.55	83.53	
Calcium	**Yes**	341.93	86.91	**<0.001**	399.12	138.83	**0.013**
	No	626.46	245.14		681.00	262.22	
Magnesium	**Yes**	232.53	27.96	**<0.001**	247.64	33.72	**<0.001**
	No	293.80	32.82		341.30	47.18	
Selenium	**Yes**	26.44	7.45	**<0.001**	41.68	10.18	**<0.001**
	No	77.49	21.26		96.21	28.09	
Zinc	**Yes**	4.25	0.41	**<0.001**	5.06	0.67	**<0.001**
	No	8.65	2.09		11.78	3.75	
Sodium	**Yes**	1655.99	253.07	**0.002**	1754.59	380.81	**0.148**
	No	1914.08	507.36		2054.78	479.95	

(Conclusion)

Variáveis nutricionais	Sarcopenia	Female			Male		
		Mean	Standard deviation	p-value	Mean	Standard deviation	p-value
Phosphorus	**Yes**	596.55	80.81	**<0.001**	692.50	128.57	**<0.001**
	No	1134.41	217.88		1339.58	257.04	
Iron	**Yes**	11.61	3.48	**0.002**	10.79	1.31	**<0.001**
	No	14.27	2.63		17.69	2.58	

Source: Prepared by the authors, 2021. IQ: Interquartile Range SD: Standard Deviation CV: Coefficient of Variation.

Vitamin B1, folate, iron, phosphorus and sodium also showed significant differences in terms of food intake when comparing sarcopenic and non-sarcopenic patients. However, even with differences in their values, both groups reached the recommended minimum. Calcium was another example of a micronutrient with significant differences, however, both the elderly diagnosed with sarcopenia and the healthy ones failed to reach the minimum recommended value, as well as magnesium for males. Vitamin B6 showed a difference in both sexes, but statistically significant among men.

The elderly with sarcopenia expressed lower value in all the nutritional data mentioned above, except for vitamin A, which was consumed more by female patients with sarcopenia.

The recommended intake for energy, proteins and lipids, based on the food consumed, showed significant differences between elderly people with and without sarcopenia, in both sexes. Table 3 lists the results of recommendations and dietary intake of these nutrients. The sarcopenic elderly did not reach the specific recommendations for energy and were inadequate in terms of the percentage required for protein. On the other hand, those who did not reflect the diagnosis of sarcopenia had adequacy in all the macronutrients evaluated, as well as in energy.

Table 3. Distribution of macronutrients and energy based on the R24h applied to the elderly, Mossoró, state of Rio Grande do Norte, 2021

Energy and Macronutrients	Recommendation	Intake		
		No sarcopenia	With sarcopenia	p-value
Energy (Kcal)	1718.41 Kcal*	1827.59 Kcal	1363.67 Kcal	**<0.001**
Carbohydrate (%)	45-65%	56.72%	60.89%	**0.071**
Protein (%)	10-35%	19.37%	9.44%	**<0.001**
Lipid (%)	20-35%	28.29%	22.54%	**<0.001**

Source: Prepared by the authors, 2021. Kcal: Kilocalorie; *Recommended overall average EER

The comparisons and associations of variables referring to the presence of sarcopenia, general and clinical data of the study participants, are presented in Table 4. It was possible to find a statistically difference between the occurrence of sarcopenia with age, BMI classification, CC diagnosis, classification of muscle strength and mass, carbohydrate and protein.

Table 4. Comparison of sarcopenia with the clinical and general profile of the elderly, Mossoró, state of Rio Grande do Norte, 2021

Characterization		Sarcopenia		Total	p-value	Odds Ratio [95% CI]
		Yes	No			
Age group	**≤ 70 years**	14.29% (n=8)	85.71% (n=48)	**100.00% (n=56)**	**0.004** (1)	**0.27 [0.11; 0.68]**
	> 70 years	37.93% (n=22)	62.07% (n=36)	**100.00% (n=58)**		
BMI classification	**Low weight**	78.95% (n=15)	21.05% (n=4)	**100.00% (n=19)**	**<0.001**(1)	**---**
	Eutrophy	31.71% (n=13)	68.29% (n=28)	**100.00% (n=41)**		
	Overweight	3.70% (n=2)	96.30% (n=52)	**100.00% (n=54)**		
CC diagnosis	**Adequate**	11.43% (n=8)	88.57% (n=62)	**100.00% (n=70)**	**<0.001**(1)	**0.12 [0.05; 0.33]**
	Inadequate	50.00% (n=22)	50.00% (n=22)	**100.00% (n=44)**		
Muscle strength classification	**Adequate**	---	100.00% (n=50)	**100.00% (n=50)**	**<0.001**(1)	**---**
	Inadequate	46.88% (n=30)	53.13% (n=34)	**100.00% (n=64)**		
Muscle mass classification	**Adequate**	---	100.00% (n=73)	**100.00% (n=73)**	**<0.001**(1)	**---**
	Inadequate	73.17% (n=30)	26.83% (n=111)	**100.00% (n=41)**		
TUG classification	**Adequate**	20.00% (n=18)	80.00% (n=72)	**100.00% (n=90)**	**0.003**(1)	**0.25 [0.10; 0.65]**
	Inadequate	50.00% (n=12)	50.00% (n=12)	**100.00% (n=24)**		
Carbohydrate	**Adequate**	19.77% (n=17)	80.23% (n=69)	**100.00% (n=86)**	**<0.005**(1)	**0.28 [0.11; 0.71]**
	Inadequate	46.43% (n=13)	53.57% (n=15)	**100.00% (n=28)**		
Protein	**Adequate**	1.18% (n=1)	98.82% (n=84)	**100.00% (n=85)**	**<0.001**(1)	**---**
	Inadequate	100.00% (n=29)	---	**100.00% (n=29)**		
Lipid	**Adequate**	26.32% (n=25)	73.68% (n=70)	**100.00% (n=95)**	**1.000** (1)	**1.00 [0.33; 3.06]**
	Inadequate	26.32% (n=5)	73.68% (n=14)	**100.00% (n=19)**		

Source: Prepared by the authors, 2021. (1) Chi-square test (2) Fisher's Exact Test; BMI: Body Mass Index; CC: Calf Circumference; TUG: *Timed Up and Go Test*

The chance of elderly people aged up to 70 years to have sarcopenia decreased by 73%, compared to those aged over 70 years. Participants with adequate CC also had a lower risk (88%) of having sarcopenia compared to those with CC below the standard recommendation, <31 cm. With regard to physical performance, the chance of users with adequate TUG to have sarcopenia decreased by 75% compared to those with inadequate TUG, and the elderly with carbohydrate intake within the required recommendation were less likely to develop sarcopenia compared to those classified as inadequate.

Furthermore, only 1.18% sarcopenic patients had adequate protein intake and those with BMI classified as nutritional risk and underweight were associated with a higher risk for developing the disease.

DISCUSSION

The present study identified a considerable prevalence of sarcopenia in the evaluated elderly, concomitantly with the presence of muscle mass depletion due to inadequate CC and low weight according to BMI, with an increased risk factor with advancing age and inadequate physical performance, considering the TUG classification. Sarcopenic individuals had a lifestyle characterized by the ingestion of an inadequate diet, which was insufficient in energy, protein and specific micronutrients, such as vitamin D, E, C, B2, B3, B12, magnesium, selenium and zinc.

The prevalence of sarcopenia found in this investigation (26.32%) was similar to that observed in other Brazilian studies with elderly people living in urban areas, such as the study by Oliveira (23.7%)[29] and Pelegrini(33.3%)[8], in addition to internationally available evidence[30,31].

The literature reports that sarcopenic individuals are mostly female, and that factors such as low income and low education significantly increase the chance of a person being affected by sarcopenia[32-34]. In the current research, however, it was not possible to reveal an association between sarcopenia and sex, even though the female public constituted the majority of the participants, there was a predominance in both sexes. However, it appears that the socioeconomic factor influences the diagnosis, since the lower the available income, the greater the difficulty in accessing food.

As for older age, this was considered an important risk factor for the development of the disease in this and other studies[35,36], in which older individuals were more likely to develop the disease. The population over 79 years of age, the "fourth age", is the segment that has been growing the most over the years and along with it, many elderly people are affected by loss of physical autonomy, which is reflected in this investigation[37,38].

The nutritional status can be a motivating factor for the development of sarcopenia[37]. Some evaluated markers indicated worse nutritional outcomes in patients with the disease. The assertion that sarcopenic individuals manifest a high prevalence of low weight or malnutrition was confirmed in that study. This finding, the relationship between low weight and sarcopenia, was described by Sieber[39] as a risk factor for the development of sarcopenia and that older individuals diagnosed with low weight are up to three times more susceptible to the disease[40,41].

The Ministry of Health[42] recommends investigating, in addition to weight and height, calf circumference, due to its power to measure muscle mass. With regard to the data obtained in the CC, an association was observed between inadequate calf circumference and the prevalence of sarcopenia, predominating the adequacy of the CC in non-sarcopenic elderly.

CC is considered a good indicator of nutritional status in the elderly[43]. Depletion of muscle mass can be observed in individuals with calf circumference <31cm[22] below the standard recommendation, which reflects the findings of this study, identifying loss of muscle mass in sarcopenic individuals and greater adequacy in elderly people who did not manifest the disease. Anthropometric assessment for characterization of nutritional status is of great relevance for clinical practice, as it identifies individuals at nutritional risk, enabling early intervention to avoid further damage to health and quality of life[44].

As for the analysis of the food intake of the participants, the sarcopenic elderly consumed significantly smaller amounts of energy and proteins. Other recent studies have also addressed the negative association between low intake of protein[45], energy[46,47] and the development of sarcopenia. Carbohydrates and lipids remained adequate in the entire population studied, with carbohydrate adequacy associated with a lower chance of developing the disease, a result that differs from others in the literature[11,48].

Agreeing with the results of the present investigation, authors admit that nutrients, especially antioxidants, which include carotenoids, selenium, vitamins E, C, D, B complex, magnesium and calcium have been considered promising to prevent and or treat sarcopenia[12, 49,50], demonstrating the protective potential of these compounds for muscle health[51,52].

In cross-sectional as well as prospective studies, low serum vitamin D levels were correlated with a higher risk of sarcopenia in elderly adults[53], which can be verified in the present study. Remelli et al.[54] reviewed the biological, clinical and epidemiological evidence, which supports the hypothesis that vitamin D supplementation and its adequate intake would be effective in the prevention and treatment of sarcopenia in the elderly, reaffirming that the older population with vitamin D deficiency presents a greater chance of developing this disease.

In the present study, elderly people diagnosed with sarcopenia ingested insufficient amounts of vitamins E and C, as well as in other studies[55,48], which pointed out that individuals not diagnosed with sarcopenia consumed adequate amounts of vitamins with antioxidant potential within the recommended range, while those with sarcopenia were not able to maintain this adequacy. The literature points out that to reach the ideal intake of vitamin C and vitamin E, it is necessary to consume a wide variety of vegetables, fruit, and whole grains, a factor that may have been responsible for the deficient intake of these vitamins in the group of elderly who presented the disease[56].

Dietary carotenoids and vitamin A are important components in the antioxidant defense system in humans[57,58]. However, in the present study, it was not possible to find a relationship between vitamin A intake and sarcopenia, since it was the only nutrient in which an inversion in its intake was observed, reaching a higher average consumption in sarcopenic elderly compared to those who did not have the disease in the female group.

All the B complex vitamins (B1, B2, B3, B6, B9 – folate, and B12) were less consumed by sarcopenic patients. However, vitamin B6 did not show a significant value for females, with the intake of B9 and B1 in both groups within the minimum recommendation required for both sexes. Their main food sources are green leafy vegetables and beans, respectively[59], whole grains and pork meat, liver, kidneys and heart[60,61].

It is known that B complex vitamins play a key role in oxidative metabolism and oxidative stress has an important effect on the pathogenesis of sarcopenia[62], thus an anti-inflammatory dietary pattern associated with a higher intake of

vegetables, nuts, vegetable oils, red meat, energy, fat, vitamin E and folate provide a lower chance of developing sarcopenia[63], as well as some specific minerals.

Van Dronkellar et al.[64] published the first systematic review evaluating the role of minerals in the results of sarcopenia and emphasized that magnesium, selenium and calcium seem to be the most promising in the prevention or treatment of the disease. These minerals, positively correlated with greater chances of developing the disease in the current investigation, except calcium, in which both the elderly with and without sarcopenia, did not reach the minimum required recommendation, with the average intake by sarcopenic patients lower than that of non-sarcopenic ones.

In the present study, dietary intake of magnesium differed significantly between sarcopenic and non-sarcopenic patients, corroborating other authors[11,65], who claimed that adequate magnesium intake contributes to the prevention of age-related loss of skeletal muscle mass and strength[66]. As for selenium, studies showed that the intake of this nutrient was significantly lower in elderly people diagnosed with sarcopenia compared to those without sarcopenia[11,65], similar to the present research. Selenium probably affects muscle synthesis and function, and although the underlying mechanisms are still unclear, it is important to confirm its potential in the prevention and treatment of sarcopenia[64].

Zinc and iron, as they are associated with oxidative stress, can also cause muscle degeneration and reduced muscle strength[67,68]. Inadequate intake of both was considerably associated with sarcopenia in the present study. However, it is known that the effect of iron deficiency on muscle growth is still little explored[69] and its role, in addition to zinc, in the development of sarcopenia, remains unclear, as well as that of other nutrients[50,64].

The possible effect of low phosphorus intake, positively associated with the presence of sarcopenia in the present study, based on current evidence, is not yet well elucidated, due to a lack of scientific publications with this focus, being essential investigations to consolidate a connection between phosphorus and sarcopenia[50,64].

When inferring the results of the study, the chances of the elderly with adequate TUG to have sarcopenia decreased substantially compared to patients with inadequate TUG, in which the practice of physical activity represented an intervening factor in the indicative of sarcopenia in the elderly[70]. However, further investigations are required, particularly on training with exercises combined with dietary strategies in disease control and prevention[71,72]. Prevention and care investigations against sarcopenia should be strengthened through nutritional and multidisciplinary follow-up with the elderly, given the damage to their quality of life.

As a limitation of the present study, the sample size was considered relatively small and restricted to a specific group of users, which does not allow the generalization of the data to the population of the studied municipality. Several adaptations imposed by the pandemic period affected the conduction of this research, one of which was the reduction of the sample and the time available for data collection and analysis since at any time the municipality could enact a lockdown and indefinitely suspend data collection.

Another limitation was the type of food survey applied. Characterized as a retrospective method, R24 depends on the user's memory. As a way to reduce this bias, the participation of a family member or caregiver was requested to accompany the report of the foods consumed during the time of data collection.

Some authors advocate the use of more than one R24 on different days of the

week to minimize errors regarding intra- and inter-individual variation, however, due to the pandemic period, it was not possible to apply more than once[73,74].

CONCLUSION

Considering the results obtained, individuals classified as sarcopenic had a lower intake of proteins and energy, as well as vitamin D, E, B2, B3, B12, C, magnesium, selenium and zinc. Furthermore, their nutritional status was worse than in the elderly without sarcopenia.

There was also an important association between increased risk factors and advancing age and inadequate physical performance, taking into account the TUG classification and greater chances of having the disease.

This study was essential for demonstrating that poor dietary intake in elderly people living in the community can contribute to changing their nutritional status, often showing loss of lean mass, strength and muscle function. These data indicate a key role of nutrition in maintaining adequate muscle mass, strength, and muscle function.

Nevertheless, additional and longitudinal studies are required to highlight the impact of good nutrition as a long-term prevention strategy for sarcopenia in the elderly.

ACKNOWLEDGEMENTS

We thank all participants in this study and the staff of the Basic Health Unit of Ilha de Santa Luzia. We also thank the Coordination for the Improvement of Higher Education Personnel (Capes) for the financial support.

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