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ORIGINAL ARTICLE

Prevalence of sarcopenia and associated factors in patients in hemodialysis

Prevalência de sarcopenia e fatores associados em pacientes em hemodiálise

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KEYWORDS
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ABSTRACT

Objective: To assess the prevalence of sarcopenia and associated factors in patients with chronic kidney disease (CKD) undergoing hemodialysis (HD).
Methods: This cross-sectional study evaluated patients with CKD undergoing HD from January to October 2016 in two dialysis centers located in Recife, Pernambuco. For the diagnosis of sarcopenia, the criteria proposed by the 2019 European Consensus on Sarcopenia, which advocates low muscle strength as the main criterion, were considered. Demographic, clinical, anthropometric, and behavioral covariates were evaluated.
Results: 108 patients were included, with a mean age of 51.4 ± 17.0 years and homogeneous distribution between the sexes. Sarcopenia was present in 38.9% of the population, of which 69% had severe sarcopenia. A higher prevalence of sarcopenia was observed among men (60% vs. 17%; $p < 0.001$), in those without a partner (48.1% vs. 30.4%; $p < 0.045$), in smokers (50% vs. 30%; $p < 0.034$), with low weight (underweight 73.3%, eutrophic 33.9%, overweight 32.4%; $p = 0.001$) and those with normal albumin levels (47.5% vs. 28.6%; $p = 0.045$).
Conclusion: Approximately one in three nephropathic patients on hemodialysis presented sarcopenia and, among these, most had the severe form of this condition. Uremic sarcopenia was more prevalent in males, in individuals without partners, underweight, in smokers, and among those with normal albumin levels.

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PALAVRAS-CHAVE
Hemodiálise
Insuficiência renal crônica
Sarcopenia

RESUMO

Objetivo: avaliar a prevalência de sarcopenia e os fatores associados em pacientes com doença renal crônica (DRC) em hemodiálise (HD).
Métodos: Estudo transversal que avaliou pacientes portadores de DRC em HD no período de janeiro a outubro de 2016 em dois centros de diálise situados em Recife, Pernambuco. Para o diagnóstico de sarcopenia, foram considerados os critérios propostos pelo Consenso Europeu de Sarcopenia de 2019, que preconiza a baixa força muscular como critério principal. Foram avaliadas covariáveis demográficas, clínicas, antropométricas e comportamentais.
Resultados: Foram incluídos 108 pacientes, com média de idade de 51,4 ± 17,0 anos e distribuição homogênea entre os sexos. A sarcopenia foi presente em 38,9% da população, dos quais 69% apresentavam sarcopenia grave. Maior prevalência de sarcopenia foi observada entre os homens (60% vs. 17%; p < 0,001), nos que não tinham companheiros (48,1% vs. 30,4%; p < 0,045), em tabagistas (50% vs. 30%; p < 0,034), com baixo peso (baixo peso 73,3%, eutróficos 33,9%, excesso de peso 32,4%; p = 0,001) e naqueles com níveis de albumina normais (47,5% vs. 28,6%; p = 0,045).
Conclusão: Aproximadamente um em cada três pacientes nefropatas em terapia hemodialítica apresentaram sarcopenia e dentre estes, a maioria tinha a forma grave dessa condição. A sarcopenia urêmica foi mais prevalente no sexo masculino, nos indivíduos sem companheiros, baixo peso, nos tabagistas e entre aqueles com níveis normais de albumina.

INTRODUCTION

Sarcopenia is a progressive and generalized disorder of skeletal muscle (SM) associated with increased morbidity and adverse outcomes[1]. Its diagnosis is established when evidence of low muscle strength is associated with reduced muscle mass. It is related to falls, fractures, physical disability, and poorer quality of life[1].

Despite its high prevalence in the elderly, sarcopenia is recognized as a syndrome that can occur at other stages of life, with many phenotypes that contribute to its occurrence, besides aging. Among these conditions, chronic kidney disease (CKD) is a significant risk factor for muscle tissue depletion due to the complexity of factors[2].

The term uremic sarcopenia (US) has been used to describe sarcopenia associated with CKD and is associated with a higher frequency of cardiovascular complications, increased morbidity and mortality, and a lower survival rate.Furthermore, sarcopenia increases the risk of hospitalization and care costs during hospitalization[1].

US can have different etiologies, such as immunological modifications, with an increase in inflammatory cytokines; protein-energy malnutrition; changes in the renin-angiotensin system; alterations in the balance of protein synthesis (increased proteolysis and reduced synthesis); uremic changes (metabolic acidosis, factors related to renal replacement therapy (RRT), dietary restriction); mechanical impairment (immobility, arthropathies, and recurrent hospitalizations); myocellular modifications (reduction of satellite cells, apoptosis, transformation and atrophy of muscle fibers); associated comorbidities (diabetes mellitus [DM], systemic arterial hypertension (SAH), cardiovascular diseases (CVD), advanced age) and hormonal alterations[2].

Some authors have reported a prevalence of sarcopenia ranging from 20% to 42.2% in elderly patients undergoing hemodialysis (HD)[3-5]. According to epidemiological studies of end-stage renal disease, the incidence of sarcopenia increases as renal function deteriorates[6] and age progressess[5].

Despite sarcopenia being a topic that has been widely explored in recent decades, few investigations address this condition in CKD, especially at the national level, and adopt the updated criteria established in international consensuses.Therefore, this study assessed the prevalence of sarcopenia and associated factors in HD patients.

METHODS

This is a cross-sectional, observational study developed in two HD centers in Recife, Pernambuco (one public and one private), with data collection conducted from January to October 2016, involving adult and elderly patients with CKD in dialysis therapy.

The minimum sample size was calculated considering the total number of patients associated with the two HD centersduring the study period (n = 180), a prevalence of sarcopenia of 33.7%, described in a study involving patients with terminal CKD5, standard error of 6% and a confidence interval of 95%, resulting in 103 participants. This number was increased by 10% to cover possible losses, totaling a final sample of 114 patients to be recruited[7].

Patients of both genders and over 18 years on HD for at least six months were included, in addition to being physically fit (not having limb amputation, physical disability, paraplegia, quadriplegia, or hemiparesis) and having cognitive conditions to perform the tests. Patients in the immediate postoperative period (seven days) of major surgeries, who presented anasarca or edema in the lower limbs that made it impossible to perform the tests and anthropometric evaluation, with a history of recent fracture (last two months), with liver disease or infected with the human immunodeficiency virus were excluded.

The diagnosis of sarcopenia was considered when the individual presented reduced strength and muscle mass. When these two conditions were present with poor physical performance, severe sarcopenia was considered, according to updated diagnostic criteria proposed by the current European Working Group on

Sarcopenia in Older People – EGWOSP2)[1].

Muscle strength was measured from the Hand Grip Strength (HGS)[1,8], using a JAMAR brand digital dynamometer, with the tests applied in triplicate and considering the largest measurement obtained. The cutoff points adopted were those recommended by the current consensus, which establishes low muscle strength when HGS < 27 kg/f for men and < 16 kg/f for women.

An Electric Bioimpedance (BIA) was executed to obtain the muscle mass, using a portable Biodynamics model 310e, which applied a current of 800 μA, with a simple frequency of 50 kHz. The appendicular skeletal muscle mass (ASMM), suggested by the EWGSOP2, was obtained from the equation by Sergi et al.: ASMM (kg) = – 3.964 + (0.227*RI) + (0.095*weight) + (1.384*gender) + (0.064*Xc). Where RI (resistance index) is obtained through the quotient of height² in cm/resistance in ohms, Xc is reactance in ohms, and gender values of 1 for men and 0 for women are applied[9].

Patients were positioned on the bed, in a supine position, with the head of the bed parallel to the floor, free of materials or metallic ornaments, the arms away from the trunk at an angle of approximately 30º, and the legs apart at an angle of approximately 45º. To start the procedure, the patient's skin where the electrodes were fixed was sanitized with 70% alcohol, then two distal electrodes were placed on the dorsal surface of the hand and foot, on the right side of the body, close to the joints the phalanx-metacarpal and phalanx-metatarsus, respectively; and two proximal electrodes over the wrist prominence and between the medial and lateral malleolus of the lateral ankle[9].

Due to water disorders common in HD patients, the application of BIA in this study was performed 30 min after the dialysis session. The water balance between the intra and extracellular spaces was reached, obtaining, in this case, greater reliability of the results presented in the test[10].

The appendicular skeletal mass index (ASMI) was calculated as follows: ASMI = total ASMM/height (m)². Values ≤ 7.7 kg/m² in men and ≤ 5.62 kg/m² in women indicated low muscle mass[11].

Physical performance was measured using the 4 m walking speed test (WST) proposed by the International Academy on Nutrition and Aging (IANA)[12], with the test being performed in triplicate and considering the mean of the three values. It was considered slow-motion when the speed was ≤ 0.8 m/s[13]. This parameter was considered only to classify the severity of sarcopenia[1].

Sociodemographic, clinical, biochemical, anthropometric, and lifestyle variables were considered covariates. For socioeconomic and demographic characterization of the study population, information was collected regarding age (obtained in complete years and classified as adult or elderly if age < 60 years or ≥ 60 years, respectively), sex, marital status (with a partner and without a partner) and race (self-reported by the respondent and classified as white, brown and black)[14]. Education (in years studied and categorized as ≤ 9 years of study and > 9 years), family income (dichotomizedinto ≥ or < 2 minimum wages), and social class according to the Brazilian Association of Companies and Research (ABEP) were also included.

Among the clinical variables, the time in which the patient started HD therapy (dichotomically categorized as ≤ 34 months and > 34 months according to the median sample time), clinical diagnosis, and presence of comorbidities (diabetes mellitus and systemic arterial hypertension) were considered). Regarding biochemical variables, the following were included: hemoglobin (g/dL), albumin (g/dL), and total lymphocyte count (TLC). Anemia was considered when hemoglobin values were below 12 mg/dL for women and less than 13 mg/dL for men (WHO, 2011)[15]. Hypoalbuminemia was determined by an albumin value < 3.5 mg/dL[16]. Low TLC, indicating malnutrition, was established when values were below 2,000 cells/mm3[17].

Anthropometric measurements and parameters were measured weight, height, body mass index (BMI), and arm circumference (AC). All measurements were taken after the HD session to minimize results resulting from common hydroelectrolytic changes in CKD[15]. For the classification of nutritional status, the cutoff points of BMI proposed by the World Health Organization (WHO, 1997)[18] for adults and the classification by Lipschitz (1994)[19] for individuals over 60 years were adopted. AC was classified according to Blackburn and Thornton (1979)[20].

Regarding behavioral variables, smoking, alcohol consumption, and level of physical activity were evaluated. Smoking was classified as smoker, nonsmoker, and ex-smoker. In the assessment of alcohol consumption, information was dichotomized into 'consumption' and 'not consumption'. To assess the level of physical activity, patients were classified as sedentary, intermediate, and active[21]. A dichotomized classification into physical activity (active and intermediate) and non-practice (sedentary) was considered for analytical purposes.

Food consumption was assessed in a sub-sample of 57 patients, using a 24-hour dietary recall for three nonconsecutive days (one day on the weekend). Calories and proteins were calculated using the NUTWIN 1.6 diet calculation program(2010). The average intake obtained from the three records was adopted, and, for diet adequacy, the protein caloric intake of 30-35 kcal/kg and 1.1-1.2 g/kg, respectively, were considered a reference[22].

The study protocol was approved by the Ethics Committee for Research of the Health Sciences Center of the Federal University of Pernambuco (CAAE: 51359415.8.0000.5208, decision no. 1,978,785). The execution of the study in human beings followed the Declaration of Helsinki and the recommendations of Resolution CNS/CONEP 466/2012.

Data were analyzed using the SPSS statistical package (SPSS Inc., SPSS for Windows, v 13.0, Chicago, IL, USA).Descriptive analysis of variables was performed by calculating frequency distributions and measures of central tendency.Continuous variables were tested according to a normal distribution using the Kolmogorov-Smirnov test, and, as they presented a normal distribution, they were described as mean and standard deviation. The association between categorical variables was analyzed using Pearson's chi-square test or Fisher's exact test. For all tests, a significance level of $p < 0.05$ was adopted.

RESULTS

After eliminating losses due to lack of response or inconsistency of information, 108 patients on HD were evaluated, with a mean age of 51.4 ± 17.0 years, and homogeneous distribution between the sexes.

Table 1 shows the sociodemographic, clinical, and behavioral characteristics of the study population. The prevalence of diabetes mellitus and systemic arterial hypertension was 87% and 20.6%, respectively. There was a high proportion of individuals from a low social class (74.1%) and education (63.9%). Most individuals were sedentary (82.4%), 44.4% were smokers, and 41.7% reported drinking alcohol.

As for nutritional variables, 13.9% of individuals were classified as underweight according to BMI. When analyzing malnutrition according to AC and TLC, percentages of 55.6% and 59.3% were found, respectively. The prevalence of anemia was 89.8%, and hypoalbuminemia was found in 45.4% of those evaluated. It was observed that more than 80% of the population had inadequate caloric and protein intake related to nutritional recommendations for patients on HD (Table 2).

It was shown that 38.9% of the patients were sarcopenic and, of these, 69% were severely sarcopenic. There was a reduction in HGS and ASMI of 49.1% and 64.8%, respectively. A reduction in SM was found in 62% of the group (Table 2).

As shown in Table 3, the highest prevalence of sarcopenia was observed among men (60% vs. 17%; $p < 0.001$), in patients without a partner (48.1% vs. 30.4%; $p < 0.045$) and who were smokers (50% vs. 30%; $p < 0.034$). Additionally, sarcopenia was higher among patients who were classified as underweight (underweight 73.3%, eutrophic 33.9%, overweight 32.4%; $p = 0.001$) according to BMI and in those with levels of normal albumin (47.5% vs. 28.6%; $p = 0.045$) (Table 4).

DISCUSSION

The high prevalence of sarcopenia revealed in our data (38.9%) corroborates the results described by Bataille et al., who reported a prevalence of 31.5% in patients with nephropathies on HD[23], adopting the diagnostic criteria of the EWGSOP (2010). However, Ren et al. reported only 13.7% of sarcopenia in adult patients who received maintenance HD for a period greater than or equal to six months[3]. The differences in the percentages of sarcopenia can be attributed to the diagnostic criteria adopted and the characteristics of the population. No investigation has yet been found on sarcopenia in HD patients who have adopted the diagnostic definition proposed by the current European Consensus, which advocates muscle strength as the main criterion[1].

The high risk of sarcopenia in HD patients is multifactorial, related to frailty and dependence, and compromised quality of life[24]. Kim et al. reported that sarcopenia is a prevalent and significant predictor of mortality and development of cardiovascular events in HD patients. Recently, the effect of sarcopenia on adverse long-term clinical outcomes has become more evident, with sarcopenia being recognized as an important marker of poor prognosis in various populations[25].

In this context, uremic sarcopenia is associated with higher morbidity, including susceptibility to fractures, higher frequency of coronary events, lower survival, and higher mortality[26]. Therefore, patients on RRT must be systematically screened for the presence of sarcopenia.

Table 1 — Sociodemographic, clinical and behavioral characteristics of patients with chronic kidney disease undergoing hemodialysis, linked to two dialysis services in the city of Recife/PE, Brazil (N = 108).

Variável	**n**	**%**
Sex		
Masculine	53	49,5
Feminine	55	50,5
Age (years)		
Adult (<60)	66	61,1
Elderly (≥60)	42	38,9
Marital Status		
With partner	56	51,9
No partner	52	48,1
Race		
White	22	20,6
Black	49	45,8
Brown	36	33,6
Schooling		
≤ 9 years	69	63,9
> 9 years	39	36,1
Income (minimum-wages)		
≤ 2	89	85,6
> 2	15	14,4
Social class (ABEP)		
Class A	0	0
Class B e C	28	25,9
Class D e E	80	74,1
SAH	22	20,6
Diabetes mellitus	94	87,0
Hemodialysis duration		
≤ 34 months	54	50,0
> 34 months	54	50,0
Physical activity		
Yes	19	17,6
No	89	82,4
Alcohol consumption		
Yes	45	41,7
No	63	58,3
Smoking status		
Non-smoking	49	45,4
Smoking	48	44,4
Ex smoker	11	10,2

ABEP: Brazilian Association of Research Companies. SAH: systemic arterial hypertension.

Table 2 — Nutritional variables and sarcopenia in patients with chronic kidney disease undergoing hemodialysis, linked to two dialysis services in the city of Recife/PE, Brazil (N = 108).

Variable	n	%
Body Mass Index		
Low weight	15	13,9
Eutrophy	56	51,9
Overweight	37	34,3
Arm Circumference†		
Malnutrition	60	55,6
Eutrophy	39	36,1
Overweight	9	8,3
Total Lymphocyte Count		
Malnutrition	64	59,3
Normal (>2.000 cells/mm³)	44	40,7
Low albumin‡	49	45,4
Anemia§	97	89,8
Caloric intake		
Proper (30-35 kcal/kg)	7	12,3
Low or high (<30 ou >35 kcal/kg)	50	87,8
Protein intake		
Proper (1,1-1,2g/kg)	9	15,8
Low or high (<1,1g ou >1,2/kg)	48	84,2
Sarcopenia	42	38,9
Severe sarcopenia	29	69,0
Low HGS//	53	49,1
Low ASMI¶	70	64,8
Low walking speed#	67	62,0

HGS: handgrip strength, ASMI: appendicular skeletal muscle mass index. * according to WHO classification[18] for adults and Lipsdchitz[19] for > 60 years. †as classified by Blackburn and Thorton[20]. ‡albumin < 3.5 mg/dL. anemia if hemoglobin < 12 mg/dL for women and < 13 mg/dL for men. //HGS < 27 kg/f for men and < 16 kg/f for women. ¶ASMI ≤ 7.7 kg/m² in men and ≤ 5.62 kg/m² in women. #speed < 0.8 m/s.

Recent studies have characterized sarcopenia as a predictor of hospitalization and mortality and its association with worse clinical and nutritional conditions in elderly patients undergoing dialysis[27]. Similar data were reported by Kim et al. (2019) when they demonstrated that the reduction in muscle strength coexisting with the reduction in lean mass was associated with an increased risk of mortality from all causes and cardiovascular events in HD patients[25].

The higher prevalence of sarcopenia among men (3.5 times higher) is a result that corroborates previous evidence.Janssen et al.[28] have shown more accentuated decreases in muscle mass and strength during aging in men compared to women. They reported a prevalence of sarcopenia in the elderly of 31% for women and 64% for men[28]. This is because men have more significant muscle loss resulting from a decline in growth hormone, insulin-related growth factor (IGF-1), and testosterone. Also, they would have a worse adaptation to muscle loss than females[29]. Giglio et al., in a study conducted with elderly individuals (≥ 60 years) on HD, also described a higher prevalence of sarcopenia in men (83.9%) than women (16.1%)[27].

The absence of association with age was also different from what is commonly found in the literature[3,27]. Sarcopenia is a condition inherent to the aging process, in which there is a progressive loss of SM mass, with a decrease in the number and size of type II fibers and a parallel decrease in muscle strength and endurance[28].

Not having a partner increased the prevalence of sarcopenia by more than 50%. This result corroborates the findings reported by Wang et al., who demonstrated an association between marital status and sarcopenia, indicating that married adults had a lower risk of this outcome. A possible justification for this finding is that the presence of a partner, especially in middle age for old age, has protective effects on health and mortality through the provision and reception of mutual care[31].

Socioeconomic status was not associated with sarcopenia, which does not corroborate previous data. Dorosty et al., in a study conducted with 654 elderly people (>60 years old), observed a significant association between lower socioeconomic status and sarcopenia. Additionally, it was also observed that, in low-income people, the prevalence of pre-sarcopenia and sarcopenia was higher compared to middle-income groups, and in high-income elderly, the prevalence of these conditions was lower than in both groups[32].

In this study, being a smoker was a risk factor for sarcopenia, increasing its prevalence by more than 50%. Confortin et al.[33] found that, for women, starting to smoke and remaining with the habit was associated with greater chances of sarcopenia. For men, no association was found between smoking and sarcopenia. Szulc et al., evaluating 845 men aged between 45 and 85 years, observed that smoking was a risk factor for developing sarcopenia in elderly men[34]. The same were observed by Castillo et al.[35] and Lee et al.[36], who reported smoking as a reversible risk factor for sarcopenia, where stopping the habit was associated with better outcomes.

This relationship can be explained by the fact that smoking causes degradation of SM proteins[37] with a direct effect on muscle function[38]. The sarcopenic effect of smoking is related to a substantial decline in muscle mass and strength, leading to functional decline and loss of independence[39].

The higher prevalence of sarcopenia among malnourished HD patients supports the hypothesis that patients with worse nutritional status are more likely to develop sarcopenia. Giglio et al. identified similar data, reporting lower BMI values in sarcopenic patients[27]. Isoyama et al.[40] and Bataille et al.[23] also found an association between the loss of muscle mass and lower BMI. It cannot be overlooked that almost 30% of overweight individuals also had sarcopenia, configuring sarcopenic obesity. This finding reinforces the need for this condition to be evaluated in HD patients, regardless of their nutritional status.

Another critical finding is that patients with normal albumin levels had a higher prevalence of sarcopenia. This finding does not corroborate previous data[41] since hypoalbuminemia is associated with low muscle mass[23,40], and this is one of the diagnostic criteria for sarcopenia.

Table 3 — Sociodemographic, clinical and behavioral factors associated with sarcopenia in patients with chronic kidney disease undergoing hemodialysis, linked to two dialysis services in the city of Recife/PE, Brazil (N = 108).

Variable	**Sarcopenia n (%)**	**Whitout Sarcopenia n (%)**	**p-value***
Sex			
Male	33 (60,0)	22 (40,0)	<0,001
Female	9 (17,0)	44 (83,0)	
Age			
Adult	21 (31,8)	45 (68,2)	0,059
Elderly	21 (50,0)	21 (50,0)	
Marital status			
With partner	17 (30,4)	39 (69,6)	0,045
No partner	25 (48,1)	27 (51,9)	
Race			
White	10 (45,5)	12 (54,5)	0,437
Black	16 (32,7)	33 (67,3)	
Brown	16 (44,4)	20 (55,6)	
Schooling			
≤ 9 years	29 (42,0)	40 (58,0)	0,373
> 9 years	13 (33,3)	22 (66,7)	
Income			
≤ 2 MW	33 (37,1)	56 (62,9)	0,480
> 2 MW	7 (46,7)	8 (53,3)	
ABEP			
Class B and C	13 (46,4)	15 (53,6)	0,342
Class D and E	29 (36,3)	51 (63,8)	
SAH	9 (40,9)	13 (59,1)	0,779
DM	35 (37,2)	59 (62,8)	0,535
HD start time			
≤34 months	24 (44,4)	30 (55,6)	0,236
>34 months	18 (33,3)	36 (66,7)	
Physical activity			
Yes	7 (36,8)	12 (63,2)	0,840
No	35 (39,3)	54 (60,7)	
Alcohol consumption			
Yes	18 (40,0)	27 (60,0)	0,841
No	24 (38,1)	39 (61,9)	
Smoking status			
No smoking and ex-smoker	18 (30,0)	42 (70,0)	0,034
Smoking	24 (50,0)	24 (50,0)	

*Pearson chi-square. MW: minimum wage, ABEP: association brazilian of research companies, SAH: systemic arterial hypertension, DM: *diabetes mellitus*, HD: hemodialysis

The lack of association of sarcopenia with food consumption was also an unexpected observation, considering the importance of protein intake to preserve muscle mass. Few studies in the literature assess the best protein-energy recommendations for patients with uremic sarcopenia on RRT and materials that address whether it is plausible to consider the same recommendations for non-sarcopenic patients.

Some limitations must be considered when interpreting our data. First, the cross-sectional design is not suitable for establishing cause-and-effect relationships. Furthermore, because individuals were recruited from only two dialysis centers, care must be taken to generalize the results. Despite this, it should be considered that this is one of the first studies to evaluate the criteria currently proposed for the diagnosis of sarcopenia and will serve to compare future studies.

CONCLUSION

Approximately one in three nephropathic patients undergoing dialysis therapy presented sarcopenia, and among these, most had the severe form of this condition, evidencing the notable vulnerability to which this group of individuals is exposed. Uremic sarcopenia was more

Table 4 — Nutritional factors associated with sarcopenia in patients with chronic kidney disease undergoing hemodialysis, linked to two dialysis services in the city of Recife/PE, Brazil (N = 108).

Variable	Sarcopenia n (%)	Without Sarcopenia n (%)	p-value
Body Mass Index			
Low weight	11 (73,3)	4 (26,7)	
Eutrophy	19 (33,9)	37 (66,1)	0,013
Overweight	12 (32,4)	25 (67,6)	
Arm Circunference†			
Malnutrition	27 (45,0)	33 (55,0)	
Eutrophy	13 (33,3)	26 (66,7)	0,286
Overweight	2 (22,2)	7 (77,8)	
Total Lymphocyte Count			
Malnutrition	25 (39,1)	39 (60,9)	0,847
Normal (> 2.000/mm^3)	16 (37,2)	27 (62,8)	
Albumin			
Low‡	14 (28,6)	35 (71,4)	0,045
Normal	28 (47,5)	31 (52,5)	
Hemoglobin			
Anemia§	39 (40,2)	58 (59,8)	0,404
Normal	3 (27,3)	8 (72,7)	
Caloric intake			
Proper (30 — 35kcal/kg)	1 (14,3)	6 (85,7)	0,186
Low or high (< 30 ou > 35kcal/kg)	20 (40,0)	30 (60,0)	
Protein intake			
Proper (1,1 — 1,2 g/kg)	4 (44,4)	5 (55,6)	0,606
Low or high (< 1,1 g/Kg ou > 1,2 g/kg)	17 (35,4)	31 (64,6)	

*According to WHO classification[18] for adults and Lipsdchitz[19] for > 60 years. † as classified by Blackburn and Thorton[20]. ‡albumin < 3.5 mg/dL. anemia if hemoglobin < 12 mg/dL for women and < 13 mg/dL for men.

prevalent in males, in individuals without partners, in malnourished individuals, in smokers, and among those with normal albumin levels.

Further studies need to be conducted in patients on RRT considering current diagnostic criteria. Additionally, listing the main factors that increase the risk of this condition will help guide preventive measures against muscle mass impairment.

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