

Nutritional problems in older adults with Alzheimer's disease: Risk of malnutrition and sarcopenia

Alterações nutricionais em idosos com doença de Alzheimer: risco nutricional e sarcopenia

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ABSTRACT

Objective

Understand the nutritional problems and detect the presence of sarcopenia in older adults with Alzheimer's disease.

Methods

Descriptive cross-sectional study carried out among elderly patients with Alzheimer's disease receiving care at the *Unidade de Saúde de Atenção ao Idoso* (Elderly Care Unit) in a capital city in Southern Brazil between

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November 2010 and July 2011. The Clinical Dementia Rating scale was used for the evaluation of staging severity of dementia. Participants' nutritional status was classified using The Mini Nutritional Assessment. The following tests were used to diagnose sarcopenia: bioelectrical impedance, hand grip strength, and the Timed Up and Go test. Anthropometric measurements and laboratory tests (hemoglobin, lymphocytes, serum albumin, and total cholesterol) were performed.

Results

Ninety-six older adults (mean age of 78 years) were evaluated. It was observed prevalence of mild Alzheimer's disease in 54.2% of the participants; 55.2% were at risk of malnutrition; unintentional weight loss was observed in 64.6%, 55.3% had lower number of lymphocytes, and 43.7% had severe sarcopenia.

Conclusion

The prevalence of risk of malnutrition and sarcopenia is high among older adults with Alzheimer's disease. Future studies should focus on the evaluation of nutritional interventions aimed at maintaining the nutritional status and muscle mass in these individuals.

Keywords: Alzheimer disease. Nutritional status. Sarcopenia.

RESUMO

Objetivo

Conhecer as alterações nutricionais e a presença de sarcopenia em idosos com doença de Alzheimer.

Métodos

Trata-se de estudo transversal descritivo, no qual foram incluídos idosos com diagnóstico de doença de Alzheimer acompanhados na Unidade de Saúde de Atenção ao Idoso em uma capital do Sul do Brasil, entre novembro/2010 a julho/2011. A escala Clinical Dementia Rating foi utilizada para definição do estágio da demência. Para classificação do estado nutricional aplicou-se a Mini Avaliação Nutricional. Para o diagnóstico de sarcopenia, foram utilizados os testes: impedância bioelétrica, força de preensão manual e teste Timed Get Up and Go. Foram realizadas medidas antropométricas e exames laboratoriais (hemoglobina, linfócitos, albumina e colesterol total).

Resultados

Foram avaliados 96 idosos com idade média de 78 anos, prevalecendo doença de Alzheimer na fase leve (54,2%), sendo que 55,2% apresentavam risco de desnutrição, 64,6% perda de peso involuntária, 55,3% redução de linfócitos e 43,7% sarcopenia grave.

Conclusão

Os idosos com doença de Alzheimer apresentam alta prevalência de risco de desnutrição e sarcopenia. Estudos futuros devem ser direcionados a avaliar intervenções nutricionais que visem a manutenção do estado nutricional e da massa muscular desses indivíduos.

Palavras-chave: *Doença de Alzheimer. Estado nutricional. Sarcopenia.*

INTRODUCTION

Population aging is a global phenomenon. It is estimated that the number of people aged 60 and over globally will increase by more than 300% over the next 50 years, from 606 million in 2000 to nearly 2 billion by 2050 [1]. Aging of the population has led to an increase in the number of people with chronic non-communicable diseases, including dementia. Brazil is the ninth

country with the largest number of people with dementia, with an estimated 1.0 million cases in 2010 [2].

Alzheimer's disease is the most common form of dementia, accounting for 60 to 70% of cases [2]. Memory loss is one of the earliest and most common signs of the disease. As the disease progresses, there is language, intellectual, independence, and autonomy

impairment, and the severe stage is characterized by loss of ability to perform the Basic Activities of Daily Living (BADL), such as eating, bathing, and, transferring (walking) [3]. Other common health issues are feeding problems, such as hyporexia, chewing difficulty, dysphagia, food refusal [3,4], and body composition changes, such as unintentional weight loss [4], rapid loss of muscle mass, and sarcopenia [5,6].

Studies have reported the high prevalence of malnutrition in older adults with Alzheimer's type dementia [7] and patients' poorer nutritional and functional status when compared with older adults without dementia [8]. There may be some overlap of morbidity and mortality caused by malnutrition with Alzheimer's disease-related morbidity and mortality. The etiology of weight loss and consequent malnutrition in Alzheimer's disease appears to be multifactorial. It is presently unclear whether energy imbalance and the weight loss associated with Alzheimer's disease are caused by reduced energy intake, high energy expenditure, or a combination of the two [5]. Cognitive impairment, eating dependency, depression, behavioral disorders, polypharmacy, and specific inflammatory responses to some chronic diseases may also be causes of malnutrition in older adults with Alzheimer's disease [9,10].

The increase in life expectancy of the population requires investments in the quality of life and health of older individuals, and nutrition has an important role in this process. Therefore, the objective of this study is to understand the nutritional problems and detect the presence of sarcopenia in older adults with Alzheimer's disease.

METHODS

This was a descriptive cross-sectional study. Elderly patients with a probable diagnosis of Alzheimer's disease receiving care at the *Unidade de Saúde de Atenção ao Idoso Ouidor Pardinho* (*Ouidor Pardinho* Elderly Care Unit) of

the *Sistema Único de Saúde* (SUS, Unified Health System) in the city of *Curitiba* (PR), were selected to participate in this study. The probable diagnosis of Alzheimer's disease is based on Ministry of Health [11] criteria. The estimated minimum sample size was 90 individuals, considering 95% confidence interval and a margin of error of less than 10%.

The patients were screened during routine geriatrician visits from November 2010 to July 2011. The inclusion criteria were as follows: elderly patient with probable clinical diagnosis of Alzheimer's disease; and patient accompanied by the primary caregiver on the day of data collection. The exclusion criteria were: age <60 years; be a resident in a long-term care institution; have heart failure or chronic kidney disease or consumptive diseases; be unable to stand up for getting the weight measured; have physical impairments or health conditions that may affect bioelectrical impedance measurements, such as any type of amputation, use of pacemaker, defibrillator or other type of metal implanted to the body (e.g., prostheses or implants); use of steroid hormones or use of diuretics that could not be discontinued within seven days before data collection; and primary caregiver not being able to properly record food consumption.

After the Informed Consent Form was signed by the caregivers and/or the patients, a trained nutritionist evaluated the patients. Demographic, social, cultural, comorbidity, and physical activity data were collected. The Clinical Dementia Rating [12] scale was used to rate the severity of Alzheimer's disease as mild, moderate, or severe. The Mini Nutritional Assessment (MNA) [13] was used to grade the nutritional status of the participants. According to this tool, scores greater than 23.5 classify the patient as eutrophic or well-nourished, scores between 17 and 23.5 indicate the patient is at risk of malnutrition; and scores lower than 17 indicate malnutrition.

The anthropometric measurements such as weight, height, and calf circumference

were performed according to standardized techniques. Body Mass Index (BMI) was calculated using the following equation: $BMI (kg/m^2) = \text{weight (kg)} / \text{height}^2 (m)$. The BMI values obtained were compared to reference values for the elderly population [14]: BMI values $<22 kg/m^2$ indicate that the patient is underweight; values between 22 and 26.9 indicate that the patient is well-nourished; and values >27 indicate that the patient is overweight. The weight loss percentage was calculated considering the usual body weight of the patient within six-month period prior to the evaluation, according to the caregiver or the patient him/herself, using the following equation: $\% \text{ body weight loss} = [(\text{usual body weight within 6 months} - \text{current body weight}) / \text{usual body weight within 6 months}] \times 100$. According to reference values, loss $>10\%$ of body weight over the last six months was considered as severe.

The following biochemical tests were performed: hemoglobin, total lymphocytes, serum albumin, and total cholesterol. The reference values that indicate adequate nutritional status are as follows: hemoglobin $\geq 12.0 g/dL$ in females and $\geq 14.0 g/dL$ in males; total lymphocyte count $\geq 2000/mm^3$; serum albumin $\geq 3.5 g/dL$; and total cholesterol $\geq 150 mg/dL$ [15].

Tetrapolar bioelectrical impedance was used to evaluate body composition by measuring resistance and reactance using the RJL Systems Quantum BIA 101Q (RJL Systems, Inc., Clinton, Michigan, United States). The test was performed according to the technique described by Rech *et al.* [16]. In order to determine Fat Free Mass (FFM), the regression equation proposed by Kyle *et al.* [17] was used, which was validated to

estimate FFM in Brazilian older adults by Rech *et al.* [16], as follows: $FFM (kg) = -4.104 + 0.518 (\text{height}^2 (m) / \text{resistance}) + 0.231 (\text{weight (kg)}) + 0.130 (\text{reactance}) + 4.229 (\text{gender; female}=0, \text{male}=1)$. Skeletal muscle mass was determined by calculating the Skeletal Muscle Mass Index (SMMI) using the following equation: $SMMI (kg/m^2) = FFM (kg) / \text{height}^2 (cm)$ [18]. The values obtained were compared to the reference values [19] described in Table 1.

The Hand Grip Strength (HGS) test was performed to evaluate muscle strength using the Jamar Hand dynamometer in compliance with the American Association of Hand Therapists recommended testing protocol [20]. Three HGS measurements were taken for the right hand with a 10 seconds rest between each measurement. The mean value of all three measurements was calculated. The HGS reference values [21] vary according to the BMI and gender of elderly individuals, as shown in Table 2.

The Timed Up and Go (TUG) test [22] was used to measure participants' muscle performance. For independent patients with no balance problems, the test is commonly performed in 10 seconds or less, which is considered normal.

The diagnosis of sarcopenia was made based on the SMMI, HGS, and TUG results. For the diagnosis of sarcopenia, in the report Sarcopenia: European Consensus on the Definition and Diagnosis [18], The European Working Group on Sarcopenia in Older People recommends using the presence of both low muscle mass and low muscle function (strength or performance). They also defined the

Table 1. Reference values for Skeletal Muscle Mass Index (SMMI) in older adults. Curitiba (PR), Brazil (2013).

SMMI classification	Female (kg/m ²)	Male (kg/m ²)
Normal muscle mass	≥ 6.76	≥ 10.76
Moderate loss of muscle mass	≥ 5.76 and ≤ 6.75	≥ 8.51 and ≤ 10.75
Severe loss of muscle mass	≤ 5.75	≤ 8.50

Source: Adapted from Janssen *et al.* [19].

Table 2. Reference values for hand grip strength in older adults. Curitiba (PR), Brazil (2013).

BMI (kg/m ²)	Reference value for HGS (kg)
<i>Male</i>	
≤24.0	>29.0
≥24.1 and ≤26.0	>30.0
≥26.1 and ≤28.0	>30.0
>28.0	>32.0
<i>Female</i>	
≤23.0	>17.0
≥23.1 and ≤26.0	>17.3
≥26.1 and ≤29.0	>18.0
>29.0	>21.0

Source: Fried *et al.* [21].

Note: BMI: Body Mass Index; HGS: Hand Grip Strength.

conceptual stages as presarcopenia, low muscle mass without impact on muscle strength or physical performance; sarcopenia, low muscle mass plus low muscle strength or low physical performance; and severe sarcopenia, low muscle mass, low muscle strength, and low physical performance.

The following instruments were used to assess functional capacity: The Katz Index of Independence in Activities of Daily Living, referred to as Katz ADL [23] and Lawton's Instrumental Activities of Daily Living (IADL) scale [24].

Statistical analysis was carried by a specialized professional using the SPSS Statistics 17.0 software (SPSS Inc., Chicago, Illinois, United States), Statgraphics Centurion (Statpoint Technologies, Inc. Warrenton, Virginia, United States) and R 2.13.0 software (Robert Gentleman and Ross Ihaka, New Zealand). Quantitative variables were expressed as mean and standard deviation and qualitative variables as frequency and percentage. The non-parametric Kruskal-Wallis test was used to compare the values of the variables between the nutritional status diagnoses according to MNA classifications (well-nourished, at risk of malnutrition, and malnourished), considering $p < 0.05$ as the level of statistical significance. The multiple

comparison test was used when there was statistically significant differences ($p < 0.05$) to assess the pairs of groups with differences.

The present study was approved by the Ethics Committee of the Curitiba Municipal Health Department, associated with the National Health Council (Protocol #132/2010).

RESULTS

A total of 328 patients were screened and of these, 187 met the study inclusion criteria, which were interviewed and 96 patients and caregivers agreed to participate and were evaluated. Seventy nine caregivers and 12 patients refused to participate in the study, totalizing 91 subjects. The main reasons given by them were lack of time and difficulty in transporting elderly patients to the care unit.

The sample was composed mostly by female individuals ($n=68$; 70.8%) aged from 60 to 94 years and a mean age of 78 years (± 6.52).

Some participants were engaged in some form of physical activity ($n=25$; 26.0%) including water aerobics and walking, and some were receiving physiotherapy treatment. As for the stage of dementia, prevalence of individuals with mild Alzheimer's disease ($n=52$; 54.2%) was found. Table 3 shows baseline characteristics of the patients evaluated.

With regard to the patients' nutritional status (Table 4), according to the MNA, 55.2% ($n=53$) of the older adults evaluated were at risk of malnutrition and 5.2% ($n=5$) were malnourished. According to their BMI, 53.1% ($n=51$) of the participants were well-nourished and 27.1% ($n=26$) were underweight, considering their usual body weight within six-month period prior to the evaluation, according to the caregiver or the patient him/herself, unintentional weight loss was observed during that period of time in 64.6% of the subjects evaluated ($n=62$); in 16.7% of the total sample ($n=16$), weight loss

Table 3. Baseline characteristics of older adults with Alzheimer's disease. *Curitiba (PR), Brazil (2013).*

Parameter	Older adults				
	n	%	Mean	±	SD
Gender	96	100.0			
Female	68	70.8			
Male	28	29.2			
Age (years)	96	100.0	78.0	±	6.52
≥60 and ≤69	10	10.4			
≥70 and ≤79	43	44.8			
≥80	43	44.8			
Marital status	96	100.0			
Single	5	5.2			
Married	37	38.5			
Divorced	6	6.3			
Widowed	48	50.0			
Level of education (years)	96	100.0	4.4	±	4.40
Illiterate	12	12.5			
Complete or incomplete Elementary and Middle School	69	71.9			
Complete or incomplete High School	8	8.3			
Complete or incomplete Higher Education	7	7.3			
Living arrangement	96	100.0			
Live with children	46	47.9			
Live with spouse	20	20.8			
Live with spouse and children	15	15.6			
Live alone	8	8.3			
Others	7	7.3			
Physical activity	25	26.0			
Prevalence of diabetes	15	15.6			
Prevalence of systemic hypertension	52	54.2			
Clinical Dementia Rating	96	100.0			
Mild	52	54.2			
Moderate	33	34.4			
Severe	11	11.5			

Note: SD: Standard Deviation.

was considered substantial or serious. It was also found that 62 (64.6%) participants had moderate and severe loss of muscle mass, and lower HGS values were found in 70 (76.9%) participants.

As for the biochemical evaluation, it was observed a large number of elderly patients with low number of lymphocytes (n=52; 55.3%).

The prevalence of severe sarcopenia was 43.7% (n=42). The majority of the older adults were independent in Basic Activities of

Daily Living (BADLs) (n=67; 69.8%), but were dependent in Instrumental Activities of Daily Living, with a mean value of 16.3 points.

The analysis of the anthropometric data (BMI, current body weight, calf circumference, SMMI) and biochemical data (hemoglobin, total lymphocytes, serum albumin, and total cholesterol), muscle strength and performance (HGS and TUG), as well as BADLs and IADLs in the different nutritional status (well-nourished, at risk of malnutrition, and malnourished)

Table 4. Nutritional assessment of older adults with Alzheimer's disease. Curitiba (PR), Brazil (2013).

Parameter	Older adults					
	n	%	Mean	±	SD	(Minimum - Maximum)
MNA (score) ¹	96	100.0	22.3	±	3.52	(12.5–28.5)
Malnourished	5	5.2				
At risk of malnutrition	53	55.2				
Well-nourished	38	39.6				
BMI (kg/m ²)	96	100.0	24.1	±	3.53	(14.9–33.7)
Underweight	26	27.1				
Normal weight	51	53.1				
Overweight	19	19.8				
Current body weight (kg)	96	100.0	58.1	±	10.57	(31.4–87.5)
Height (cm)	96	100.0	155.0	±	9.82	(137.4–180.5)
Unintentional weight loss over the last 6 months						
Some weight loss	62	64.6				
Severe weight loss (>10% of usual weight)	16	16.7				
Calf Circunference (cm)	96	100.0	32.6	±	2.72	(25.3–38.2)
Hemoglobin (g/dL) ²	94	97.9	13.7	±	1.24	(10.6–16.9)
Normal	78	83.0				
Low	16	17.0				
Total lymphocytes (/mm ³) ²	94	97.9	2014.5	±	721.26	(882.0–4847.0)
Normal	42	44.7				
Low	52	55.3				
Serum albumin (g/dL) ²	95	99.0	4.3	±	0.36	(3.3–5.4)
Normal	94	98.9				
Low	1	1.1				
Total cholesterol (mg/dL) ²	95	99.0	197.6	±	42.41	(118.0–338.0)
Normal	84	88.4				
Low	11	11.6				
SMMI (kg/m ²)	96	100.0	7.1	±	1.08	(4.8–9.4)
Normal muscle mass	31	32.3				
Loss of muscle mass	31	32.3				
Severe loss of muscle mass	34	35.4				
HGS (kg) ³	91	94.8	16.9	±	5.98	(3.6–32.7)
Normal	21	23.1				
Low	70	76.9				
TUG ⁴	88	91.7	13.4	±	6.56	(5.7–40.0)
Normal	30	31.3				
Low	58	60.4				
Sarcopenia	96	100.0				
Without sarcopenia	31	32.3				
Presarcopenia	4	4.2				
Sarcopenia	19	19.8				
Severe sarcopenia	42	43.7				
Katz ADL (score) ⁵	96	100.0	4.6	±	1.64	(0.0–6.0)
Independence	67	69.8				
Moderate dependence	16	16.7				
Great dependence	13	13.5				
Lawton IADL scale (scores) ⁶	96	100.0	16.3	±	5.59	(9.0–26.0)

Note: ¹Score variation: 0–30; the lowest score indicates the most severe condition; ²Some test results were lost; ³Four participants were unable to understand and follow the instructions during the HGS test; one female participant had the carpal tunnel syndrome and could not take the HGS test; ⁴The highest score indicates the most severe condition. Eight participants were unable to understand and follow the instructions during the TUG test; ⁵Score variation: 0–6; the lowest score indicates the most severe condition; ⁶Score variation: 9–27; the lowest score indicates the most severe condition.

MNA: Mini Nutritional Assessment; BMI: Body Mass Index; SMMI: Skeletal Muscle Mass Index; HGS: Hand Grip Strength; TUG: Timed Up and Go test; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; SD: Standard Deviation.

Table 5. Relationship between nutritional parameters in older adults with Alzheimer's disease and the Mini Nutritional Assessment classification. Curitiba (PR), Brazil (2013).

Parameters	Nutritional status/MNA									p-value ¹
	Well-nourished (n=38)			At risk of malnutrition (n=53)			Malnourished (n=5)			
	Mean	±	SD	Mean	±	SD	Mean	±	SD	
BMI (kg/m ²) ²	25.4 ^a	±	2.88	23.6 ^b	±	3.65	19.6 ^c	±	1.24	<0.001
Current weight (kg) ²	61.8 ^a	±	9.38	56.3 ^b	±	10.65	48.3 ^b	±	8.09	0.003
CC (cm) ²	33.6 ^a	±	2.37	32.1 ^b	±	2.79	30.6 ^b	±	2.26	0.007
Hemoglobin (g/dL) ²	14.2 ^a	±	1.15	13.4 ^b	±	1.25	13.9 ^{ab}	±	0.52	0.011
Total lymphocytes (/mm ³)	2073.8	±	673.64	2011.6	±	766.57	1488.3	±	355.43	0.165
Serum albumin (g/dL)	4.3	±	0.32	4.2	±	0.35	4.4	±	0.66	0.617
Total cholesterol (mg/dL)	194.8	±	42.51	201.8	±	42.81	166.8	±	25.12	0.127
SMMI (kg/m ²) ²	7.4 ^a	±	0.99	6.9 ^b	±	1.11	6.3 ^b	±	1.02	0.051
HGS (kg) ²	18.6 ^a	±	5.74	15.2 ^b	±	5.70	20.5 ^{ab}	±	6.76	0.008
TUG (seconds) ³	12.7	±	6.09	12.8	±	4.82	23.7	±	14.24	0.190
Katz ADL (score)	5.0	±	1.15	4.3	±	1.80	3.4	±	2.30	0.067
Lawton IADL scale (score)	17.6	±	5.05	15.5	±	5.93	14.0	±	4.06	0.103

Note: ¹The Kruskal-Wallis test was used to compare the three groups, considering $p < 0.05$ as the level of statistical significance. ²The multiple comparison test was used when there was statistically significant differences ($p < 0.05$) to assess the pairs of groups with significant differences (well-nourished versus at risk of malnutrition (well-nourished vs malnourished; at risk of malnutrition vs malnourished), which are identified by superscript lowercase letters. Different letters indicate statistically significant difference between the pairs; same letters indicate that there is no statistically significant difference between the pairs; ³The highest score indicates the most severe condition.

MNA: Mini Nutritional Assessment; BMI: Body Mass Index; CC: Calf Circumference; SMMI: Skeletal Muscle Mass Index; HGS: Hand Grip Strength; TUG: Timed Up and Go test; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living.

obtained using the MNA, indicated significant reduction in the following variables: BMI ($p < 0.001$), current body weight ($p = 0.003$), calf circumference³ ($p = 0.007$), hemoglobin (0.011), SMMI ($p = 0.051$), and HGS ($p = 0.008$) (Table 5).

DISCUSSION

The Mini Nutritional Assessment scores showed the poor nutritional status of the studied population since the majority of the elderly subjects were at risk of malnutrition. However, according to their BMI, the majority would be classified as well-nourished. The MNA scale is probably more effective in rating the nutritional status of elderly individuals than the BMI since it considers a greater number of anthropometric variables, including those related to the evaluation of muscle mass and individuals' clinical and dietary history.

The NutriAlz [9] study, probably the most comprehensive research carried out with non-institutionalized elderly patients with dementia, evaluated 946 individuals living in Spain and found a similar prevalence of malnutrition (5.2%) but a lower proportion of elderly individuals at risk of malnutrition (36.9%) using the same assessment instrument (MNA). The elderly patients evaluated were considered well-nourished according to both MNA (57.9%) and BMI (82.6%). A review of the literature on the use of MNA [25] identified five studies that investigated demented community-dwelling elderly individuals and reported that the prevalence of undernourished elderly individuals ranged from 0 to 6% and of individuals at risk of malnutrition from 19 to 36% [25]. Among these studies is the REAL.FR, with a sample of 686 elderly subjects [26], and the Brazilian Longitudinal Study of Adult Health with 318 elderly subjects with Alzheimer's disease [27]. Spaccavento *et al.* [3] found that

42.8% of elderly individuals with dementia were classified as at risk of malnutrition and 57.1% as well-nourished. The lower prevalence of risk of malnutrition in the population evaluated in their study compared to those obtained in the present study may have several causes, such as lower proportion of elderly individuals in the moderate and severe stages of dementia, better socioeconomic status, or a better level of care provided to these patients.

Guigoz [25] found higher prevalence of malnutrition in elderly people with a diagnosis of dementia than in individuals without the disease. The author identified 23 studies carried out on community-dwelling elderly people without dementia ($n=14,149$), in which the following nutritional profile was described: 74% were well-nourished, 24% were at risk of malnutrition, and 2% were malnourished.

The mean BMI values were significantly lower in each one of those MNA diagnoses, and malnourished elderly subjects had the lowest value. However, BMI was within the normal range in the group of individuals at risk of malnutrition, as reported in previous studies [3,10]. Thus, it is not recommended to use BMI alone for the nutritional assessment of elderly patients, as it does not identify all patients at risk of malnutrition [25].

The anthropometric evaluation corroborated the MNA scores, evidencing higher scores for the groups with better nutritional status and showing that these individuals had greater amount of muscle mass and greater muscle strength. The correlation between the nutritional status evaluated using MNA and anthropometric, biological, and hematologic parameters and also with FFM and HGS has been previously described in the scientific literature [25]. It is also important to highlight the positive relationship between SMMI and calf circumference. The latter has been considered the most sensitive anthropometric index of muscle mass in the elderly [28]. The fact that these parameters were significant lower when correlated with

worse nutritional status may be useful in clinical practice, especially calf circumference. Tetrapolar bioelectrical impedance analyzers are hardly found in Brazilian outpatient clinics; therefore calf circumference measurements can be used to evaluate and monitor the amount of muscle mass in elderly patients.

In a study comparing BMI of young adults (26 ± 5 years) and older adults (78 ± 7 years), it was found that the main cause of low BMI values in young adults was the decrease in fat mass, while in the elderly, there was loss of fat-free mass (muscle) first [29]. Accordingly, unintentional weight loss reported in studies involving patients with Alzheimer's type dementia [4,5], also found in a large percentage of the sample of the present study (64.6%), probably contributes to accelerate muscle mass loss, development of sarcopenia, and functional decline [5].

According to the European Society for Clinical Nutrition and Metabolism guidelines on nutrition in dementia, screening for malnutrition and monitoring of body weight are recommended for every individual with dementia [4]. The deleterious effects of weight loss and malnutrition in older adults are well known, and they are not different in individuals with dementia. Loss of body weight implies loss of muscle mass, accompanied by functional decline, and frailty, and it is associated with an increased risk of morbidity and mortality [4]. In a study carried out on elderly people with advanced dementia living in long-term care institutions, weight loss was an independent predictor of death [30].

No statistically significant difference was found in the mean values of serum albumin, lymphocytes, and total cholesterol between the groups with different nutritional diagnoses according to the MNA. Guigoz [25] explained that the MNA detects risk of malnutrition before changes in serum proteins occur in relatively healthy elderly individuals. Kuzuya *et al.* [31] did not find a correlation between MNA scores and total lymphocyte count either. However, it has been reported that immune function is impaired

in older adults with an MNA score indicative of malnutrition [25]. In the present study, 55.3% of the older adults evaluated had low lymphocyte counts, indicating that immunodeficiency in this population deserves closer attention.

Most of the patients evaluated had moderate or severe loss of muscle mass according to their SMMI, and they also showed low muscle function, according to the HGS and TUG tests. Low HGS values are a clinical indicator of mobility impairment and a better predictor of negative clinical outcomes than low muscle mass [18]. Menant *et al.* [32] found that lower limb strength assessment was as effective in predicting balance, mobility, and falls in 419 older adults (mean age of 81.2 years) as muscle mass-based measures. Weaker individuals were 43% more likely to fall at home than their stronger counterparts.

The accuracy of HGS and TUG tests depends on the cognitive levels in elderly individuals. However, two studies have evaluated the use of these tests in demented elderly people and concluded that they are reliable for evaluating the muscle function in this population [33,34]. Blankevoort *et al.* [34] found that the reliability of the TUG and HGS tests with Jamar dynamometer were excellent (intra class correlation coefficient=0.90-0.95). In the present study, 9 subjects (9.4%) were unable to perform one or both of these tests (n=6; n=3, respectively) due to cognitive impairment; 2 of them had moderate Alzheimer's disease, and 7 had severe Alzheimer's disease. However, since cognitive impairment accompanies functional decline in advanced stages of dementia [3,4], these patients were maintained in the analysis of these variables and were considered as individuals with low strength and/or muscle performance. Further studies are needed to evaluate this proposed methodology in patients with dementia.

Based on the results of SMMI, HGS, and TUG, the diagnosis of mild to moderate sarcopenia was made in 19.8% of the participants and severe sarcopenia in 43.7%, totaling

63.5% of sarcopenic individuals in the sample studied. The scientific literature on sarcopenia in elderly people with dementia is scarce. No studies were found addressing the prevalence of sarcopenia in older adults with Alzheimer's disease, according to the current definition of sarcopenia (low muscle mass and low muscle function) [18]. Investigating 260 community-dwelling non-demented elderly individuals aged 80 years of age or older in Italy, Landi *et al.* [35] found a prevalence of 25.4% of sarcopenia with the same diagnostic methodology used in the present study. The authors found that the elderly individuals with sarcopenia were more likely to have functional and cognitive impairment, lower BMI, and performed less physical activity when compared to non-sarcopenic individuals. Based on these data, it appears that there is higher prevalence of sarcopenia among elderly people with dementia than among their non-sarcopenic counterparts.

Burns *et al.* [6] found that lean mass loss is accelerated in Alzheimer's disease and is associated with brain atrophy and cognitive performance, perhaps as a consequence of Alzheimer's disease pathophysiology or through shared mechanisms common to both Alzheimer's disease and sarcopenia. Brain pathology may contribute to decline in body composition, perhaps because it impairs by disrupting the regulation of energy metabolism and food intake by the central nervous system [6].

Other factors that may contribute to sarcopenia are sedentary lifestyle, inflammation, and low energy and protein intake. Burns *et al.* [6] also found that Individuals with early Alzheimer's disease had lower levels of physical activity than nondemented individuals. These authors associated lower physical activity with the lower amount of lean mass suggesting that the behavioral changes associated with Alzheimer's disease, such as impairments in mobility and activities of daily living, may result in loss of muscle mass. However, since lean mass remained associated with brain volume even after controlling for physical activity levels, the authors

suggested that the decline in physical activity did not fully explain their study's results [6]. Canon & Crimmins [36] reported an association between sarcopenia and low cognitive function in older adults, and for females, this association may be partly due to systemic inflammation. It has been suggested that the decrease in muscle mass in older adults with Alzheimer's disease is related to the progression of the disease and decreased oral or swallowing function. Therefore, this fact requires strategies to manage these dysfunctions [37].

Although in the present study there was no statistically significant difference between the mean values found for basic and instrumental activities of daily living in the different nutritional statuses, it was observed that deterioration of nutritional status tends to be accompanied by functional decline. Some studies have reported statistically significant associations between these variables. Spaccavento *et al.* [3] found significant differences in the BADL and IADL scores between well-nourished patients with Alzheimer's disease and patients at risk of malnutrition ($p=0.03$, $p=0.006$). Lower BADL scores were found among malnourished elderly individuals living in a long-term care institution (66.8% of them had dementia) compared to those of obese patients (2.15 ± 1.22 versus 2.59 ± 1.15 , $p=0.04$) [7]. Roque *et al.* [10] found that dependence on any basic or instrumental activities of daily living was significantly related to higher risk of malnutrition. Further research is needed to better understand the relationship between nutritional status and functional capacity of demented elderly individuals.

In this study, the number of patients with severe dementia was small since the research involved outpatient clinic patients, and the access of individuals with more severe Alzheimer's stage to this type care facility is more difficult. Moreover, the use of bioelectrical impedance led to the exclusion of individuals whose condition could affect the measurements, such as those with chronic kidney disease, edema, metallic

prosthesis, use of diuretics that could not be discontinued and also to the exclusion of more frail individuals who were unable to stand up for getting the weight measured. Thus, future studies should focus on individuals with these health conditions.

The present study highlights the high prevalence of risk of malnutrition and sarcopenia, with lower muscle mass, lower strength, and decreased muscle performance in older adults with Alzheimer's disease. Therefore, multiprofessional care including nutrition care should be provided early with individualized guidance addressing particular difficulties and inadequacies that can be overcome, such as diet, gastrointestinal symptoms, behavioral changes, and issues related to the caregivers. This measure will contribute to improve the quality of life and the prognosis of older adults with Alzheimer's disease. Well-nourished patients with preserved muscle mass have lower risk of falls, fractures, pressure ulcers, and infections, which results in a reduced number of hospitalizations and reduced costs to treat this type of complications. Future studies should focus on the evaluation of nutritional interventions aimed at maintaining the nutritional status and muscle mass in these individuals.

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CONTRIBUTORS

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