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Nutritional status and food intake of Brazilian patients at various stages of Alzheimer's disease: A cross-sectional study

Vanessa Fernanda Goes[1]; Jacqueline Aparecida Eidam Horst[1]; Juliane Cristina de Almeida[1]; Weber Cláudio Francisco Nunes da Silva[1,2]; Najeh Maissar Khalil[1]; Juliana Sartori Bonini[1]*

[1] Department of Pharmacy, *Universidade Estadual do Centro-Oeste*, Simeão Camargo de Sá 03, Guarapuava, PR 85040-080, Brasil.
[2] Memory Center, Brain Institute, Pontifícia Universidade Católica do Rio Grande do Sul, Ipiranga 6690, Porto Alegre, RS 90610-000, Brasil

ABSTRACT

Alzheimer's disease (AD) is characterized by disorders that can impair the nutrition of the patient and lead to weight loss and nutritional deficits during the course of the disease. The aim of this study was to assess the nutritional status and food intake of Brazilian patients with Alzheimer's disease at 3 different stages of the disease. The sample consisted of 30 subjects of both genders, mean age 77 years, with probable AD. Subjects were assessed by collecting anthropometric data, the Mini Nutritional Assessment (MNA), serum albumin content, Mini Mental State Examination and 24-hour records of food and drink. Although a steady decrease in average weight was observed as the disease progressed (CDR1: 70.8±15.9 kg; CDR2: 61.4±15.7 kg; CDR3: 56.1± 8.4 kg), the differences were not significant. MNA and serum albumin both fell during the progression of the disease (p = 0.042; p = 0.047, respectively) and, at the severe stage, half the patients were found to be undernourished and the other half at risk of undernutrition. According to their body mass index, 23.3% of patients were overweight. The nutritional value of the food consumed was similar across the stages of AD. In conclusion, the majority of Brazilian patients with AD in this study exhibited cognitive decline and malnutrition. However, food intake was similar among the stages of the disease, thus having no direct association with the progression of AD.
Keywords: Nutritional assessment. Alzheimer's disease. Undernutrition. Overweight. Elderly.

Corresponding author: Juliana Sartori Bonini, *Universidade Estadual do Centro-Oeste*, Departamento de Farmácia, Rua Simeão Camargo Varela de Sá, 03, CEP: 85040-080, Guarapuava-PR, Brazil. E-mail: jsartoribonini@gmail.com

INTRODUCTION

In this study, the elderly population is defined as people aged 60 years or more (Brasil, 2003). This age group has undergone remarkable changes in size and lifestyle in recent decades. According to the census conducted in 2010, there are currently 20 million people over 60 years old in Brazil (IBGE, 2011), and some projections show that in 2050 there will be more than 64 million (IBGE, 2008). This phenomenon will result in adjustments in social policies, particularly those designed to meet the increasing demands related to the health of the elderly (IBGE, 2008).

Among the main causes of morbidity and mortality in the elderly are chronic illnesses such as dementia, a clinical syndrome that is progressive in nature, wherein multiple cognitive functions are disturbed (Brasil, 2006).

The commonest cause of dementia, Alzheimer's disease (AD), leads to cognitive and behavioral disorders that can impair nutrition, such as difficulty in chewing, swallowing or the preparation of meals, and behavioral disorders that make the patient slow and distracted during meals, hindering proper eating habits. This situation can cause nutritional imbalance, leading to weight loss and nutritional deficits (Gillette-Guyonnet et al., 2000).

By paying greater attention to nutritional issues, caregivers may be able to improve the general condition, quality of life and well-being of AD patients (Manthorpe & Watson, 2003; McKhann et al., 1984). However, adequate nutritional therapy can only be achieved when the nutritional status and food intake of the patients are known. When making a nutritional assessment for this purpose, it is important to use several methods, in order to obtain a more accurate diagnosis of the nutritional status.

Few studies have been carried out about the nutritional status of Alzheimer's disease patients in Brazil. In this study, a survey was conducted on a sample of Alzheimer's disease patients in a medium-sized Brazilian city, with the purpose of assessing their nutritional status and food intake at successive stages of the disease.

MATERIAL AND METHODS

Subjects

This cross-sectional study was conducted among AD patients enrolled in the "Program for Drug Dispensing in Exceptional Cases" of the Brazilian Ministry of Health in the city of Guarapuava, Paraná, Brazil, in the months of August to October, 2011. The initial sample consisted of 66 subjects, of both genders, with probable AD diagnosed by the criteria of the *National Institute of Neurologic and Communicative Disorders and Stroke and the Alzheimer Disease and Related Disorders Association* (NINCDS-ADRDA) (McKhann et al., 1984). Home visits were made to patients and caregivers who signed the Informed Consent Form. Upon completion of the home visits, it was found that 7 patients had recently died, 11 had moved to stay with relatives in other locations and 18 patients were not found at their recorded addresses. Thus, the final sample was 30 patients. It was not possible to expand the sample because the number of patients in attendance was small and restricted to 66 subjects. This research was approved by the Ethics Committee of *Universidade Estadual do Centro-Oeste* (protocol 026/2011).

A cognitive evaluation was conducted, in which the Mini-Mental State Examination (MMSE) (Folstein et al., 1975) was used to assess temporal and spatial orientation, memory, attention, calculation, language and praxis. The Clinical Dementia Rating (CDR) (Hughes et al., 1982; Morris 1993) was administered to determine the stage of the AD.

Demographic data were also collected for all subjects and included: educational level, average household income, age, marital status, smoking habits before the disease, physical activity, comorbidities and medication. Those patients who had smoked some form of tobacco at least once a day before the onset of AD were considered smokers.

Nutritional status

The nutritional status of each subject was assessed from anthropometric and biochemical data and the MNA (Mini Nutritional Assessment) (Vellas et al., 2006). The anthropometric data included: height (m), current weight (kg), body mass index (BMI, kg/m2), arm circumference (AC, cm) and calf circumference (CC, cm). Digital weighing scales with a capacity of 150 kg and a stadiometer graduated in centimeters were used to measure weight and height, respectively. For subjects who had difficulties with posture and/or balance, and for bedridden patients, the height and weight were estimated by means of the equations proposed by Chumlea (Chumlea et al., 1985; Chumlea et al., 1988) to avoid biases in the measuring of height and weight. For the biochemical data, serum albumin (g/L) was collected after 12 hours of fasting, on a date scheduled after the first interview, and was analyzed by colorimetry at a clinical laboratory in Guarapuava, Paraná, Brazil.

Dietary intake

The caregivers provided information about the food intake of the patients. It was assessed from 24-hour food recalls that listed all foods/beverages, types of preparations and quantities of each food item eaten on the previous day. The collected information was recorded on a weekday, because weekend food intake tends to vary and hence may not be representative of the usual dietary patterns for most days. Diet analysis included values of energy, macronutrients and micronutrients and was carried out with the program Avanutri 4.0 (*Avanutri Informática* LTDA, Brazil).

Statistical analysis

Descriptive statistics were performed, with mean and standard deviation for the continuous variables and frequency for the categories. ANOVA, Kruskal-Wallis or Fisher's exact test were used to compare the three groups of AD stages with respect to the demographic, anthropometric, biochemical, MNA, MMSE and dietary intake variables. The chi-square test was used to determine possible differences in assessment of undernutrition by the various methods used and to study possible associations between the usage of some types of medication and nutritional status. Significance was accepted when $P < 0.05$. All analysis was conducted with SPSS Statistics 19 for Windows (SPSS Inc.).

RESULTS

Sixty-six subjects formed the initial sample and 45.4% (n = 30) participated in the study. Among these patients, 33.3% (n=10) were in the mild stage of AD (CDR1), 26.6% (n=8) in the moderate stage (CRD2) and 40% (n = 12) in the severe stage (CDR3). All of them were under specific medication for AD: 50% (n=15) with rivastigmine and the other 50% (n=15) with donepezil. The group that completed the study was composed of 60% females (n = 18) and 40% males (n = 12), of mean and median age 77 and 78 years, respectively. Table 1 shows there was a statistical difference in mean age among the stages of the disease ($p = 0.042$), older patients showing more advanced stages of disease. Table 1 also shows that a significant difference ($p = 0.003$) was found in the practice of physical activity among the stages of AD. There was no significant difference among the 3 stages of AD in any of the following variables: gender, average family income, education level, marital status, smoking before AD and comorbidities.

The average weights (Table 2) in the 3 patient groups show a decreasing tendency with progression of the disease, although the differences were not significant ($p= 0.061$). The mean values for the nutritional status, MNA (Table 2), showed a significant difference among the stages of the disease ($p= 0.042$), the MNA score falling with increasing severity of AD. Patients at the more severe stages of the disease were classified as being either at risk of undernutrition or undernourished.

The serum albumin content (Table 2) also showed a significant difference among the stages of AD ($p = 0.047$), the content decreasing with its progression and the lowest values being found in the severe stage. There were significant differences between the mean scores for the MMSE (Table 2) at each stage of AD ($p < 0.001$).

The rate of undernutrition among the patients with AD differed according to the method used to assess its frequency. According to the BMI, AC, CC, MNA and

Table 1. Characteristics of the study population grouped by severity of AD.

	Mild (n)	Moderate (n)	Severe (n)	P[a]
Mean age (years)[a c]	73.0 ± 11.5	75.0 ± 8.1	82.0 ± 5.4	0.042*
Gender [b]				
Female (%)	50.0 (5)	62.5 (5)	66.6 (8)	
Male (%)	50.0 (5)	37.5 (3)	33.3 (4)	
Average family income [a c] (BRL)	2032.0 ± 1539.2	2258.0 ± 1213.0	2318.0 ± 1394.0	0.887
Schooling (years) [a c]	5.0 ± 3.0	3.1 ± 3.5	5.9 ± 4.2	0.264
Marital status (%)[b]				
Single	0.0 (0)	0.0 (0)	16.6 (2)	
Married	60.0 (6)	37.5 (3)	41.6 (5)	
Widowed	40.0 (4)	62.5 (5)	41.6 (5)	
Smoking before AD (%)[a]	70.0 (7)	50.0 (4)	41.6 (5)	0.432
Physical activity (%)[b]				0.028*
Bedridden	0.0 (0)	0.0 (0)	41.6 (5)	
Sedentary	30.0 (3)	50.0 (4)	41.6 (5)	
Light physical activity	70.0 (7)	50.0 (4)	16.6 (2)	
Comorbidities (%)[b]				
Hypercholesterolemia	50.0 (5)	12.5 (1)	33.3 (4)	0.303
Diabetes mellitus	40.0 (4)	25.0 (2)	33.3 (4)	0.889
Parkinson's disease	0.0 (0)	25.0 (2)	33.3 (4)	0.152
Hypertension	60.0 (6)	75.0 (6)	66.6 (8)	0.889
CVA	40.0 (4)	25.0 (2)	41.6 (5)	0.796
Cancer	20.0 (2)	12.5 (1)	33.3 (4)	0.651

AD: Alzheimer Disease; BRL: Brazilian Real; CVA: cerebrovascular accident (stroke)
[a]Anova comparing three groups.
[b]Fisher's exact test comparing three groups.
[c]Continuous variables are presented as mean±SD.
*P<0.05 shows a statistically meaningful difference between groups.

Table 2. The anthropometric, MNA, albumin and MMSE profiles for each category of AD severity.

	Mild (n = 10)	Moderate (n = 8)	Severe (n = 12)	P[a]
Weight	70.8 ± 15.9	61.4 ± 15.7	56.1 ± 8.4	0.061
	(50.2 – 93.0)	(43.6 – 90.0)	(45.5 – 67.2)	
Height	1.6 ± 0.1	1.5 ± 0.0	1.5 ± 0.1	0.504
	(1.5 – 1.8)	(1.5 – 1.6)	(1.4 – 1.7)	
AC	29.0 ± 5.4	26.0 ± 4.6	24.9 ± 2.3	0.142
	(23.5 – 39.0)	(20.0 – 33.0)	(22.0 – 29.5)	
CC	34.5 ± 2.9	33.1 ± 3.6	31.1 ± 2.7	0.081
	(30.5 – 39.5)	(26.5 – 36.5)	(27.0 – 34.5)	
BMI	26.8 ± 4.6	24.6 ± 6.5	22.8 ± 3.5	0.101
	(21.8 – 35.0)	(17.1 – 36.5)	(17.0 – 30.0)	
MNA	21.9 ± 2.3	19.3 ± 4.8	17.2 ± 4.2	0.042*
	(17.0 – 26.0)	(14.0 – 26.0)	(10.0 – 22.0)	
Albumin	36.6 ± 2.6	34.6 ± 2.2	30.6 ± 3.1	0.047*
	(33.0 – 40.0)	(31.0 – 38.0)	(27.0 – 36.0)	
MMSE	20.6 ± 3.6	13.4 ± 4.2	7.3 ± 4.5	<0.001*
	(16.0 – 26.0)	(7.0 – 18.0)	(0.0 – 13.0)	

AC: arm circumference; CC: calf circumference; BMI: Body Mass Index; MNA: Mini Nutritional Assessment; MMSE: Mini Mental State Examination;
[a] Kruskal-Wallis Test.
Data are presented as mean ± SD (range).
*P < 0.05 shows a statistically meaningful difference between groups.

serum albumin, the global prevalence of undernutrition in the population was 36.6% (n=11), 66.6% (n=20), 20.0% (n=6), 30.0% (n=9) and 56.6% (n=17), respectively. The MNA showed that 53.3% of patients were at risk of undernutrition. The percentage of overweight patients, according to the BMI, was 23.3% (n=7).

Regarding energy, 43.33% (n = 13) of the patients had an adequate caloric intake, according to the recommendation from the Dietary Reference Intakes (DRI) (IOM & FNB, 2002). There was no significant difference in nutritional value of meals among patients at different stages of AD (Table 3).

DISCUSSION

Here we have demonstrated that AD patients attending the Brazilian Ministry of Health Program (SUS-Health Unique System) in Guarapuava, Brazil, exhibit weight loss and undernutrition as the disease develops, but no change in food intake.

The mean anthropometric figures, MNA and serum albumin content were lower in the later stages (moderate and severe) of the disease, showing that there was weight loss and undernutrition in these patients. Several studies

Table 3. Nutritional value of food intake of patients grouped by severity of AD.

	Mild (n=10)	Moderate (n=8)	Severe (n=12)	P[a]
Energy (kcal)	1644.1± 479.6	1719.0± 683.0	1555.0± 763.0	0.897
Protein (g/kg)	1.1± 0.4	1.2±0.4	1.2±0.8	0.779
Protein (%)	19.3 ±6.7	17.5±2.8	18.8±10.2	0.709
Carbohydrates (%)	50.7±11.5	53.5±5.3	52.4±11.6	0.848
Lipids (%)	29.8±10.3	28.9±4.4	28.8±8.8	0.955
Vitamin A (RE)	250.0±169.0	685.4±747.0	609.7±526.9	0.416
Vitamin D (µg)	3.8± 4.2	2.3±1.3	2.6±1.7	0.812
Niacin (mg)	37.7±47.7	19.8±12.0	19.4±16.0	0.619
Vitamin B12 (µg)	3.2±2.4	9.5±20.7	8.0±10.1	0.857
Vitamin C (mg)	49.8 ± 52.9	68.2±61.0	77.8±79.3	0.676
Vitamin E (mg)	13.9±7.9	17.9±15.5	15.7±14.4	0.684
Folate (µg)	113.2± 40.5	139.2±78.0	119.2±71.2	0.752
Calcium (mg)	571.7 ± 360.8	453.5±242.8	419.3±275.1	0.407
Iron (mg)	13.6±8.2	14.3±7.1	10.7±5.8	0.681
Zinc (mg)	10.5±5.1	10.8±7.3	7.6±7.5	0.231
Selenium (µg)	58.3± 25.8	60.6±37.3	62.5±44.6	0.998
Sodium (mg)	1797.9±1014.8	2833.0±1044.6	1994.0±1221.5	0.128

[a] Kruskal-Wallis Test.
Data are presented as mean ± SD

have shown weight loss/undernutrition in AD patients, relative to control groups (Gillette-Guyonnet et al., 2000; Heidi et al., 2004; Wang et al., 2004; Ousset et al., 2008; Guérin et al., 2005). Weight loss can worsen the patient's condition, favoring the emergence of other diseases and potentially exacerbating the progression of AD. Hence, it is important to obtain an accurate nutritional assessment at an early stage of AD, to ensure that the dietary needs of each patient are supplied and thus avoid the occurrence of unwanted weight loss, as shown by Jyvakorpi et al., in a study that provides data on whether tailored nutritional care is beneficial to home-dwelling AD patients (Jyvakorpi et al., 2012). Although weight loss predicts rapid cognitive decline, it remains an open question whether the prevention of weight loss (by improving nutritional status) can slow cognitive decline (Soto et al., 2012).

On the other hand, 23.3% of the patients were overweight, according to the BMI, but they may have been overweight or obese before the development of AD. Some studies show that a raised BMI in middle age can be associated with a higher risk of dementia (Kivipelto et al., 2005; Whitmer et al., 2005), and one study showed that in patients with AD, a worse psycho-functional status was associated with obesity (Saragat et al., 2012).

The potential mechanisms linking adiposity to AD include hyperinsulemia, advanced glycosylation products, adipocyte-derived hormones (adipokines and cytokines), and the influence of adiposity on vascular risk and cerebrovascular disease (Luchsinger & Gustafson, 2009).

The significant difference in the diagnosis of undernutrition between serum albumin and CC indicates that the latter method may not have identified undernutrition in the same way as serum albumin. It is thus suggested that CC must be used along with other methods, because it was not sensitive enough on its own to assess undernutrition accurately. BMI showed a statistical tendency in the same direction as serum albumin, but it also failed to identify all the cases of undernutrition indicated by serum albumin. Thus, measuring the height and weight of AD patients (and noting that some of these measures were estimated from formulas) may be an inadequate means of identifying undernutrition in these patients and therefore needs to be complemented by other nutritional assessment methods, such as biochemical tests.

The patients' food intake was found to be similar throughout the different stages of the disease, showing that it may not be a factor in the greater weight loss seen in the more advanced stages of AD. A study that investigated two modes of weight loss (progressive and severe) found no differences in food intake related to the pattern of weight loss (Guérin et al., 2005). Moreover, it is known that weight loss, especially in the early stages of AD, occurs even in patients who have adequate energy intake (Gillette-Guyonnet et al., 2000). Similar findings that do not seem to support the hypotheses of either a hypermetabolic state or inadequate energy intake in AD patients have been reported (Mazzali et al., 2002).

Practicing physical activity may also be inversely associated with weight loss. The patients who engaged in some light physical activity were mainly in the mild stage, while the bedridden patients were all in the severe stage of AD. A study carried out among AD sufferers showed that body weight was correlated with immobility, the bedridden subjects having the lowest body weight (Berkhout et al., 1998).

A limitation of the present study was the small sample size, which limited the comprehensiveness of the findings. Studies with larger sample sizes are necessary to estimate more accurately the impact of the findings reported here.

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RESUMO

Estado nutricional e consumo alimentar de pacientes brasileiros em diferentes estágios da doença de alzheimer: um estudo transversal

A doença de Alzheimer (DA) é caracterizada por distúrbios que podem comprometer a nutrição do paciente e causar perda de peso e deficiências nutricionais durante a doença. O objetivo deste estudo foi avaliar o estado nutricional e o consumo alimentar de pacientes brasileiros com doença de Alzheimer em diferentes estágios da doença. A amostra foi composta por 30 indivíduos, com idade média de 77 anos, de ambos os sexos, com provável DA. Os indivíduos foram avaliados através de dados antropométricos, Mini Avaliação Nutricional (MAN), albumina sérica, Mini Exame do Estado Mental, e recordatório de 24 horas. Embora tenha sido encontrada uma diminuição no peso médio entre os estágios da doença (CDR1: 70,8±15,9 kg; CDR2: 61,4±15,7 kg; CDR3: 56,1± 8,4kg) conforme a progressão da doença, a diferença não foi significativa. Os parâmetros MAN e albumina sérica mostraram uma diminuição entre os estágios da doença (p = 0,042, p = 0,047, respectivamente), sendo que no estágio grave metade dos pacientes estava desnutrida e a outra metade em risco de desnutrição. De acordo com o índice de massa corporal, 23,3% dos pacientes estavam com sobrepeso. O valor nutricional da ingestão alimentar foi similar nos estágios de DA. Em conclusão, a maioria dos pacientes brasileiros com DA neste estudo apresentaram desnutrição, apesar de o consumo alimentar ter sido similar entre os estágios da doença, uma vez que não apresentou associação direta com a progressão da DA.

Palavras-chave: Avaliação nutricional. Doença de Alzheimer. Desnutrição. Idosos.

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