Nutrire

Nutritional risk in outpatients of a geriatric neuropsychiatry clinic

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Abstract

Background: There are few published studies investigating the nutritional status of elderly individuals with psychiatric disorders. This study aims to describe the nutritional status of elderly patients from a neuropsychiatry outpatient clinic, investigating their nutritional status according to the type of psychiatric diagnostic, specifically Alzheimer's disease (AD), depression (DEP), and other types of dementia (OTD).

Methods: Elderly individuals from two outpatient clinics ($n = 217$) were evaluated for nutritional risk (using a validated tool) and for some anthropometric and biochemical measurements.

Results: We found a high prevalence of nutritional risk in the sample (about 60%). The major dietary problems found were low daily meal frequency and the low daily intake of water. Biochemical analyses indicated blood glucose and total cholesterol to be above the reference values, while hemoglobin and vitamin D were below the reference values. Anthropometric measurements did not differ between the groups with different psychiatric diagnostics, except for calf circumference, which showed to be lower in the OTD group ($p = 0.006$).

Conclusions: Although we found a high prevalence of nutritional risk, the differences between the diagnostic groups were very subtle. The nutritional risk is certainly associated with inadequate eating habits. It is necessary to seek strategies to improve the diet and other lifestyle factors in geriatric neuropsychiatry, in order to mitigate the negative outcomes brought about by the diseases.

Keywords: Aging, Geriatric neuropsychiatry, Nutritional status

Background

Aging is associated with the development of several non-communicable diseases, including brain disorders [1, 2]. Among these disorders, dementias and depressive morbidity must be carefully understood, due to their emotional-, financial-, and health-related burden [3]. Dementias are neurodegenerative disorders encompassing different types, for instance, vascular cognitive impairment, frontotemporal dementia, dementia with Lewy bodies, and, particularly, Alzheimer's disease (AD). In fact, AD accounts for approximately 60–80% of all dementia cases worldwide [3]; the disease, characterized by plaques and tangles in the brain, is associated with a dramatic loss of cognitive functions and a progressive

loss of autonomy, and therefore with a need for complete care [4, 5]. In turn, depressive morbidity represents a complex group of mental illnesses, including major depressive disorder, dysthymia, and clinically significant depressive symptoms [6].

There are a number of risk factors for AD, some of these are well characterized and, at this time, are not modifiable, for instance, the polymorphism in the apolipoprotein ε4 allele [7]. In turn, due to the risk factors of depressive morbidity, some importance has been given to epigenetic mechanisms during the life course of individuals [8]. In addition, some common factors involved in the development of depressive morbidity and dementias are modifiable [9, 10] and may be exploited to prevent or to attenuate the clinical manifestations of these diseases. Lifestyle and, in particular, nutrition have been extensively studied [11]; there are a number of publications that report that the intake of different nutrients, or

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different dietary patterns, can enhance or make the resilience of the brain worse, therefore reducing or increasing the risk of psychiatric diseases [12]. Nutrition is attached to the regulation of immune system homeostasis, which in turn can regulate neuroinflammation and neurotransmitter synthesis and metabolism [10]. It is important to remember that the brain is an organ with an intense metabolic activity, with a high-energy expenditure, and therefore highly affected by nutritional deficiencies and imbalances.

Therefore, the relationship between nutrition and brain disorders, especially during aging, demands a permanent monitoring of the nutritional status and nutritional risk [13–15]. It is important to reinforce the two-way relationship between nutritional status and these diseases; an inadequate nutritional status can accelerate the development of brain disorders, and the presence of brain disorders can make the nutritional status worse. This two-way relationship has been identified in AD [16–18], as well as in depressive morbidity [19–21].

As such, this study aims to describe the nutritional status of individuals registered and accompanied in a geriatric neuropsychiatry outpatient clinic. As a secondary aim, we will investigate the nutritional status according to the type of psychiatric diagnostic, highlighting the AD and depressive morbidity.

Methods
Type of study
This is a cross-sectional study with a convenience sample from geriatric neuropsychiatry outpatient clinics that form part of the *Old Age Research Group* (PROTER), Institute of Psychiatry, Medical School, University of São Paulo. The project is responsible for the following two outpatient clinics : (a) Depression clinic (on Mondays) takes care of patients diagnosed with depressive morbidity, without meeting the criteria for mild cognitive impairment, nor for any type of dementia and (b) Dementia clinic (on Thursdays) takes care of patients who meet criteria for major cognitive impairments, which includes all the different types of dementia. With regard to AD dementia, the clinics attend only patients in the mild and moderate stages; patients diagnosed as at severe stages are forwarded to another clinic, in the same university. Details of this project have been published elsewhere [22]. The present study was performed from July 2014 to October 2015.

Sample and data collection
During the period designated for the study, the researchers approached patients in the waiting room during the clinics (on both days of the week) to invite the patients to take part in the study. This approach consisted of explaining the study, inviting the patient to take part in the study, and the verification of patient's inclusion criteria (aged above 60 years, both genders,

being diagnosed or in the process of being diagnosed with depressive morbidity or any type of dementia). Patients who declined to take part, or were unable to be submitted to the evaluations required, were excluded from the study. In order to investigate whether the different psychiatric diseases were associated with different nutritional status classification, the participants were distributed into three groups: depressive morbidity (DEP) (from the depression outpatient clinic), Alzheimer's disease (AD) (patients who met the criteria for probable AD), and other types of dementia (OTD), which included the patients with major cognitive disorders but did not meet the criteria of AD.

Anthropometric measurements
Body weight and height were self-reported by the patient or by his/her caregiver. This information was used to calculate the body mass index [(BMI = weight (kg)/height^2 (m)]. The BMI was classified according to a Brazilian multicenter study (SABE Study) [23]: underweight (< 23 kg/m^2), normal weight (≥ 23 and < 28 kg/m^2), overweight (≥ 28 and < 30 kg/m^2), and obesity (≥ 30 kg/m^2). Arm circumference (AC) and calf circumference (CC) were objectively assessed with a fiberglass tape and were classified according to the percentile described for the SABE study. As such, measurements were classified as $< $ P25; $\geq$ P25 and $<$ P50; $\geq$P50 and < 75; and $\geq$ P75.

Biochemical data
The biochemical profile of the patients was obtained by consulting medical records, considering only those results obtained during the three previous months. We obtained the following measurements: fasting blood glucose and glycated hemoglobin; plasma total protein and albumin; total-cholesterol, HDL-cholesterol, and LDL-cholesterol; vitamin D, vitamin B$_{12}$, and folic acid; and hemoglobin.

Screening for nutritional risk
All the participants responded to the mini nutritional assessment (MNA). In brief, this tool is composed of 18 questions about anthropometric measures (BMI, CC, AC, and body weight loss in the last 3 months), global evaluation (lifestyle, medication, mobility, stressful events, cognition, and depression), diet information (number of meals, intake of some food groups, intake of liquids, and autonomy for feeding), as well as subjective assessment (self-perception of health) [24]. Each answer corresponds to a score, and the summation of these scores determines the classification as "malnourished" (score below 17), "at risk of malnutrition" (score between 17 and 23.5), and "normal nutritional status" (score above 23.5). Apart from this classification, we detailed four questions from this tool, specifically related to food intake, as follows: Question "J": How many full meals does the patient eat

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daily? The answer could be: 1 meal, 2 meals, 3 meals. Question "K" selected consumption markers for protein intake; the respondent had to select all the alternatives that applied: at least one serving of dairy products (milk, cheese, yogurt) per day? (Yes or No); two or more servings of legumes or eggs per week? (yes or no); meat, fish, or poultry every day? (Yes or No). The answers could be: zero or one yes answer; two yes answers; three yes answers. Question "L": Consumes two or more servings of fruit or vegetables per day? The answer could be "no" or "yes." Question "M": How much fluid (water, juice, coffee, tea, milk...) is consumed per day? Possible answers: less than three cups, three to five cups, or more than five cups.

Data analyses
The data were presented as mean and standard deviation (continuous variables) and as percentages (categoric variables). The groups of patients (DEP, AD, and OTD) were compared by one-way ANOVA with Fisher test as post-hoc (continuous variables) or by chi-square test (categorical variables). Data analysis was performed with the Statistica® software, and significance was defined as a *p* value < 0.05.

Results
From the 243 patients invited to take part in our study, 217 were considered fit to respond to the assessments and accepted participation. From these patients, 150 (69.1%) were women. The mean age of the participants was 76.5 years (SD = 7.8 years). With regard to psychiatric diagnosis, 107 (49.3%) were diagnosed as presenting DEP, 59 (27.2%) as probable AD, and 51 (23.5%) as OTD. The biochemical variables were available only for a subsample of individuals (varying according to the variable).

Table 1 describes the score and the classification of the participants, according to MNA. For the three groups, the highest percentage of individuals was classified as at nutritional risk, and there were no significant differences between the groups. Although insignificant,

Table 1 Classification of nutritional risk, according to the mini nutritional assessment (MNA)

MNA data	Groups			*p* value
	DEP	AD	OTD	
Score (mean ± SD)	20.5 ± 3.4	20.5 ± 3.6	19.9 ± 4.3	0.64[a]
Classification [*n* (%)]				
Adequate nutritional status	20 (18.7)	10 (16.9)	9 (17.6)	0.78[b]
Nutritional risk	72 (67.3)	41 (69.5)	28 (54.9)	
Undernutrition	15 (14.0)	8 (13.6)	14.0 (27.5)	
Total	107 (100.0)	59 (100.0)	51 (100.0)	

[a]ANOVA one-way;
[b]chi-square test (X^2)

the OTD group presented the highest percentage of malnourished persons.

Table 2 presents the demographic and anthropometric description of the participants, according to diagnosis. The three groups presented similar demographic characteristics, where the majority were women that were over 75 years old; the OTD group was slightly older. With respect to BMI, the DEP and AD groups presented a relatively high (about 25%) percentage of low BMI, and the OTD group presented the highest percentage of low BMI (45%). The AD group presented a frequency of 22% for obesity, which was slightly higher than those of the other groups (but not significant); the OTD group presented the lowest percentage of overweight and obesity. The measurement of arm circumference and calf circumference showed that the majority of individuals in the three groups presented values below the 25th percentile, and this finding was more evident in the OTD group.

Table 3 depicts the frequency of the responses to specific questions of MNA. More than 50% of the participants allocated in the DEP and AD groups referred to the intake of only two meals per day, while the majority of the OTD group consumed three meals or more per day. With regard to markers of protein intake, more than 50% of participants of the three groups presented the best classification for this question (intake of three or more markers of protein intake daily), although there was a relatively high percentage of individuals reporting the intake of just two markers. The three groups referred to the intake of more than two servings of fruit and vegetables per day. With regard to the intake of water, we observed a high percentage of patients referring to low intake, without any significant difference between groups.

Table 4 depicts the biochemical analysis (as means and standard deviation) of some of the participants. The mean blood glucose and glycated hemoglobin were above normal in the three groups. The plasma proteins were in the normal range, and plasma lipids (total cholesterol, HDL, and LDL) were above the normal range. The three groups were within the normality ranges for vitamin B_{12} and folic acid and also showed insufficiency for vitamin D. Mean hemoglobin values were within the normal range. However, when the percentage of individuals with anemia in each group was observed, about half of the individuals presented hemoglobin levels below those of the normality range. None of these variables showed significant differences between groups.

Discussion
We found a high prevalence of nutritional risk in the groups of patients with different diagnoses of geriatric neuropsychiatry (about 60% of the total group). With regard to dietary aspects, the main problems found were

Table 2 Values and categories of demographic and anthropometric variables of the participants, per diagnostic

Variables considered as categorical

Categories[a] [n(%)]	Groups																p-value[b]
	DEP					AD					OTD						
	Cat. 1	Cat. 2	Cat. 3	Cat. 4	TOTAL	Cat. 1	Cat. 2	Cat. 3	Cat. 4	TOTAL	Cat. 1	Cat. 2	Cat. 3	Cat. 4	TOTAL		
Gender	30(28.0)	77(72.0)	–	–	107(100.0)	19(32.2)	40(67.8)	–	–	58 (100.0)	17(33.3)	34(66.6)	–	–	51 (99.9)	0.75
BMI	31 (29.0)	44 (41.1)	14 (13.1)	18 (16.8)	107(100.0)	14 (24.1)	25(43.1)	6 (10.3)	13 (22.4)	58 (100.0)	23 (45.1)	16 (31.4)	5 (9.8)	7 (13.7)	51 (100.0)	0.32
AC	41 (38.3)	28 (26.2)	20 (18.7)	18 (16.8)	107(100.0)	22 (37.3)	14 (23.7)	10(16.9)	13 (22.0)	59 (100.0)	27 (52.9)	7 (13.7)	8 (15.7)	9 (17.6)	51 (99.9)	0.50
CC	35 (32.7)	19 (17.8)	28 (26.2)	25 (23.4)	107(100.0)	18 (30.5)	15 (25.4)	15 (25.4)	11(18.6)	59 (100.0)	25 (49.0)	7 (13.7)	11(21.6)	8 (15.7)	51 (100.0)	0.34

Variables considered as continuous

Variables	Groups			p value[c]
	DEP	AD	OTD	
Age (years)	75.9 ± 7.2	75.6 ± 8.1	78.7 ± 8.4	0.06
BMI (kg/m²)	25.8 ± 4.6	26.4 ± 4.9	24.6 ± 5.2	0.14
AC (cm)	28.6 ± 4.4	28.5 ± 4.1	27.3 ± 5.2	0.22
CC (cm)	34.9 ± 4.0	34.3 ± 3.7	32.7 ± 4.6[d]	0.006

BMI body mass index, *AC* arm circumference, *CC* calf circumference
[a]Categories of gender: 1= male, 2= female; categories of BMI: 1 =< 23 kg/m², 2 = 23–28 kg/m², 3= 28–30 kg/m², 4 = > 30 kg/m²; categories of AC and CC (percentiles, according to SABE project): 1 = < P25; 2 = P25-P50; 3 = P50-P75; 4 = > P75
[b]The groups, with their respective categories, were compared by chi-square test
[c]The means were compared by one-way ANOVA with Fisher-test as post-hoc
[d]Means difference in comparison to the other groups

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Table 3 Frequency of the responses to specific questions of MNA

Questions	Alternatives	Groups			p value (X^2)
		DEP	AD	OTD	
How many meals per day	1 meal	10 (9.3)	4 (6.8)	3 (5.9)	0.19
	2 meals	59 (55.1)	33 (55.9)	20 (39.2)	
	3 meals	38 (35.5)	22 (37.3)	28 (54.9)	
Total		107 (100.0)	59 (100.0)	51 (100.0)	
Markers of protein intake[a]	0.0	15 (14.0)	10 (16.9)	5 (9.8)	0.251
	0.5	38 (35.5)	17 (28.8)	11 (21.6)	
	1.0	54 (50.5)	32 (54.2)	35 (68.2)	
Total		107 (100.0)	59 (100.0)	51 (99.6)	
Intake of two or more servings of fruit and vegetables per day	No	27 (25.2)	11 (18.6)	14 (27.4)	0.509
	Yes	80 (74.8)	48 (81.4)	37 (72.5)	
Total		107 (100.0)	59 (100.0)	51 (99.9)	
Amount of liquids ingested per day	Less than 3 cups	28 (26.2)	14 (23.7)	20 (39.2)	0.240
	3–5 cups	38 (35.5)	21 (35.6)	19 (37.2)	
	More than 5 cups	41 (38.3)	24 (40.7)	12 (23.5)	
Total		107 (100.0)	59 (100.0)	51 (99.9)	

[a]Selected consumption markers for protein intake. The score was 0.0 if the participant answered zero or one yes answer, 0.5 if two yes answers, and 1.0 if three yes answers to the following items: at least one serving of dairy products (milk, cheese, yogurt) per day (yes or no); two or more servings of legumes or eggs per week (yes or no); meat, fish, or poultry every day (yes or no)

Table 4 Description of some biochemical values from a subsample of the study

Parameter	DEP		AD		OT		p value
	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	
Fast blood glucose (mg/dL)[a]	52	108.5 ± 29.1	27	105.4 ± 25.4	24	119.7 ± 56.6	0.33
Glycated hemoglobin (%)[b]	37	6.0 ± 0.9	16	6.2 ± 1.2	13	5.9 ± 0.9	0.73
Total Protein (g/dL)[c]	18	7.3 ± 3.5	12	6.96 ± 3.3	5	6.48 ± 0.75	0.82
Albumin (g/dL)[d]	18	4.5 ± 2.1	12	4.2 ± 2.0	5	3.86 ± 0.55	0.43
Total cholesterol[e]	52	198.7 ± 46.9		183.1 ± 45.6	22	190.5 ± 46.2	0.40
HDl-cholesterol[f]	51	55.6 ± 24.9	23	50.4 ± 17.7	21	54.7 ± 19.9	0.64
LDL-cholesterol[g]	51	116.3 ± 40.9	23	106.1 ± 39.8	20	110.9 ± 41.3	0.60
Vit B_{12} (pg/mL)[h]	42	394.3 ± 258.3	21	442.4 ± 125.1	21	474.5 ± 371.5	0.95
Folic Acid (ng/mL)[i]	39	16.1 ± 10.3	23	14.2 ± 9.1	18	12.1 ± 6.3	0.14
Vitamin D (ng/mL)[j]	36	23.9 ± 16.9	12	28.2 ± 14.5	19	23.3 ± 33.0	0.48
Hemoglobin (g/dL)[l]	63	13.3 ± 1.3	29	13.4 ± 1.5	28	13.1 ± 1.5	0.60
Presence of anemia [n(%)]		28 (53.8)		13 (48.1)		10 (41.7)	

[a]Reference values for blood glucose: normal = < 100; low tolerance to glucose = between 100 and 126; diabetes = ≥ 126 mg/dL
[b]Reference values for glycated hemoglobin: risk for diabetes = between 5.7 and 6.4%; diabetes = > 6.5%
[c]Reference values for total proteins: 6.4 to 8.3 g/dL
[d]Reference values for Albumin: 3.2 to 5.0 g/dL
[e]Reference value for total cholesterol: optimal = < 100 mg/dL; desirable = < 200 mg/dL; borderline = between 200 and 239 mg/dL; high = ≥ 240 mg/dL
[f]Reference value for HDL-cholesterol: > 60 mg/dL desirable; low = < 40 mg/dL
[g]Reference value for LDL-cholesterol: desirable = 100–129 mg/dL; borderline = 130–159 mg/dL; high = 160–189 mg/dL; very high = ≥ 190 mg/dL
[h]Reference values for B_{12}: 210 to 980 pg/mL
[i]Reference values of folic acid: 2.7 to 17.0 ng/mL
[j]Reference values of vitamin D: < 20 = deficiency; entre 21 e 29 = insufficiency; 30 to 100 = normality, where the ideal range is 40 and 60; > 150 ng/mL = toxic level
[l]Reference values hemoglobin:12 to 15.5 g/dL

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a low daily intake of water and low food intake. Although we did not have any precise information about the number of calories consumed from diet, we can assume a low food intake from the high prevalence of individuals consuming only two meals per day. In contrast to this low food intake, the patients referred to an adequate intake of protein food sources, as well as of fruits and vegetables. All the anthropometric measurements showed an expressive percentage of the patients in the lowest percentiles (about 30% for DEP and AD and about 50% in the OTD). Biochemical analyses showed blood glucose and total cholesterol to be above the reference values for the majority of patients; hemoglobin and vitamin D were below the reference ranges.

Brain disorders, such as depressive morbidity, AD, and other dementias, can be associated with nutritional risk due to a number of factors; the low food intake shown in our data certainly may be one important factor. Brain disorders, together with other expected changes related to aging, are capable of modifying the gustatory receptors, affecting the perception of flavors [25]. Other factors, such as disincentives for food intake, modifications in mouth cavity, and digestive disturbances due to the excessive intake of medications, can also contribute to low food intake and, consequently, nutritional risk [26].

As such, considering these aspects, the expressive percentage of anthropometric measures that were below normality was somewhat expected. For instance, despite an adequate intake of protein, as shown by MNA, our patients presented a risk for low muscle mass; about 30% of DEP and AD patients, and almost 50% of OTD patients, presented percentiles of calf circumference and arm circumference that were below 25th. The association between low muscle mass and frailty is very well known and can increase the risk of negative outcomes [27–29]. In fact, the self-referred intake of an adequate number of protein servings was probably not enough to maintain muscle mass. Some authors have highlighted the difficulties of elderly people to digest and metabolize the proteins from the diet, and this has been denominated *anabolic resistance* [30]. Our data suggest that the summation of aging and brain disorders can increase this resistance.

Despite the identification of low muscle mass, we found a high percentage of patients classified as overweight or obesity (about 30% in the DEP and AD groups), which may contrast with the natural course of these diseases, especially AD [27]. However, it is important to consider epidemiological data showing obesity as a risk factor for the clinical manifestations of dementias; considering that our sample included only patients in the mild-to-moderate stage of disease, we can infer that they still preserve their body mass but are certainly at risk of losing weight, as the disease progresses [29, 31, 32]. To

reinforce this possibility of these patients losing weight in the future, we can cite a Brazilian study comparing nutritional status, according to the stage of AD; the study showed the worst results at the advanced stage of disease [33]. In addition, some studies, although controversial, have suggested U-shaped curves when investigating the association between body weight and depressive morbidity; this means that low body weight, as well as an excessive body weight, is considered as risk factor for depressive morbidity [34]. Low body weight is generally accompanied by sarcopenia and frailty; the association between physical frailty and brain disorders involves hormones and neurotransmitters and has been intensively studied [35]. Conversely, overweightness and obesity, besides demonstrating a relationship with chronic diseases in general, can increase the inflammatory status and, therefore, increase neuroinflammation and its brain outcomes [36, 37]. The possibility of an elevated inflammatory status in our sample can be indirectly suggested by some biochemical results. Our sample showed a high prevalence of anemia, which may suggest altered iron homeostasis in the brain, due to inflammation [38, 39]. In the same way, the high prevalence of vitamin D insufficiency may suggest an imbalance of inflammation control, since vitamin D can act in different inflammatory pathways [40].

The biochemical variables also showed elevated values of blood glucose, glycated hemoglobin, and plasma lipids, which can be considered "expected" in these patients. A number of studies have shown a strong relationship between these parameters and the development of chronic diseases, including neurodegeneration. For instance, insulin resistance increases oxidative stress, systemic inflammation, and consequently neuroinflammation [37]. The endothelial dysfunction, which is a consequence of dyslipidemia, can also increases the inflammatory status [37].

At this point, it is important to highlight the limitations of our study. Considering the small size and convenience feature of the sample, our results cannot be generalized to the population. The transversal design of the study did not allow causal inference. The inclusion of only patients in the early stages of disease limited the comparison with other stages, especially in AD. We did not measure body mass or diet objectively; in addition, biochemical analyses did not involve the entire sample studied. All these limitations did not allow inferring specific nutritional treatment or recommendations, according to the different neuropsychiatric diagnoses. Finally, information such as functional status as well as comorbidities could have improved our discussion. On other hand, we did not find any published study comparing different aspects of nutritional status in different neuropsychiatric diseases of aging. As such, we believe that

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our data could help the search of clinical interventions of this type of patients.

Conclusions

Although we found a high prevalence of nutritional risk, the differences between the diagnostic groups were very subtle. The nutritional risk is certainly associated with inadequate eating habits. It is necessary to seek strategies to improve the diet and other lifestyle factors in geriatric neuropsychiatry, in order to mitigate the negative outcomes brought about by the diseases.

Availability of data and materials
Please contact author for data requests.

Authors' contributions
AHFF collected and analyzed the data and helped in writing the final manuscript, GWMS and GC collected the data and helped in writing of the final manuscript, SMLR planned and supervised the study, analyzed the data, and wrote the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate
PROTER is a project with academic aims, and all the information about the profiles of the participants was approved by the local Ethics Committee (CAPPesq), process number 0009/08. All the participants signed a consent term according to the Helsinki declaration.

Consent for publication
Not applicable. This publication does not include individual data or images.

Competing interests
The authors declare no competing interests in this study.

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