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Nutritional screening by different methods and indicators of elderly patients admitted to hospital

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Abstract

Objective: To identify appropriate methods and indicators to assess the nutritional status of elderly people admitted to a hospital. *Methods:* Cross-sectional study that evaluated 41 elderly patients of both sexes (≥ 60 years). Body weight, height, body mass index (BMI), brachial circumference (BC), waist circumference (WC), calf circumference (CC), hematocrit, hemoglobin, and total lymphocyte count were evaluated. The Mini Nutritional Assessment (MNA) was also applied. *Results:* Among 41 elderly people evaluated, 53.7% were females. The classification of the nutritional status obtained through MNA and BMI showed that 80.48% and 70.73% of the elderly were diagnosed with inadequate nutritional status, respectively. There was a strong positive correlation between MNA x BMI, MNA x CC, MNA x BC, BMI x CC and BMI x BC. Kappa analysis showed a moderate agreement only between MNA x BMI and MNA and BC. *Conclusion:* The results suggest that MNA, BMI and BC were the most suitable methods for nutritional screening of hospitalized elderly.

Keywords: Elderly. Nutritional Assessment. Body Mass Index. Mini Nutritional Assessment.

Introduction

The elderly population has increased all over the world. It is estimated that there will be 1.2 billion people aged 60 years or older by 2020, and about 2.0 billion by 2050.[1] As we age, there is an increase in the number of hospitalizations. The occurrence of previous protein-energy malnutrition is also common, and it may become worse during hospital stay. The prevalence of malnutrition among the elderly ranges from 1.1% to 100%, according to the type of variable assessed and the standards used to classify their nutritional status.[2]

This situation has been related to high morbidity rates, which increase the probability of clinical and surgical complications and infections, leading to increased medical care costs and increased mortality rate among the elderly.[3] Thus, it is crucial that the nutritional profile of this population is assessed using nutritional assessment methods and indicators that can identify patients with inadequate nutritional status; moreover, early intervention measures need to be established to minimize health damage. However, a reliable assessment of the nutritional status of the elderly is complex, because changes occur in anthropometric and biochemical parameters during the natural aging process. Therefore, more appropriate evaluation indicators and methods should be used for this group.

There is still no gold standard method to evaluate malnutrition in the elderly. Anthropometric measures and biochemical tests (total lymphocyte count, albumin and cholesterol, hemoglobin, hematocrit and transferrin) are considered benchmarks for assessing nutritional status of the elderly.[4] Nevertheless, these methods are often not used in clinical practice because of physical and financial limitations of the elderly.

Body Mass Index (BMI), calf circumference (CC) and brachial circumference (BC) are tools used to identify patients with nutritional risk, and they can be used in population studies because they are simple, quick, non-invasive and inexpensive methods.[5,6] MNA is a more specific method to assess the risk of malnutrition in the elderly before clinical changes ocurr.[7] This method is used for evaluating the main factors that represent nutritional risk such as cognitive function, social behavior, autonomy, mobility and anthropometry.[8]

Given the above context, the present study was aimed at assessing the nutritional status of hospitalized elderly patients, using different methods and indicators, in order to identify the most appropriate evaluation criteria for this group.

Material and Methods

The study was performed in a hospital in Viçosa, Minas Gerais state, Brazil. It was a cross-sectional study, in which 41 male and female elderly patients (≥ 60 years) were evaluated at hospital admission (considering until the second day). The sample represented 51.3% of the number of elderly people hospitalized from October to November, 2007, and most of them were women (53.7%). Bedridden and physically disabled patients were excluded from the study because they could not possibly undergo anthropometric assessment. Those who had difficulty answering the MNA and did not have a caregiver or guardian who could help them were also excluded.

Anthropometric measurements - weight, height, Body Mass Index (BMI), brachial circumference (BC), waist circumference (WC), calf circumference (CC) - and biochemical tests (hematocrit, hemoglobin and total lymphocyte count) were evaluated. In addition, the subjective method MNA[9] was applied by a single trained researcher so that minimize distortions could be minimized in the final diagnosis.

Weight was measured with the use of a portable scale (Sunrise®) with 130 kg capacity. The patients were barefoot, in light clothes, in standing position, with outstretched arms and eyes towards the horizon. Height was estimated through length from the heel to the kneecap,[10] measured by using an anthropometer with wooden rod, graded at 0.5 cm and 1 meter capacity. BMI was calculated by dividing weight (kg) by squared height (m). The classification of nutritional status was performed according to Lipschitz.[11]

WC, BC and CC were measured using an inelastic tape. WC was measured at the midpoint between the bottom of the last rib and the iliac crest. Measurement was taken at the time of expiration to the nearest millimeter (0.1 cm). The risk for development of cardiovascular diseases was also assessed according to the World Health Organization (WHO).[12] BC was measured on the right side of the body, at the midpoint between the lateral projection of acromion process of the scapula and the inferior margin of the olecranon process of the ulna. CC was measured with the patient in supine position, with the left knee raised and the calf at a right angle to the bed.[13] The measurement tape was placed around the calf at the maximal circumference. Subcutaneous tissues were not compressed. The classification of nutritional status by BC was performed according to Blackburn[14] with percentile values established by the NHANES III[15], while WHO recommendations were used for CC.[13]

It should be stressed that the present study was not funded by any agency. For this reason, biochemical tests were evaluated through data registered on the patients' medical records. The reference values proposed by Martins et al.[16] were used to classify the nutritional status through the biochemical tests.

The results were grouped into two classification levels: adequate nutritional status and inadequate nutritional status, in order to facilitate comparison between the methods of nutritional assessment. In the case of BMI, the patients that showed values within the normal weight range (22-27 kg/m^2) were considered with adequate nutritional status, while those who showed values below or above this range were considered with inadequate nutritional status. Since overweight patients cannot be classified with adequate nutritional status and may also show micronutrient deficiencies, which may worsen health conditions during hospital stay, all obese patients were considered to have inadequate nutritional status. For MNA, the malnourished elderly and those at risk of malnutrition were grouped into a single category - inadequate nutritional status. Patients with CC < 31 cm, and BC $< 90\%$ adequacy were classified with inadequate nutritional status. Those with CC > 31 cm and $90 \leq$ BC adequacy < 110 were classified with adequate nutritional status. Elderly patients with total lymphocyte count, hematocrit and hemoglobin values below the range of 1500 - 5000/mm^3, 36-48%, 13,5-18g/dl (men); 12-16g/dl (women), respectively, were considered to have inadequate nutritional status. Those who showed the values within the recommended range were considered to have adequate nutritional status.

Information about the occurrence of diseases associated with the health of the elderly was also collected from their medical records. Morbidity data were categorized according to the nomenclature proposed by the International Classification of Diseases 10th Revision (ICD-10). Diseases were grouped into classes: diseases of the circulatory system (hypertension); endocrine, nutritional and metabolic diseases (hypothyroidism, diabetes); diseases of the respiratory system (pulmonary disease); diseases of the digestive system (diseases of the gastrointestinal tract); external causes (lesions); other causes (surgery, infections); diseases of the genitourinary system (kidney diseases).

Statistical analysis was carried out with SPSS version 17.0 and Epi info 6.0 software systems. Means, standard deviations, medians, minimum and maximum were used as descriptive statistics. Spearman's correlation coefficients were determined in correlation analysis and were kappa-adjusted. The Mann-Whitney test was used for statistical comparisons. Chi-square analysis was used to determine the association between nutritional assessment methods. P-values lower than 0.05 were considered statically significant.

This study was approved by the Ethics Committee of the Federal University of Viçosa (029/2007, Viçosa, Minas Gerais, Brazil). The study followed the Helsinki guidelines and all participating subjects gave their written consent.

Results

Mean age, BMI and WC of the 41 elderly adults (22 women and 19 men) assessed were 71.61 ± 9.70 years and 25.18 ± 6,35 kg/m^2, 93.31 ± 11.63 cm, respectively. The most frequent disease types presented by the elderly of this study were: diseases of the circulatory system (63.5%); endocrine, nutritional and metabolic diseases (34.2%) and diseases of the digestive system (24.4%). The highest incidence of these diseases was found in the group with inadequate nutritional status ($p>0.05$), 54.0%; 29.3% and 19.5%, respectively.

Among the participants, 36.6% showed BMI < 22 kg/m^2; 29.3% had BMI ranging from 22 to 27 kg/m^2; and 34.1% presented BMI > 27 kg/m^2. Table 1 shows the values for age, anthropometry, body composition, biochemical tests, BMI and MNA measured per sex of the hospitalized elderly.

Table 1. Mean ± SD and median (minimum/maximum) age, anthropometric data, body composition, biochemical test, BMI and MNA values obtained according to the gender of the hospitalized elderly, Viçosa-MG, 2007.

Variables	Total	Gender				*p*
		Female (n = 22)		Male (n = 19)		
	Mean ± SD	Mean ± SD	Median (min/max)	Mean ± SD	Median (min/max)	
Age (years)	71.61 ± 9.70	73.82 ± 9.80	73 (61/89)	69.05 ± 9.15	66 (60/91)	0.117
Weight (kg)	64.04 ± 15.33	59.23 ± 14.17	58 (36/84)	68.84 ± 16.75	68 (48/107)	0.053
Height (cm)	158.89 ± 7.67	153.44 ± 7.87*	153.73 (139.3/170.65)	164.35 ± 7.26*	164.05 (149.58/178.3)	0.001**
WC (cm)	93.31 ± 11.63	91.89± 12.15	91.6 (71/119)	94.95 ± 11.09	94 (79.5/119.5)	0.407
BC (cm)	28.18 ± 4.34	28.00 ± 4.38	27.25 (21.50/35.50)	28.37 ± 4.20	27.00 (22.50/38.00)	0.786
CC (cm)	34.30 ± 5.46	33.09 ± 4.74	32.50 (24.60/43.50)	35.49 ± 6.05	34.50 (27.00/55.00)	0.158
TLC* (cels/mm^3)	1379.87 ± 515.12	1232.52 ± 426.26	1258 (205/2100)	1521.63 ± 562.78	1564 (396/2472)	0.073
Hct (%)*	36.04 ± 6.81	33.45 ± 6.32	35.80 (16.60/39.90)	38.64 ± 7.10	39.70 (21.30/48.00)	0.008**
Hb (g/dl)*	11.56 ± 2.33	10.75 ± 2.16	11.60 (5.50/13.00)	12.57 ± 2.42	12.60 (6.90/15.70)	0.011**
BMI (kg/m^2)	25.18 ± 6,35	24.80 ± 6.00	23.37 (15.46/37.30)	25.61 ± 6.85	23.38 (17.62/47.98)	0.734
MNA	19.53 ± 4.44	18.97 ± 4.28	20.00 (13.00/26.00)	20.10 ± 4.59	20.00 (11.50/28.50)	0.421

SD: standard deviation; BMI - body mass index; WC – waist circumference; BC - brachial circumference; CC – calf circumference; TLC: total lymphocyte count; Hct: hematocrit; Hb: hemoglobin. MNA: Mini-Nutritional Assessment; SGA: subjective global assessment; * n = (40) and **$p < 0.05$ (Mann-Whitney test). Obs: One patient had no biochemical tests in their medical records.

Men showed significantly higher hematocrit and hemoglobin mean values, as compared to women. However, the other variables evaluated in the study did not differ as to sex (Table 1). According to WC, 70.7 % (n=29) of the elderly showed risk of cardiovascular diseases, which according to sex corresponded to 46.3% (n=19) of women and 24.4% (n=10) of men. The risk of cardiovascular disease was 5.70 times greater for women (p=0.04). Table 2 shows the percentage of elderly patients classified with adequate nutritional status and with inadequate nutritional status, according to anthropometric, biochemical and subjective methods per sex. Females showed higher percentages of inadequate nutritional status according to MNA, BMI and TLC. On the other hand, there was a higher percentage of male patients with inadequate nutritional status according to the assessment by BC and MNA.

Table 2. Percentage of elderly classified with adequate nutritional status and inadequate nutritional status, according to the anthropometric and biochemical indicators and the subjective method used for nutritional assessment, by gender. Viçosa-MG, 2007.

Variables	Total % (n)		Female % (n)		Male % (n)	
	ANS	INS	ANS	INS	ANS	INS
BC (cm)	33.61	65.39	40.91 (9)	59.09 (13)	26.32 (5)	73.68 (14)
CC (cm)	71.65	32.85	59.10 (13)	49.90 (9)	84.21 (16)	15.79 (3)
TLC* (cels/mm^3)	37.61	2.39	22.72 (5)	77.28 (16)	52.63 (10)	47.37 (9)
Hct (%)*	50.95	9.05	54.54 (12)	45.46 (9)	47.37 (9)	52.63 (10)
Hb(g/dl)*	36.60	63.40	36.36 (8)	63.64 (13)	36.84 (7)	63.16 (12)
MNA	19.62	0.38	18.18 (4)	81.82 (18)	21.05 (4)	78.95 (15)
BMI (kg/m^2)	29.43	0.57	27.27 (6)	72.73 (16)	31.58 (6)	68.42 (13)

BMI: body mass index; BC: brachial circumference; CC: calf circumference; TLC: total lymphocyte count; Hct: hematocrit; Hb: hemoglobin. MNA: Mini-Nutritional Assessment SGA: Subjective Global Assessment; ANS: adequate nutritional status; INS: inadequate nutritional status. * n= (40).

Comparing the classification of the nutritional status obtained by MNA and BMI, it was found that 80.48% and 70.73% of the elderly were classified with inadequate nutritional status, respectively (Table 2). The results indicate that MNA and BMI were effective at identifying a large percentage of patients with inadequate nutritional status, hence demonstrating a higher sensitivity to identifying inadequate nutritional status of the elderly.

There was a strong positive correlation between the scores of MNA and BMI ($r=0.69$; $p<0.0001$); MNA and CC ($r=0.73$; $p<0.0001$); MNA and BC ($r=0.90$; $p<0.0001$); BMI and CC ($r=0.85$; $p<0.0001$); BMI and BC ($r=0.90$; $p<0.0001$). On the other hand, according to Kappa analysis, there was a moderate agreement only between MNA x BMI (kappa=0.41; CI95%=-0.03-0.58) and MNA and BC (kappa=0.41; CI95%=-0,03-0.58).

Discussion

Hospitalized elderly usually have a higher risk of malnutrition,[3] which is indicative of the need for early nutritional assessment in this group. Therefore, the use of a tool capable of quickly identifying patients with inadequate nutritional status is very important. It has been shown that low body weight increases the risk of morbidity-mortality, reduces functional independence and quality of life, as well as extends the patient's stay in hospital and increase health care costs.[3]

Age did not differ between males and females; however, it is noteworthy that the average age found (71.61 ± 9.70 years) should be considered (Table 1) in the nutritional assessment of the study patients. The literature reports a higher death rate in individuals aged 70 or more, regardless of sex, with the highest proportion in hospitalized elderly when compared to those living in households and institutionalized patients.[17,18]

There was no significant difference for mean BMI between males and females. However, higher percentages of inadequate nutritional status were found in the elderly (72.7% of females and 68.4% of males) (Table 1). Nascimento et al.[19] found a significant difference between sexes, and a higher prevalence of underweight among elderly males (18.2%) than females in the same age group (9%). Furthermore, there was a higher prevalence of overweight among women (54.5%) compared to men (29.6%). It should be noted that in the latter study,[19] the elderly were not in a hospital as in the present study, and the sample size was different, which may partly explain the difference between the results.

Although BMI is an important method for classification of nutritional status, it does not reflect the regional distribution of body fat or changes in body fat distribution that occurs with aging. The identification of the type of body fat distribution is important, since the accumulation of fat in the abdominal region is closely related to metabolic changes, which may favor the occurrence of cardiovascular diseases and diabetes mellitus.[4]

Currently, one of the most common anthropometric indicators for abdominal obesity is waist circumference, whose values can be associated with the risk of developing cardiovascular diseases. Considering all patients evaluated, 70.3% showed risk of developing cardiovascular diseases. This risk was significantly higher (p=0.04) for females (n=19) compared to males (n=10). A similar result was found by Santos & Sichieri[20] when body fat distribution in women of different age groups was evaluated by computed tomography. The authors found that aging promotes physiological changes that affect abdominal adiposity, mainly in females. After menopause, reduced estrogen levels and increased androgenic activity lead to body fat redistribution, with higher concentration in the abdominal region, and lower concentration in the gluteal-femoral region. This body fat redistribution is associated with the increased visceral adipose tissue and reduced subcutaneous adipose tissue in the central region of the body, which increases the risk of cardiovascular disease.[20]

BC is another method for nutritional status assessment of the elderly, which can be used in substitution to BMI or be used as an additional measure because of its good correlation with BMI.[20] This method was able to predict inadequate nutritional status in 59.09% of females and 73.68% of males (p>0.05) (Table 1). A similar result was found by Menezes & Marucci,[21] in which BC measurement showed high ability to identify older men with inadequate nutritional status. This result may be related to the higher content of subcutaneous fat in women, which represents an important source of energy for them, contributing to greater BC.

CC has been indicated as a more sensitive indicator of fat free mass loss in the elderly.[22] Tsai et al.[23] evaluated 497 elderly from Taiwan through different methods. Two of these methods were the original MNA and its simplified version, in which BMI was replaced by CC to verify if this measurement could be an acceptable alternative for those who do not know their current weight. In this study, 18.5% of the subjects aged 65 years or older did not know their current weight or if there had been any change in previous months. The authors found that the use of the simplified MNA (with CC) allowed the identification of 93% of the elderly under nutritional risk, while in the original version, only 68.6% were classified as such. Therefore, it was suggested that CC may be an alternative method to replace BMI in MNA.

There was no significant difference in the classification of nutritional status by CC between sexes (Table 1). This method showed lower percentages of inadequate nutritional status (49.90% for females and 15.79% for males) when compared to BC.

According to the total lymphocyte count (TLC), 62.5 % of the elderly showed inadequate nutritional status. This value was higher than the one found (26.8%) in another study which involved the participation of 46 non-hospitalized elderly, assisted by a municipal program for elderly care.[24] This result is likely to be due to the fact that the participants in the present study were hospitalized elderly, thus favoring inadequate nutritional status (malnutrition). However, Kuzuya et al.[7] found that TLC was not an appropriate indicator to assess malnutrition in the elderly, as this variable was not correlated with anthropometric measurements, biochemical markers or MNA. However, it must be noted that the participants of this study presented co-morbidities that could have affected the result.

TLC has been considered a useful indicator for nutritional status assessment. Its values are progressively reduced as the nutritional status worsens, correlating with morbi-mortality in hospitalized patients.[25] However, although it is an easily achieved indicator of nutritional status, there is still little evidence that its low concentrations reflect malnutrition in the elderly.

The erythrogram components evaluated in this study indicated that 47.5% of the elderly were considered to have inadequate nutritional status by their hematocrit values, and 62.5% by their hemoglobin values. A similar result was found in a study involving hospitalized elderly with decompensated heart failure, also using hemoglobin values[26] as an assessment parameter. However, lower values, 30.4% for hematocrit and 32.6% for hemoglobin, were found in another study,[24] which can be explained by the fact that these patients participated in a municipal program for elderly care and received ambulatory assistance and home care.

The interpretation of these variables requires attention, and although they are able to identify nutrition problems in early stages, the values found for these biochemical tests may be influenced by the presence of diseases, stress and use of drugs, which are conditions usually observed in hospitalized elderly.[4] The findings showed a worse nutritional and immunological status in elderly women and subclinical deficiencies in this group. However, it must be emphasized that the biochemical tests should be interpreted in association with patients' anthropometric and clinical data. This form of assessment provides a more accurate diagnosis and enables early nutrition interventions to prevent energy-protein malnutrition.

MNA presents 96% of sensitivity and 98% of specificity for malnutrition identification.[27] MNA is a useful tool, as it is able to detect risk of malnutrition in elderly people, allowing the adoption of a quick intervention to prevent further worsening of their health condition, even before the occurrence of clinical and anthropometric changes (WC, BC, CC). Its use in nutritional status assessment of the elderly is recommended by both the European Society of Parenteral and Enteral Nutrition, and the French program *Programme National Nutrition Santé*.[27,28]

In the present study, 80.48% of the elderly evaluated were diagnosed with inadequate nutritional status by MNA (Table 2). This result was higher than the one found by Kuzuya et al.[29] (77.9 %) among Japanese elderly when underweight and overweight people were grouped as inadequate nutritional status for comparison. However, it was lower than the percentage found by Izaola et al.[30] (97.8%) in cancer patients, who are a group under higher malnutrition risk. Panissa & Vanisson found that 21 of the individuals (41%) presented malnutrition.[31]

There was a strong positive correlation between the scores of MNA and BMI, MNA and CC; MNA and BC; BMI and CC; BMI and BC. Soini et al.[32] found a strong correlation between MNA score and anthropometric variables (BMI and CC). Bonnefoy et al.[6] found better correlations between CC and BMI ($r=0.706$ and $p<0.001$), CC and albumin ($r=0.219$ and $p<0.001$) in 911 hospitalized elderly. Langkamp-Henken[33] found a positive correlation between the scores of MNA and BMI, CC, hemoglobin and hematocrit.

On the other hand, by using kappa analysis, there was a moderate agreement only between MNA and BMI, (kappa=0.41; CI95%=-0.03-0.58) and MNA and CB (kappa=0.41; CI95%=-0.03-0.58). This is probably due to the fact that the correlation coefficient is a type of analysis that shows associations between variables, which is sensitive to the magnitude and the variability between individuals, and it may overestimate the association.

It must be highlighted that the variation in the values found in the studies can be attributed to differences in the study population: institutionalized, hospitalized or not; ethnical differences; occurrence of diseases; type of pharmacological treatment in use; length of hospital stay; and sample size of the study. Another aspect concerns the difference in the forms of nutritional status classification reported in scientific papers, which makes it difficult to compare the findings among studies.

In addition, it must be pointed out that there was a higher occurrence of diseases, although non-significant ($p>0.05$), in the group of patients classified with inadequate nutritional status. This result indicates the clinical relevance of performing early health screening of the elderly patients, since low weight may favor increased susceptibility to infections and morbidity in the elderly population. On the other hand, the occurrence of overweight may be related to higher risk of cardiovascular diseases, mainly in association with higher prevalence of metabolic, hormonal, inflammatory and hemodynamic disorders.

However, the main limitation of this study is sample size, which may not have been sufficient to demonstrate statistical differences between the methods used to assess nutritional status of patients. Therefore, further studies should be conducted to confirm or refute these results.

In addition, patients that were excluded because of physical disability, bedridden and those who had difficulty answering the MNA and did not have a caregiver or guardian who could help them should be considered in further studies on nutritional assessment. It is suggested that more appropriate methods and indicators should be used in this group, since these patients may show even more precarious nutritional status that needs to be taken into account at hospital admission.

Conclusion

The results suggest that MNA, BMI and CB were the most suitable methods for nutritional screening of elderly hospitalized patients. Despite the strong correlation between most methods, there was only a weak to moderate agreement between them.

It should be mentioned that although there are several tools for nutritional assessment, none of them is completely satisfactory, which requires the use of several of these tools for an appropriate evaluation. Therefore, further studies should be conducted to establish methods for assessing nutritional status, favoring a reduction in morbidity and mortality and the cost of geriatric medical care, and also contributing the rapid recovery of patients, reducing the length of their stay in hospital.

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