World Academy of Science, Engineering and Technology
International Journal of Nutrition and Food Engineering
Vol:8, No:7, 2014

The Coexistence of Dual Form of Malnutrition among Portuguese Institutionalized Elderly People

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***Abstract*—**In the present study we evaluated the nutritional status of 214 institutionalized elderly residents of both genders, aged 65 years and older of 11 care homes located in the district of Viseu (center of Portugal). The evaluation was based on anthropometric measurements and the Mini Nutritional Assessment (MNA) score.

The mean age of the subjects was 82.3 ± 6.1 years-old. Most of the elderly residents were female (72.0%). The majority had 4 years of formal education (51.9%) and was widowed (74.3%) or married (14.0%).

Men presented a mean age of 81.2±8.5 years-old, weight 69.3±14.5 kg and BMI 25.33±6.5 kg/m^2. In women, the mean age was 84.5±8.2 years-old, weight 61.2±14.7 kg and BMI 27.43±5.6 kg/m^2.

The evaluation of the nutritional status using the MNA score showed that 24.0% of the residents show a risk of undernutrition and 76.0% of them were well nourished.

There was a high prevalence of obese (24.8%) and overweight residents (33.2%) according to the BMI. 7.5% were considered underweight.

We also found that according to their waist circumference measurements 88.3% of the residents were at risk for cardiovascular disease (CVD) and 64.0% of them presented very high risk for CVD (WC≥88 cm for women and WC ≥102 cm for men).

The present study revealed the coexistence of a dual form of malnutrition (undernourished and overweight) among the institutionalized Portuguese concomitantly with an excess of abdominal adiposity. The high prevalence of residents at high risk for CVD should not be overlooked.

Given the vulnerability of the group of institutionalized elderly, our study highlights the importance of the classification of nutritional status based on both instruments: the BMI and the MNA.

***Keywords*—**Nutritional status, MNA, BMI, elderly.

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I. Introduction

PORTUGAL, like the other western European countries, is facing the phenomenon of an aging population.

Significant changes have been described in the Portuguese population pyramid with an increase in life expectancy, falling fertility and mortality rates and a reduced population growth [1], [2]. In fact, 18.4% of the Portuguese people are aged 65 and older [3] and 27.2% of this elderly population can be considered functionally dependent. These indicators are considerably different between the various regions of the country. Central Portugal, which includes the district of Viseu, presents one of the highest ageing indexes in the country (163.4%) [3].

The increasingly older population, alongside the growing changes in family structure and society dynamics, with a growing insertion of women in the work market, can help explaining why many families choose to institutionalize their elderly. However, this institutionalization imposes changes in the daily routine of these individuals, including their feeding habits. This can lead to an increased fragility of their health, as they tend to be less accepting of the food they are served, with the consequent compromise of their nutritional status. In Portugal, at least 10% of the population over 65 years of age is institutionalized [3].

Malnutrition is an overall term used for different deviations from the normal nutritional status. As such it can refer to subjects who are either over or undernourished. Undernutrition is the state produced by an insufficient intake in macronutrients and/or micronutrients: protein-energy malnutrition or vitamin and mineral deficiency [4]. However, the causes of poor nutritional status in older people are complex, and may be a result of poor dietary intake or a secondary consequence of acute or chronic disease.

Malnutrition in older patients is frequently underdiagnosed [5] and many physicians have expressed their need for more education regarding nutritional status in older patients [6]. For example, health practitioners may not readily recognize weight loss in the elderly as a morbid symptom of malnutrition because it may be associated with age-related reductions in muscle mass [7]. Similarly, elderly patients with concurrent obesity often have protein deficiencies that may be overlooked.

The effects of malnutrition are especially dramatic among the institutionalized elderly people, who tend to be the most fragile [8]. Available data from published studies shows values ranging from 24% to 74% for the prevalence of malnutrition in this population [9]. Malnutrition affects the

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function of organs and systems, leading to an impaired immune response and to a decrease in muscle mass and muscle strength promoting disability [10], [11]. Therefore, prevention and treatment of malnutrition is an important focus of clinical nutrition. An early and accurate diagnosis of malnutrition is essential in order to initiate nutritional therapy as soon as possible which contributes for a better quality of life in the elderly, while also allowing for a potential reduction of associated treatment and health care costs.

The evaluation of nutritional conditions in the elderly population requires the use of easy, precise and fast methods. Anthropometric measurements are generally considered as the most easily obtainable and non-invasive method by which to assess nutritional state [12]. The Mini Nutritional Assessment (MNA) test, that attributes scores based on dietetic, anthropometric, subjective and global assessments, congregates those advantages and has been validated for use in geriatric patients [13], [14].

Considering the influence and importance of the nutritional status in the health of older people, especially those who are institutionalized, the main purpose of this study is to evaluate the risk of malnutrition in institutionalized elderly residents of care homes located in the district of Viseu (center of Portugal).

II. Experimental Procedure

A. Subjects

The present study was performed in the district of Viseu (center of Portugal) and assessed the nutritional status of 214 residents (60 men and 154 women) of 15 long-term care institutions with similar characteristics, with ages ranging from 65 to 95.

Inclusion criteria adopted were elderly residents of care homes located in the district of Viseu, aged 65 and older, able to walk (with or without the use of a walking aid) and that voluntarily accept to collaborate with the study.

The exclusion criteria used was the presence of a high degree of functional dependence which confines the individual to bed and dementia.

B. Study Design

Sociodemographic characteristics, anthropometric measurements and MNA were assessed in all the participants in an observational study, between September 2012 and June 2013.

C. Nutritional Questionnaire

The MNA is composed of 18 questions divided in the following parts: 1-Anthropometric measurements (weight, height and weight loss); 2-Global assessment (six questions related to lifestyle, medication and mobility); 3-Dietary questionnaire (eight questions, related to number of meals, food and fluid intake and autonomy of feeding); 4-Subjective assessment (self-perception of health and nutrition).

The MNA score was calculated as the sum of the points assigned to the answers given to the 18 items. A person was considered well-nourished with a score >24, at a risk for malnutrition with a score from 17 to 23.5 and malnourished with a score <17 [15].

D. Anthropometric Measurements

The anthropometric measurements taken included: weight, height, body mass index (BMI), and mid-arm (MAC), calf (CC), hip (HP) and waist (WC) circumferences.

Body mass index (BMI) was calculated as weight/height^2. Residents were weighed with a digital chair scale (OMRON®, BF500) to the nearest 0.1 kg. Height was measured with a measuring rod to the nearest 0.1 cm with the resident standing up without shoes. When patients were unable to stand or had either deformations of the spinal column or osteoporosis, knee height was measured to the nearest 0.1cm and height calculated according to Chumlea et al. [16]. The BMI was classified according to the World Health Organization [17] criteria (BMI for women: underweight ≤21.9, normal ≥22.0 ≤27.0, overweight ≥27.1 ≤32.0 and obese ≥32.1; BMI for men: underweight ≤21.9, normal ≥22.0 ≤27.0, overweight ≥27.1 ≤30.0 and obese ≥30.1).

The waist circumference (WC) was taken as the plane between the umbilical scar and the inferior rib border. The WC was used to identify individuals with possible health risks based upon threshold values of WC >80 cm for women and WC >94 cm for men for augmented risk and WC ≥88 cm for women and WC ≥102 cm for men for very high risk [18].

Mid-arm circumference (MAC) was measured at the mid-point of the relaxed, non-dominant arm between the tip of the acromion and the olecranon process. Calf circumference (CC) was measured at the widest part of the undressed calf. The measurements of circumferences were taken in triplicate using a non-stretch tape measure calibrated in mm and with an accuracy of 0.1 cm. Both the CC and MAC were utilized for the anthropometric questions in the MNA. A MAC under 21 cm and a CC under 31 cm were considered reduced [19].

E. Ethics

The study was performed in adherence to the principles established in the Declaration of Helsinki. All the participants were able to understand the procedures of the study and gave their written informed consent.

F. Statistical Analysis

The collected data was analyzed using the IBM SPSS Statistics, version 22.0, 2013software.

The analysis of data involved descriptive statistics such as mean, standard deviation and frequencies. The analysis of variance (ANOVA) with Bonferroni post-hoc tests was used to compare the means of the continuous variables according to the MNA and BMI classes and the Chi-square test with Monte-Carlo simulation was used for the categorical variables. Pearson's Correlation Coefficient was used to evaluate correlations. The level of significance was $p<0.05$.

III. Results

Data was recorded on 214 elderly subjects residing in 11 long-term care structures with similar characteristics.

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A. Characterization of Sample by Gender and Age

The sociodemographic characterization of the subjects based on gender, scholarship and civil status is in Table I.

Most of the elderly residents were female (72.0%), but there was no significant difference in MNA scores between genders (p=0.360).

The majority of the subjects had 4 years of formal education (51.9%). Most of them were widowed (74.3%) or married (14.0%).

TABLE I
SOCIODEMOGRAPHIC CHARACTERIZATION OF ELDERLY RESIDENTS ACCORDING TO MNA SCORE

	Total	MNA score		*p-value*
		At risk	Well nourished	
Gender				
Female	72.0 (154)	18.7 (40)	53.3 (114)	0.360
Male	28,0 (60)	5.6 (12)	22.4 (48)	
Scholarship				
Illiterate	36.9 (79)	10.7 (23)	26.2 (56)	
1-4 years	51.9 (111)	10.7 (23)	41.1 (88)	0.429
>4 years	11.2 (24)	2.8 (6)	8.4 (18)	
Civil Status				
Single	11.7 (25)	3.3 (7)	8.4 (18)	
Married	14.0 (30)	4.7 (10)	9.3 (20)	0.387
W/S/D	74.3 (159)	16.4 (35)	57.9 (124)	

W/S/D – Widow/Separated/Divorced. Number of cases between brackets

B. Nutritional Status of Institutionalized Elderly According to MNA Score

The age of the subjects ranged from 65 to 95 years-old. The mean age ±standard deviation was 82.3 ± 6.1 years-old. In males, mean age was 81.2±8.5 years, weight 69.3±14.5 kg and BMI 25.33±6.5. In females, mean age was 84.5±8.2 years, weight 61.2±14.7 kg and BMI 27.43±5.6 (data not shown).

Despite the fact that 52 individuals presented a risk of undernutrition according to the MNA score, their mean BMI was considered normal (26.9Kg/m^2). The mean values of CC and MAC are higher than the reference values and are significantly different according MNA score (Table II).

TABLE II
AGE AND ANTHROPOMETRIC MEASURES ACCORDING TO MNA SCORE

	MNA score		*p-value*
	At risk	Well nourished	
n (%)	52 (24.3)	162 (75.7)	
Age (years)	82.6±6.1	82.3±6.1	0.734
Height (cm)	155.5±6.7	155.3±8.3	0.834
Weight (kg)	65.0±14.4	69.5±13.1	0.035
BMI (Kg/m^2)	26.9±5.8	28.8±4.4	0.037
Calf circumference (cm)	34.5±4.0	35.9±3.8	0.025
Mid-arm circumference (cm)	28.7±3.9	29.0±3.4	0.631
Waist circumference (cm)	96.3±12.5	96.8±10.3	0.692
Hip circumference (cm)	105.6±12.0	106.4±9.2	0.786

BMI-Body Mass Index; Values are mean ± SD. SD – Standard deviation.

According to MNA classification, 24.0% of the residents presented risk of malnutrition, and 76.0% were well nourished (Table II). Malnutrition (MNA score < 17) was not observed among the residents.

According to our investigation, women presented more risk of undernutrition than men (18.7% vs 5.6%), independently of the age considered (data not shown).

Table III shows the correlation analysis performed between MNA scores and anthropometric parameters. No correlations were observed between the anthropometric parameters and MNA scores. Nevertheless, all the correlations between anthropometric parameters are high (values between 0.624 for CC vs HC and 0.836 BMI vs HC, respectively).

The correlation between BMI and WC in the elderly residents was positive and high (Table III and Fig. 1).

TABLE III
CORRELATION BETWEEN ANTHROPOMETRIC MEASURES AND MNA SCORE

	HC	MAC	CC	BMI	MNA
Waist circumference (cm)	0.790	0.734	0.605	0.715	0.129
Hip circumference (cm)		0.763	0.624	0.836	0.129
Mid-arm circumference (cm)			0.654	0.749	0.105
Calf circumference (cm)				0.715	0.221
BMI (Kg/m^2)					0.278

HC-Hip circumference; MAC-Mid-arm circumference; CC-Calf circumference; BMI-Body Mass Index; MNA-Mini Nutritional Assessment score.

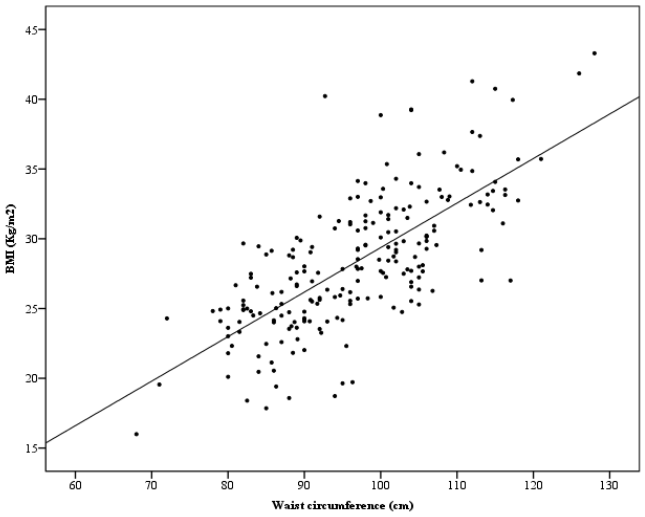


Fig. 1 Scatter plot of BMI according waist circumference (WC) in elderly residents. r - Pearson correlation coefficient.

C. Nutritional Status of Institutionalized Elderly According BMI and Cardiovascular Risk

Table IV shows age, MNA score and anthropometric measures according to the BMI. The prevalence of overweight residents was 33.2% and 24.8% of them presented obesity. The percentage of underweight subjects represented 7.5% (Table IV).

Sarcopenia is characterized by a marked reduction in muscle mass measured by CC and MAC and can lead to loss of strength and a decline in physical function in the elderly. Although we observed a decrease in muscle mass, even the residents presenting low weight have mean values of MAC within the reference values. Only the CC measurements in the underweight group presented values below 31cm that may be associated with disability. However, muscle strength was not

evaluated and thus results must be interpreted cautiously.

TABLE IV
AGE, MNA SCORE AND ANTHROPOMETRIC MEASURES ACCORDING BMI

	BMI				*p-value*
	Underweight	Eutrophy	Overweight	Obesity	
n (%)	16 (7.5)	74 (34.6)	71 (33.2)	53 (24.8)	
Age	84.7±5.5	81.7±6.6	83.2±5.3	81.4±6.3	0.123
MNA	21.8±2.5[a]	25.0±2.0[b]	25.0±2.2[b]	25.6±2.2[b]	0.000
Weight	48.0±4.7[a]	60.1±6.4[b]	69.3±7.7[c]	85.1±9.8[d]	0,000
Height	156.1±6.9	155.3±7.5	154.0±8.3	156.9±8.2	0.259
WC	84.6±7.6[a]	89.8±7.5[a]	98.0±7.5[b]	108.3±7.8[c]	0.000
HC	93.2±6.2[a]	99.8±5.0[b]	107.1±5.8[c]	117.8±8.1[d]	0.000
MAC	25.0±2.8[a]	27.0±2.1[b]	29.1±2.5[c]	32.6±3.0[d]	0.000
CC	30.4±2.3[a]	33.6±2.5[b]	35.6±2.8[c]	39.7±3.0[d]	0.000

BMI-Body Mass Index; MNA-Mini Nutritional Assessment score; WC-Waist circumference; HC-Hip circumference; MAC-Mid-arm circumference; CC-Calf circumference. Values are mean ± SD. SD – Standard deviation.

Waist circumference was used to identify individuals at a possible health risk, mainly of cardiovascular disease (CVD). We found that 64% of the residents presented a waist circumference considered of very high risk (≥88 cm, women and ≥102 cm, men) for CVD and24.3% of the residents have augmented risk for CVD. Only 11.7% of the residents presented a WC not associated with increased CVD risk (Fig. 2). When we consider WC separately by gender we found that while there is a higher percentage of male subjects whose WC is compatible with an increased risk for CVD (30.0% vs 22.1%), women presented a higher percentage of subjects whose WC is considered of very high risk for CVD (70.8% vs 46.7%) (data not shown).

The distributions of CVD risk among the different nutritional status according to the BMI are shown in Fig. 2.

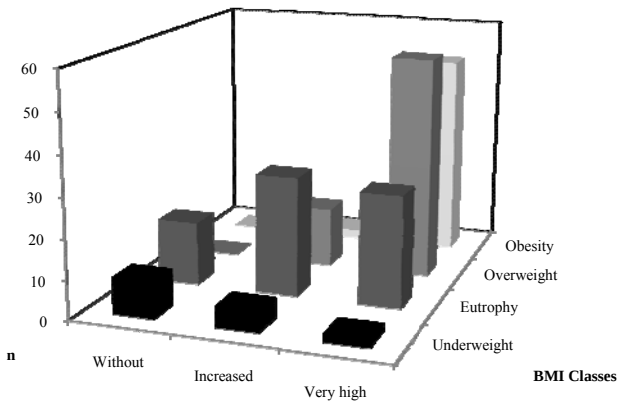


Fig. 2 Cardiovascular risk according to nutritional status evaluated by BMI

IV. CONCLUSION

The present study revealed the coexistence of a dual form of malnutrition among the Portuguese institutionalized elderly, consisting of a high prevalence of overweight (33.3%) and obesity (24.8%) according to the BMI and a risk of malnutrition (24.0%) according to the MNA. This was verified concomitantly with an excess of abdominal adiposity measured by WC.

Excessive BMI and high abdominal fat are highly and positively correlated and have an important impact in the risk of cardiovascular disease. Moreover they are often associated with the occurrence of dyslipidaemia, hypertension, insulin resistance and diabetes, especially among the elderly. Therefore, the high prevalence of residents at a high risk of CVD should not be overlooked.

Given the vulnerability of the group of institutionalized elderly our study highlights the importance of the classification of nutritional status based on both the BMI and the MNA.

Despite the fact that the majority of Portuguese elderly resident in care homes located in the district of Viseu have shown a good nutritional state, the number of people at risk of malnutrition (undernutrition and obesity) remains important, due to the number of co-morbidities they usually present. An earlier diagnosis using both anthropometry and MNA score will allow for the implementation of adequate measures in order to prevent or correct the situation and thus ameliorate the nutritional state of elderly institutionalized patients and prevent the health risks frequently associated with malnutrition, while also allowing for a potential reduction of associated treatment and health care costs.

ACKNOWLEDGMENT

The authors thank the Polytechnic Institute of Viseu research center Centre for the Study of Education, Technologies and Health (CI&DETS).

M. J. Reis Lima thanks FCT for financial support through project PEst-OE/CED/UI4016/2014.

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