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MID UPPER ARM CIRCUMFERENCE AS A PREDICTOR OF MALNUTRITION IN OLDER ADULTS AND ITS RELATION TO MALNUTRITION SCREENING AND ASSESSMENT TOOLS

M. Mascarenhas de Menezes Costenla[1], C.A. da Cunha Santos[1], J. Celso Dias Correia da Fonseca[1]

Abstract: *Background:* Undernutrition is associated to worse clinical outcome. Malnutrition screening and assessment tools are recommended, but only use the BMI as an anthropometric reference. *Objectives:* To evaluate the prevalence of undernutrition and nutritional risk amongst hospitalized patients and to compare the mid upper arm circumference with nutritional screening and assessment tools. *Patients and methods:* 199 patients were admitted to our hospital between October and December 2010. Weight, height, age, sex, mid upper arm circumference and cause of hospital admission were collected. The NRS-2002 was applied to all patients. When at risk, the MNA-SF was used in patients above 65 years old and PG-SGA was applied to cancer patients. *Results:* 199 patients were evaluated, 53,2% with heart and lung diseases. NRS - 2002 scored ≥3 was 61,8%, from which 71,5% MUAC <15th P, 28,5% had a MUAC over the 15th P (n=35) and 47 patients (61,8%) with no risk had MUAC < 15th P. 33 (58.9%) patients considered malnourished by the MNA-SF had a MUAC < 15th P. MNA-SF results are consistent with NRS-2002. *Conclusion:* The use of NRS-2002 revealed a high rate of malnourished patients. The difficulty of use of the BMI in bedridden patients gave MUAC especial relevance and revealed to be more useful to identify older patients at nutritional risk.

Key words: MUAC, NRS-2002, malnutrition assessment, geriatrics.

Introduction

Disease related undernutrition was defined by the Council of Europe in 2003 as a state of insufficient ingestion or absorption of energy and nutrients due to individual or systemic factors that result in recent and rapid weight loss along with functional changes all associated to a worse clinical outcome (1). The European Society for Clinical Nutrition and Metabolism (ESPEN) defined undernutrition as a combination of cachexia, weight loss, decrease in fat and muscle mass and increase in protein catabolism associated to disease, with inadequate ingestion of nutrients (2). The concept of disease related undernutrition forms a complex interaction between metabolic changes and reduced nutrient availability and are well documented in hospitalized patients (2). Undernutrition is associated to worse clinical outcome, higher infection rate (3-6), loss of muscle mass (4, 7, 8), worse tissue cicatrization (4, 9), increase in length of hospital stay (10-12) and increase in morbidity and mortality (10, 11, 13-15). It is crucial to identify and monitor those patients using viable and validated screening tools (16). The ESPEN recommends the use of protocols such as the Malnutrition Universal Screening Tool (MUST) for the community, the Nutritional Risk Screening 2002 (NRS-2002) for hospitalized patients and the Mini Nutritional Assessment (MNA) for the geriatric population (16). The Patient-generated Subjective Global Assessment (PG-SGA) adapted from the Subjective Global Assessment (SGA) and recommended by the American Society for Parenteral and Enteral Nutrition (ASPEN) (16) was validated for oncology patients (17).

The objectives of this study were:

a) To evaluate the prevalence of undernutrition and nutritional risk amongst 199 hospitalized patients;
b) To compare the mid upper arm circumference with nutritional screening and assessment tools.

1. Hospital Garcia de Orta, Gene - Grupo de Estudo de Nutrição Entérica, Piso 3 – Bloco de exames especiais, Hospital Garcia de Orta, EPE, 2801-951 Almada, Portugal

Corresponding Author: Mariana Mascarenhas de Menezes Costenla, Hospital Garcia de Orta, Gene - Grupo de Estudo de Nutrição Entérica, Piso 3 – Bloco de exames especiais, Hospital Garcia de Orta, EPE, Av. Torrado da Silva, Pragal, 2801-951 Almada, Portugal. Phone: 00351 912273307, Email: marianacostenla@gmail.com

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Methods

Patients

An observational and transversal study was applied to 199 patients admitted to a large hospital (600 beds) of Lisbon area between October and December 2010. Patients were admitted to the medicine, oncology and endocrinology units and chosen by a matter of convenience. Patients were considered eligible for the study if (1) they gave informed consent, (2) they were able to understand and answer questions and (3) it was possible to gather the anthropometric measures needed.

Patients with hospital stay less than 24 h were excluded.

Data collection

Anthropometric measures and screening and assessment tools were evaluated. Weight, height, age, sex, mid upper arm circumference (MUAC) and cause of hospital admission were collected. Causes of admission were grouped according to Table 1.

Table 1
Causes of hospital admission

Heart disease	Lung disease
Digestive, liver and pancreas	Kidney and urinary disease
Metabolism and endocrine disease	Blood cancer
Head and neck cancer	Gastrointestinal cancer
Other diseases	Other cancer

All data was collected by the same observer following standard procedures for anthropometric measures (18).

The NRS-2002 was applied to all patients. Mini Nutritional Assessment short form (MNA-SF) was only applied to patients above 65 years old (except 2 for not being able to provide the information needed) that were classified as at risk by the NRS-2002 and the PG-SGA to cancer patients also when classified as at risk by the NRS-2002.

Mid upper arm circumference (MUAC)

MUAC is an anthropometric measure that represents the arm's bone, muscle and fat masses characterizing the patients' nutritional status and is very useful in the presence of ascites or edema (19). It was measured in the non-dominant arm. All values were grouped in percentiles according to reference values of the National Health and Nutrition Examination Survey (NHANES 2003-2006) (20).

Nutritional Risk Screening 2002 (NRS-2002)

NRS-2002 is a screening tool aiming to detect the risk of developing and the presence of undernutrition in hospitalized patients through the BMI, recent weight loss, food ingestion decay and the severity of the disease. Patients were considered at risk for scores ≥ than 3 (21).

Mini Nutritional Assessment - short form (MNA-SF)

MNA-SF is a screening and assessment tool for the prevalence of malnutrition validated for the geriatric population (22). It uses anthropometric data and physical, mental and environmental factors. It has been demonstrated its relation to length of hospital stay, cost of hospital stay and mortality (23, 24).

The short form is an easier way to detect the presence of undernutrition (25). Results below 7 indicate the prevalence of undernutrition, between 8 and 11 indicates the risk of malnutrition and results between 12 and 14 indicate the patient is well nourished (26).

Patient-generated Subjective Global Assessment (PG-SGA)

PG-SGA is a nutritional assessment tool, adapted from the SGA, developed in 1994 by Ottery (17). The American Dietetic Association (ADA) considered it standard in nutritional screening for patients with cancer (27). It includes additional questions regarding the presence of nutritional symptoms and short-term weight loss. To each parameter a score is given, giving the final score 3 categories, SGA A meaning well-nourished, SGA B, moderately malnourished and SGA C, severely malnourished (27).

Statistical analysis

To describe the sample's characteristics, frequencies, means and standard deviation (s.d.) were calculated. MUAC was transformed in percentiles (< P15, P15-P85 and > P85) to facilitate the comparison with screening and assessment tools.

The Chi-square test was used to compare MUAC with NRS-2002. To compare MUAC with MNA-SF and PG-SGA, Mann-Whitney U and Kruskall Wallis H non parametric tests were used respectively. Results were considered significant when $p < 0.05$. Measures of diagnostic performance (sensitivity, specificity, positive and negative predictive values) were calculated for the NRS-2002 and MNA-SF. In order to estimate sensitivity and specificity it was necessary to consider the percentiles of MUAC as <15th P and >15th P. These not calculated

for the PG-SGA because of the small samples' number.

All statistical analysis was performed with Statistical Package for Social Sciences for Windows, version 18.0 (SPSS Inc., Chicago, IL, USA).

Results

Sample's characteristics

199 patients were evaluated, 84 (42,2%) female, with an average age of 70,3±14,6 years. Heart and lung diseases were responsible for most of the hospitalization, 53,2% from total diseases (Table 2).

Table 2
Samples' characteristics'*, by gender

		Male	Female	Total
Age	mean ± sd	70,5 ± 14,2	69,9 ± 15,1	70,3 ± 14,6
MUAC	mean ± sd	27,6 ± 4,9	29,0 ± 4,5	28,2 ± 4,8
MUAC, n (%)	< P_{15}	89 (77,4)	46 (54,8)	135 (67,8)
	P_{15}-P_{85}	19 (16,5)	32 (38,1)	51 (25,6)
	> P_{85}	7 (6,1)	6 (7,1)	13 (6,6)
Patient's distribution by units, n (%)				
	Medicine I	42 (36,5)	32 (38,1)	74 (37,2)
	Medicine II	55 (47,8)	32 (38,1)	87 (43,7)
	Endocrinology	12 (10,4)	12 (14,3)	24 (12,1)
	Oncology	6 (5,2)	8 (9,5)	14 (7,0)

*n=199 (115 men, 84 women)

NRS-2002

NRS-2002 was applied to all patients (n=199). The prevalence of nutritional risk (score ≥3) was 61,8% (123 patients).

MUAC

MUAC was measured in all patients. 135 patients (67,8%) had MUAC values below the 15th percentile (<15th P), 51 (25,6%) stood between the 15th and 85th percentiles (15th P- 85th P) and only 13 (6,6%) had values above the 85th percentile (>85th P) (Table 2).

MUAC values were compared to NRS-2002 results from which 88 (71,5%) patients considered nutritionally at risk had MUAC below the 15th percentile. From all patients with a MUAC over the 15th P (n=64), 35 (54,6%) were nutritionally at risk by the NRS-2002. From all the patients with no nutritional risk, according to the NRS-2002, 47 (61,8%) had MUAC < 15th P (Table 3). Although patients are distributed along all MUAC percentiles, that difference has no statistical meaning (p=0,309). The NRS-2002 has a sensitivity of 65,2% but a specificity of 45,3%. Positive predictive values (VP+) and negative predictive values (VP-) were, respectively, 71,5% and 61,8%.

Table 3
MUAC according to NRS- 2002

	NRS-2002, n (%)		p*
	No nutritional risk	Nutritionally at risk	
<15th P (n=135)	47 (61,8)	88 (71,5)	
15th -85th P (n=51)	24 (31,6)	27 (22,0)	0,309
>85th P (n=13)	5 (6,6)	8	(6,5)

*Chi-square test;

MNA-SF

MNA-SF was applied to 104 elderly patients considered nutritionally at risk by the NRS-2002. According to MNA-SF, 48 (47,5%) were at risk of malnutrition and 56 (52,4%) were malnourished. No patient considered nutritionally at risk by the NRS-2002 was classified well-nourished by the MNA-SF. When we relate both MNA-SF and MUAC, 33 (58.9%) patients considered malnourished had a MUAC < 15th P, 20 (35,7%) had a MUAC between 15th P – 85th P and 3 (5,4%) had a MUAC >85th P (Table 4). Although this relation is not significant (p=0,067, malnourished vs. nutritional risk) it shows a statistical tendency. MNA-SF offers a sensitivity of 53,5%, a specificity of 69,7% and VP+ and VP- of, respectively, 79,1% and 41,1%.

PG-SGA

PG-SGA was applied to all oncology patients. 17 were considered nutritionally at risk by the NRS-2002, from which 9 (52,9%) were well-nourished (SGA-A), 3 (17,6%)

Table 4
MNA-SF and PG-SGA applied to patients identified as nutritionally at risk by NRS-2002 and MUAC

	MNA-SF* (n=104) (1)			PGSGA** (n=17)			
	Mal nourished n, (%)	Nutritional risk n, (%)	p*	A n (%)	B n (%)	C n (%)	p**
< 15th P	33 (58,9)	38 (79,2)		8 (88,9)	3 (100,0)	4 (80,0)	
15th -85th P	20 (35,7)	5 (10,4)	0,067	1 (11,1)	0 (0,0)	1 (20,0)	0,858
> 85th P	3 (5,4)	5 (10,4)		0 (0,0)	0 (0,0)	0 (0,0)	

* Mann-Whitney' U proof; ** Kruskall-Wallis' H proof; (1) Kappa index= 0,196

were moderately malnourished (SGA-B) and 5 (29,4%) were severely malnourished (SGA-C).

According to MUAC values, only 2 patients were above the 15th percentile, 1 considered severely malnourished and 1 considered well-nourished by the PG-SGA (p=0,858) (Table 4).

Discussion

There are several anthropometric and biochemical parameters used to screen and evaluate malnourished patients (28) but they are not usually compared to other screening tools.

In this study the use of NRS-2002 revealed a high rate of malnourished patients. Whilst relating NRS-2002 with MNA-SF, no patients' nutritionally at risk by the NRS-2002 were considered well-nourished by the MNA-SF, verifying the liability of the MNA-SF. But using PG-SGA, some patients nutritionally at risk by the NRS-2002 were considered well-nourished. Nevertheless, there may have been other factors contributing to this result such as a small sample, the main cause of hospitalization may not be cancer related or patients might be already recovering from treatments.

Screening tools used in this study use the BMI as the anthropometric measure to screen nutritional risk. Nevertheless, patients can be under nourished even with a normal BMI and SGA can detect the presence of undernutrition before the BMI gets below 20 kg/m2 (29). For this and also for the difficulty of use of the BMI in bedridden patients other parameters have been suggested to screen malnutrition, such as MUAC. Powell Tuck and Hennessy have related MUAC with BMI and body weight and concluded that MUAC, despite its relation with BMI, predicts better the patient's clinical outcome (30). Although MUAC reflects total body composition and does not distinguish fat form lean mass, unlike BMI it is easy to perform in severely ill patients and can easily become part of the everyday routine with no need of expensive equipment.

Using MUAC to assess the patients nutritional status, most of the patients had a MUAC < 15th P. This was compared with the NRS-2002 results. The number of patients considered malnourished by MUAC percentiles (<15th P) was higher than those considered nutritionally at risk by the NRS-2002. The same happens with those with no nutritional risk by NRS-2002, those with a MUAC < 15th P are in a higher number. NRS-2002 is a sensitive but not a specific test. If by one hand NRS-2002 can identify patients with a MUAC > 15th P and consider them at nutritional risk, MUAC < 15thP itself can trace other patients that by the NRS-2002 would be considered with no nutritional risk. This suggests it would be useful to use both NRS-2002 and MUAC to identify patients at nutritional risk or undernourished.

Regarding the MNA-SF, even patients with a MUAC > 15th P, though less frequent, were considered undernourished or at risk of malnutrition, confirming once more the sensibility of the MNA-SF.

Concerning PG-SGA, our small sample wasn't enough to get to any significant results.

Conclusions

There is still a high undernutrition rate at hospital admission amongst older persons. Several nutritional screening and assessment tools are needed to identify patients who need adequate nutritional support in order to improve their clinical outcome and lower complications and length of hospital stay. The use of MUAC at hospital admission revealed to be an easy and useful anthropometric tool to identify those patients at nutritional risk therefore should be included in nutritional screening in addition to NRS-2002.

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