Original article

Applying various criteria to assess the nutritional status among hospitalised patients aged 65 and over

Joanna Maria Ostrowska, Dorota Szostak Węgierek, Anna Jeznach Steinhagen
Department of Clinical Dietetics, Faculty of Health Sciences, Medical University of Warsaw, Poland - E-mail: jostrowska@wum.edu.pl

Summary. *Introduction:* Malnutrition commonly occurs among hospitalised patients. Should the condition be diagnosed early, it is possible to counteract development of negative effects associated with a weight loss and the systemic consequences of malnutrition. *Objective:* To determine the prevalence of abnormal nutritional status in patients aged 65 and over using various criteria for diagnosis, as well as an analysis of correlations between the criteria that were used. *Material and methods:* The study included 102 patients over the age of 65 years. Basic anthropometric measurements and a body composition analysis were performed. An abnormal nutritional status was diagnosed based on the results of the MNA-SF test, laboratory tests (serum albumin levels, total lymphocyte count - TLC) and the European Society for Clinical Nutrition and Metabolism's (ESPEN) 2015 criteria regarding nutritional status. *Results:* An abnormal nutritional status was found in 75% of the subjects. It was most frequently diagnosed based on the MNA-SF score (66%) and laboratory test results (53%), and most rarely based on a BMI measuring less than 18.5 kg/m^2 (5%). There was no statistically significant correlation between a BMI < 18.5 kg/m^2, the MNA-SF score and laboratory test results. The MNA-SF test score had the strongest correlation with results obtained using the ESPEN criteria which included a reduced fat-free mass index (FFMI) combined with an unexpected loss of body weight. *Conclusions:* Of the analysed criteria used to assess nutritional status, the MNA-SF screening tool and the laboratory test results had the highest sensitivity. In this age group, the ESPEN criteria including FFMI were the most useful, and the criterion based only on a BMI of less than 18.5 kg/m^2 was the least useful.

Key words: nutritional status, MNA-SF test, fat-free mass index (FFMI), laboratory test results

Introduction

Malnutrition among patients admitted to hospitals is usually underdiagnosed and untreated, and causes what is known as hospital malnutrition (1, 2). The condition is considered a separate disease entity, and is therefore is listed in the International Statistical Classification of Diseases and Related Health Problems under the "malnutrition" heading (E40 - E46) (3). Malnourished patients usually develop more common complications, which result in longer hospitalisation, longer recovery periods and even higher mortality compared to patients with a normal nutritional status. As with all diseases, malnutrition should be treated according to valid guidelines, and its early diagnosis should be considered a priority for medical staff (4-6).

The process of diagnosing malnutrition starts with a screening test, performed when patients are admitted to hospital. In Poland, according to the regulation of the Ministry of Health dated 15.09.2011 (amended 22.11.2013), the tools recommended for the routine evaluation of hospitalised patients' nutritional status are the NRS-2002 (Nutritional Risk Score-2002) and the SGA (Subjective Global Assessment) scales (7,8). For elderly patients, an alternative to these scales is the widely used MNA (Mini-Nutritional Assessment) scale. A shorter version of this tool (MNA-Short Form, MNA-SF® Nestlé Nutrition Institute)

(9) contains questions regarding reduced intake of food and loss of body weight during the previous 3 months; ability to move independently; presence of a serious somatic disease or severe psychological stress during the previous 3 months; assessment of cognitive impairment and/or depression; and current Body Mass Index (BMI). A total evaluation of nutritional status should be performed for each patient suspected to be malnourished or at risk of malnutrition. Apart from standard anthropometric measurements, this evaluation should include selected laboratory tests and a body composition analysis by the electrical bioimpedance method (10).

In 2015 the European Society for Clinical Nutrition and Metabolism (ESPEN) convened a group of experts to determine a minimum set of criteria to be used, irrespective of the related disease entity and its aetiology, to diagnose malnutrition, as well as to standardize international terminology. According to ESPEN, patients at risk of malnutrition should be initially identified using validated screening tools. Moreover, it was unanimously concluded that a BMI value below 18.5 kg/m^2 is not sufficient to diagnose malnutrition. However, when the patient's BMI is above this value, it is necessary to use one of two other equivalent methods to diagnose malnutrition. It is necessary to confirm both an unexpected loss of body weight and a low value for either BMI or fat-free mass index (FFMI). Such a loss of body weight is defined as a loss of more than 10% of body weight within an unspecified time frame, or more than 5% within 3 months. A reduced BMI is defined as less than 20 kg/m^2 and less than 22 kg/m^2 for young people and subjects over the age of 70 years, respectively. Meanwhile, a low value of fat-free mass index (FFMI) is defined as less than 15 kg/m^2 and less than 17 kg/m^2 for women and men, respectively (11).

Objective

The research aimed to determine the prevalence of abnormal nutritional status among patients over 65 years of age using various diagnostic criteria. An additional objective was to analyse correlations between the various criteria used to diagnose abnormal nutritional status.

Material and methods

The study included 102 patients (87 women and 15 men) of a geriatric unit in one of Warsaw's hospitals who were over the age of 65 years. The presence of a pacemaker was a criterion for exclusion from the study.

Examination included a short version of the MNA screening test (MNA-SF® Nestlé Nutrition Institute) (9, 12), patients who scored 12 points or greater were classified as subjects with a normal nutritional status; those with a lower score were classified as subjects with an abnormal nutritional status (8-11 points – risk of malnutrition; 0-7 points – malnutrition). In addition, body height was measured with a SECA stadiometer, and an analysis of body composition combined with body mass measurement was performed with a TANITA analyser. Based on the measurements obtained, BMI was calculated as the quotient of body weight in kilograms divided by the square of body height in metres; while fat-free mass index (FFMI) was calculated by dividing the fat-free mass in kilograms by the square of body height in metres. Additionally, laboratory test results for serum albumin levels and total lymphocyte count (TLC) per 1 mm^3 of blood, obtained during the hospitalisation, were used. The results obtained were interpreted on the basis of MNA-SF ® Nestlé Nutrition Institute test criteria (9), laboratory test standards, and the criteria for assessing nutritional status suggested by ESPEN in 2015 (Table 1). All measurements and evaluations were done by the same investigator.

The results were analysed with STATISTICA software, version 13.1. Elements of descriptive statistics were used, such as sample size tables, determination of distribution measures using measures of central tendency (arithmetic mean, median) and measures of variability (standard deviation, minimum, maximum). Moreover, the chi-square test for independence was used with appropriate modifications (corrections) depending on the predicted size samples in study groups (namely Pearson chi-square, chi-square with Yates correction, Fisher's exact test) to analyse correlations between the criteria used to diagnose abnormal nutritional status. A P value < 0.05 was assumed as the level of statistical significance. The C Pearson's contingency coefficient was used to assess the strength of correlations between variables analysed in the chi-square test.

Table 1. Criteria used to diagnose an abnormal nutritional status according to various criteria used.

Interpretation	Abnormal nutritional status
MAIN CRITERIA	
MNA-SF® Nestlé Nutrition Institute (9)	<12 points
ESPEN 1	BMI < 18.5 kg/m^2 or unexpected body weight loss (> 5% within the last 3 months or > 10% within an unspecified time frame) and BMI < 20 kg/m^2 for subjects < 70 yrs BMI < 22 kg/m^2 for subjects > 70 yrs
ESPEN 2	BMI < 18.5 kg/m^2 or unexpected body weight loss (> 5% within the last 3 months or > 10% within an unspecified time frame) and FFMI < 15 kg/m^2 for women FFMI < 17 kg/m^2 for men
Alb and/or TLC	serum albumin < 3.5 g/dL and/or total lymphocyte count (TLC) < 1500/mm^3 of blood
PARTIAL CRITERIA	
ESPEN 1/2a	BMI < 18.5 kg/m^2
ESPEN 1b	unexpected body weight loss (> 5% within the last 3 months or > 10% within an unspecified time frame) and BMI < 20 kg/m^2 for subjects < 70 yrs BMI < 22 kg/m^2 for subjects > 70 yrs
ESPEN 2b	unexpected body weight loss (> 5% within the last 3 months or > 10% within an unspecified time frame) and FFMI < 15 kg/m^2 for women FFMI <17 kg/m^2 for men

Results

The mean age of subjects was approximately 80 years, mean body weight was 69.3 ± 14.5 kg, body height 160.5 ± 7.3 cm, and BMI 26.8 ± 5.06 kg/m^2.

Table 2 presents laboratory test results, and tables 3 and 4 present results of the body composition analysis.

Of the 102 patients studied, 26 (25.5% of all participants) were classified as patients with normal nutritional status according to all accepted criteria. The remaining patients (n=76, 74.5%) were classified as patients with

Table 2 Laboratory test results of patients participating in the study (n=102)

	Mean ± SD	Median	Minimum	Maximum	Percentage of patients below the norm
Serum albumin levels (g/dL)	3.550 ± 0.427	3.600	2.500	4.600	34.3
Total lymphocyte count (TLC/ mm^3 of blood)	1,890.8 ± 1,158.6	1,608.0	697.0	8,000.0	39.2

Table 3 Results of the anthropometric measurements and body composition analysis in women participating in the study (n= 87)

	Mean ± SD	Median	Minimun	Maximum	% of patients – below the norm	% of patients – above the norm
Body weight (kg)	67.45 ± 3.45	68.40	33.40	109.80	-	-
BMI* (kg/m2)	26.69 ± 5.02	26.22	15.25	41.33	29.8	32.2
Fat tissue (%)	32.92 ± 8.90	33.00	15.00	51.00	20.7	41.4
Fat-free mass index (FFMI) (kg/m^2)	3.07 ± 3.07	16.10	8.10	23.40	41.4	-
Body hydration (%)	48.50 ± 6.58	48.20	36.00	65.70	32.2	5.8

** reference values 24–29 kg/m² (11,13)*

Table 4 Results of the anthropometric measurements and body composition analysis in men participating in the study (n= 15)

	Mean ± SD	Median	Minimum	Maximum	% of patients – below the norm	% of patients – above the norm
Body weight (kg)	80.02 ± 6.02	81.30	60.60	96.80	-	-
BMI* (kg/m2)	27.53 ± 4.60	27.80	20.29	33.52	13.3	40.0
Fat tissue (%)	24.59 ± 6.42	23.50	15.70	37.10	0.0	46.7
Fat-free mass index (FFMI) (kg/m^2)	19.48 ± 2.36	55.30	15.11	22.42	20.0	-
Body hydration (%)	55.17 ± 5.53	20.21	44.90	65.70	20.0	6.7

** reference values 24–29 kg/m² (11,13)*

Table 5 Number of patients classified as subjects with an abnormal nutritional status depending on the criteria accepted.

	MNA-SF	ESPEN 1	ESPEN 2	Alb and/or TLC	ESPEN 1/2a	ESPEN 1b	ESPEN 2b
Number of patients (N)	67	17	34	54	5	16	34
Percentage of patients	66%	17%	33%	53%	5%	16%	33%

abnormal nutritional status based mainly on the MNA-SF malnutrition screening test (66%, including 40% of patients with risk of malnutrition and 26% of patients with malnutrition) and laboratory test results (Alb and/or TLC) (53%). However, the fewest patients were identified as malnourished, (5%), by a particular interpretation of ESPEN criteria which included only a body mass index of less than 18.5 kg/m^2 (ESPEN 1/2a) (Table 5).

Table 6 presents the results of a statistical analysis of correlations between the interpretations used to assess the nutritional status of the patients in the study. There was no statistically significant correlation between results of the BMI (ESPEN 1/2a) and the MNA-SF test, nor between BMI (ESPEN 1/2a) and laboratory tests (Alb and/or TLC). In the remaining cases, the studied correlations were statistically significant. The strongest correlation was observed between the ESPEN criteria: ESPEN 2 and ESPEN 2b (contingency coefficient ≈ 0.71), and ESPEN 1 and ESPEN 1b (contingency coefficient ≈ 0.69). Moreover, it was found that results from the MNA-SF test have the strongest predictive value for the results of ESPEN 2 and ESPEN 2b criteria (contingency coefficient ≈ 0.42). The weakest correlation was observed between laboratory test criteria (Alb and/or TLC) and ESPEN 1b (contingency coefficient ≈ 0.24), and between laboratory tests (Alb and/or TLC) and ESPEN 1 (contingency coefficient ≈ 0.25).

Of the 102 patients studied, 76 were classified as having an abnormal nutritional status according to any of the criteria. Taking this number of patients as 100%, 22.4% of the patients were classified with abnormal nutritional status by the MNA-SF test alone (according to which 17.1% patients were at risk of malnutrition, and 5.3% patients were classified as malnourished). A further 10.5% were classified according to laboratory test criteria alone (Alb and /or TLC) , and about 20% according to the MNA-SF test combined with laboratory tests criteria (Alb and/or TLC).

Table 6 Results of a statistical analysis of correlations between criteria used to assess the nutritional status of studied patients.

	Contingency coefficient	*P* value
MNA-SF vs ESPEN 1	0.3075624	< 0.01
MNA-SF vs ESPEN 2	0.4233308	< 0.0001
MNA-SF vs Alb and/or TLC	0.3667788	< 0.0001
MNA-SF vs ESPEN 1/2[a]	0.1619295	Ns
MNA-SF vs ESPEN 1b	0.2976232	< 0.01
MNA-SF vs ESPEN 2b	0.4233308	< 0.0001
ESPEN 1 vs ESPEN 2	0.4619431	< 0.0001
ESPEN 1 vs Alb and/or TLC	0.2548236	< 0.01
ESPEN 1 vs ESPEN 1/2a	0.4526787	< 0.0001
ESPEN 1 vs ESPEN 1b	0.6942101	< 0.0001
ESPEN 1 vs ESPEN 2b	0.4619431	< 0.0001
ESPEN 2 vs Alb and/or TLC	0.4166547	< 0.0001
ESPEN 2 vs ESPEN 1/2a	0.3057089	< 0.01
ESPEN 2 vs ESPEN 1b	0.4440715	< 0.0001
ESPEN 2 vs ESPEN 2b	0.7071068	< 0.0001
Alb and/or TLC vs ESPEN 1/2a	0.1221591	Ns
Alb and/or TLC vs ESPEN 1b	0.2376260	< 0.05
Alb and/or TLC vs ESPEN 2b	0.4166547	< 0.0001
ESPEN 1/2a vs ESPEN 1b	0.3725964	< 0.0001
ESPEN 1/2a vs ESPEN 2b	0.3057089	< 0.01
ESPEN 1b vs ESPEN 2b	0.4440715	< 0.0001

Ns - no statistical significance

Finally, 21% of the patients were classified as having an abnormal nutritional status based on all three criteria – MNA-SF, ESPEN 2 and Alb and/or TLC – and 15.8% of the patients were shown to have abnormal nutritional status by all of the criteria which were selected for this study (Figure 1).

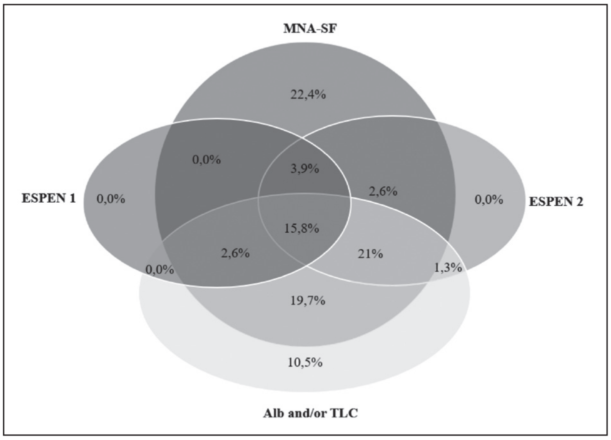

Figure 1 Percentages of patients classified as having an abnormal nutritional status according to the 4 main criteria.

Discussion

The average age of the patients studied was approximately 80 years, which is 'elderly' by the World Health Organisation (WHO) definition (14). Subjects of this age are often malnourished and it may be the result of chronic diseases common in this age group.

Moreover, malnutrition may be a result of insufficient energy supply and disorders associated with nutrient digestion and absorption (9,15). This is confirmed by the results of the authors' study - in the group of 102 patients studied, 76 or about 75% of the research participants, were classified as having an abnormal nutritional status. Similar results were obtained in a Portuguese study by *Antunes AC et al.* (16) using various methods to assess nutritional status: in a group of 201 hospitalised elderly patients, approximately 70% were shown to have an abnormal nutritional status. Meanwhile, studies in Ireland by O'Shea E. et al. (17) on a group of 606 patients aged over 70 years found that almost 60% had an abnormal nutritional status (45% were at risk of malnutrition and 18% were malnourished).

Analysing the results of the 7 interpretations studied (4 overall interpretations and 3 partial), it was concluded that the rate of studied patients classified as having an abnormal nutritional status (both at risk of malnutrition and malnourished) was the highest when the MNA-SF malnutrition screening tool (66%, n = 67) and the laboratory test results (Alb and/or TLC) (53%, n = 54) were used (Table 5). This may indicate that these methods are more sensitive for diagnosing abnormal nutritional status compared to the other interpretations analysed. The use of such criteria ensures a low risk of overlooking such disorders - a negative result is highly likely to indicate a normal nutritional status. However, it should be acknowledged that this would come at the cost of increasing the probability of obtaining a positive result in a subject with a normal nutritional status (a falsely positive result) (18). This may be confirmed by the results of the analysis performed on the group of patients who were diagnosed with abnormal nutritional status based on any of the interpretations presented (n = 76). For 22.4% of the patients, this diagnosis was made based only on the results of the MNA-SF test – it was not confirmed by any other criteria. A similar situation may be observed for the interpretation of laboratory test results – 10.5% of the 76 patients analysed were classified as having an abnormal nutritional status based on this criterion, a classification not supported by the results of other criteria (Figure 1). However, in this case it may also show that biochemical indicators do not necessarily overlap with the other criteria used to diagnose malnutrition, and this might be due to other factors, mainly in connection with a disease.

The criterion which found the lowest percentage of patients with abnormal nutritional status (merely 5% of all respondents) was a BMI of less than 18.5 kg/m² (ESPEN 1/2a) (Table 5). This proves that this method is the least sensitive compared to the other criteria and has limited practical use for evaluating patients' nutritional status. This is also confirmed by the results which indicate no statistically significant correlation between the criteria described above (ESPEN 1/2a), the results of the MNA-SF test and laboratory test results (Alb and/or TLC). It should be also emphasised that all of the other correlations studied were statistically significant (Table 6).

Analysing only the diagnostic criteria suggested by the European Society for Clinical Nutrition and Metabolism (ESPEN) in 2015, it can be concluded that criteria based on the fat-free mass index (FFMI) (ESPEN 2 and ESPEN 2b interpretations) are more effective in detecting abnormal nutritional status than the results based on BMI (ESPEN 1, ESPEN 1b, ESPEN 1/2a interpretations). This is understandable considering the fact that the process of ageing is associated with a loss of muscle mass and an increase of fat tissue. Reduced muscle mass (sarcopenia) is often observed among elderly patients. *Roubenoff et al.* (19) noticed that these unfavourable changes in the body composition develop irrespective of changes in the body mass and, consequently, in the body mass index. Moreover, in elderly patients, sarcopenia very often coexists with obesity, leading to sarcopenic obesity. Whereas the incidence of sarcopenia is estimated at 13% of patients at the age of 60, this problem affects as many as 50% of patients at the age of 80 years old (20,21).

Three of the criteria for diagnosing abnormal nutritional status presented in this study, MNA-SF, Alb and/or TLC and ESPEN 2, are largely consistent (Figure 1). Moreover, correlations between these interpretations show a high contingency coefficient and this indicates a strong correlation (Table 8). Based on these results, it is concluded that such a set of criteria should be used widely to assess the nutritional status of patients over 65 years of age.

Conclusions

An abnormal nutritional status is common among hospitalised patients over the age of 65 years.

Of the nutritional status criteria analysed, the MNA-SF screening tool and laboratory test results seem to have the highest sensitivity.

For patients over 65 years of age, the results of the MNA-SF malnutrition screening tool have the strongest predictive value with regard to the results of a nutritional status assessment, including the reduced fat-free mass index (FFMI), combined with a confirmation of an unexpected loss of body weight (ESPEN 2 and ESPEN 2b).

The criterion based only on a BMI less than 18.5 kg/m² was the least useful for assessing nutritional status in patients in this age group, due to the unfavourable changes in body composition observed in elderly patients.

The set of criteria most effective for assessing nutritional status of patients over 65 years of includes the MNA-SF test, laboratory tests and a reduced FFMI, combined with confirmation of an unexpected loss of body weight.

Acknowledgments

The research was carried out within the framework of Research project, implemented in the years 2017 - 2019, financed from the statutory subsidy obtained by the Faculty of Health Sciences of the Warsaw Medical University (No. NZF/PMI 1/17 to JO).

References

1. Correia M, Waitzberg D. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. Clin Nutr 2003; 22,3:235-239
2. Ostrowska J, Jeznach-Steinhagen A. Fight against malnutrition (FAM). Selected results of 2006 - 2012 Nutritionday survey in Poland. Rocz Panstw Zakl Hig 2016; 67(3): 291-300
3. International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)-2015-WHO Version for 2015: http://apps.who.int./11.07.2017
4. Saunders J, Smith T, Stroud M. Malnutrition and undernutrition. Medicine 2011;391:45-50
5. Von Bokhorst-de van Schueren M, Soeters P, Allison S. Influence of malnutrition on function. Basics in Clinical Nutrition. Fourth Edition. Publishing House Galen 2011; 32-36
6. Kondrup J, Johansen N, Plum L et al. Incidence of nutritional risk and causes of inadequate nutrition care in hospitals. Clin Nutr 2002; 21: 461-468.
7. Rozporządzenie Ministra Zdrowia z dnia 15 września 2011 r. zmieniające rozporządzenie w sprawie świadczeń gwarantowanych z zakresu leczenia szpitalnego, Dz. U. 2011 nr 202 poz. 1191.
8. Jeznach-Steinhagen A, Ostrowska J, Czerwonogrodzka-Senczyna A. Evaluation of conducting a screening assessment of nutritional status of hospitalized patients. Presentation of main goals and objectives of the global health project "NutritionDay". Przegl Epidemiol 2016; 70(1):71-75
9. Nestle Nutrition Institute: Ocena stanu odżywienia Mini Nutritional Assessmen – MNA. Downloaded on 26.01.2018 r. (http://www.mna-elderly.com/forms/MNA_polish.pdf)
10. Wronka L, Sińska B, Wójcik Z. Przegląd metod oceny stanu odżywiania osób dorosłych. Żywienie Człowieka i Metabolizm 2010; 37:10-15
11. T. Cederholm, I Bosaeus, R Barazzoni, J et al. Diagnostic criteria for malnutrition – An ESPEN Consensus Statement. Clin Nutr 2015; 34(3), 335 – 340
12. Kaiser J, Bauer M, Ramsch C et al.: Validation of the Mini Nutritional Assessment short-form (MNA®-SF): A practical tool for identification of nutritional status. J Nutr Health Aging 2009; 13:782
13. Beck AM., Ovesen L.: At which body mass index and degree of weight loss should hospitalized elderly patients be considered at nutritional risk? Clin Nutr 1998;17:195-8
14. World Health Organization (WHO): Definition of an older or elderly person: http://www.who.int/healthinfo/survey/ageingdefnolder/en /08.07.2017.
15. Pertkiewicz M. Niedożywienie i jego następstwa. Postępy Żywienia Klinicznego, 2008; 2: 1–4
16. Antunes AC, Araújo DA, Veríssimo MT et al. Sarcopenia and hospitalisation costs in older adults: a cross-sectional study. Nutrition & Dietetics, 2017,74(1):46-50
17. O'Shea E Trawley S, Manning E et al. Malnutrition in Hospitalised Older Adults: A Multicentre Observational Study of Prevalence, Associations and Outcomes. J Nutr Health Aging 2017, 21(7):830-836
18. Altman D, Bland J. Diagnostic tests 2: Predictive values. BMJ 1994; 308: 1552
19. Roubenoff R. Sarcopenia: Effects on Body Composition and Function. The Journals of Gerontology Series A Biological Sciences and Medical Sciences, 2003, 58 (11): 1012-1017.
20. von Haehling S, Morley J, Anker S.: An overwiew of sarcopenia: facts and numbers on prevalence and clinical impact. J. Cachexia Sarcopenia Muscle 2010, 1(2), 129-133
21. Janssen I.: Evolution of sarcopenia research. Applied Physiology Nutrition and Metabolism, 2010, 35(5), 707-712

Correspondence:
Joanna Maria Ostrowska
Department of Clinical Dietetics, Faculty of Health Sciences, Medical University of Warsaw, Poland
E-mail: jostrowska@wum.edu.pl