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Undernutrition measured by the Mini Nutritional Assessment (MNA) test and related risk factors in older adults under hospital emergency care

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ABSTRACT

Objectives: In developed countries, undernutrition affects mostly older adults, worsens with hospitalization, and affects immune response, with higher rates of infection and delayed wound healing—which leads to an increase in hospital stay and health costs. The aim of this study was to assess the prevalence of undernutrition and related risk factors in a sample of older adults who presented at the emergency room (ER) of a university hospital in Spain.

Methods: This was a cross-sectional study of 288 patients ≥70 y of age who were seen at the emergency department at the University Hospital of Valladolid. Variables of nutritional evaluation, including a Mini Nutritional Assessment Test, sociodemographic factors, comorbidities, chronic treatments, frequency of visits to the ER, and destination after hospital discharge were collected.

Results: The percentage of undernutrition was 14.9% and the risk for undernutrition was 54.5%. Most patients were able to independently conduct basic activities of daily living (BADLs), lived at home, resided in an urban environment, and had autonomous mobility. The mean body mass index (BMI) was 26.14 ± 4.52 kg/m^2. Patients who were dependent on others for BADLs; institutionalized or bedridden; and with hematologic disease, chronic depressive syndrome, polymedication, low hemoglobin or low hematocrit, and hypochromia were associated with a higher prevalence of undernutrition. In the multivariate analysis, for each unit of increase in BMI, patients had 12% lower risk for developing undernutrition, and for each unit of increase in the frequency of ER visits, patients had a 41% higher risk for developing undernutrition.

Conclusions: Older adults who presented to the ER had a high percentage of undernutrition, which is related to sociodemographic factors, comorbidities, polymedication, and biochemical factors. We also found a direct association between the frequency of ER visits and undernutrition, in addition to an inverse relationship with BMI. Detecting undernutrition in an ER may improve health and reduce related complications in older adults.

Introduction

Malnutrition, according to the World Health Organization definition, refers to deficiencies, excesses, or imbalance in a person's intake of energy, nutrients, or both. This includes undernutrition and overnutrition (overweight and obesity).

In this study, we analyzed the factors related to undernutrition. In this state, weight and body mass index (BMI) can be decreased and should be distinguished between undernutrition owing to fasting or illness, either associated with an inflammatory state (such as cancer) or without accompanying inflammation (such as dysphagia) [1].

This situation can cause measurable adverse effects on the composition and function of tissues and organs. It is characterized by weight loss, decreased muscle mass [2–4], and deficit of essential nutrients. When this situation appears or gets worse in hospitalized

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patients, it is associated with an increase in morbidity and mortality with aggravation of acute or chronic pathologies [5], which causes an increase in hospital length of stay (LOS) and, as a consequence, higher health care costs. Additionally, it is associated with an overall deterioration in patient quality of life [6,7].

Moreover, undernutrition is a health problem that increases with age, particularly affecting older adults in developed countries [8–11]. Age physiologically causes changes in different organs and body compartments, affecting nutritional status in adults [12], which, combined with the pluripathology and medication, can trigger those changes. Additionally, undernutrition is an important cause of immunosuppression, with involvement of the cellular, humoral, and complement immune system [13].

Undernutrition may appear or worsen during hospitalization. When it exists, there is an increase in morbidity and mortality [5]. The immune response is affected, the risk for infectious processes increases, and there is a loss of muscle mass and a delay in wound healing. Therefore, there is an increase in complications, adverse events, and a higher mortality rate in patients suffering from undernutrition. Both acute and chronic diseases are aggravated, which means that hospital stay is lengthened, with a consequent increase in health expenditure [14].

In the ER, undernutrition is an important issue because the ER is the site through which patients most frequently enter to the hospital. The aging of the population induces more frequent ER visits because age increases fragility [15]. In the ER there are a number of peculiarities in the care of older adults such as diseases often show with atypical presentations, patients do not collaborate in many occasions because they can present a cognitive deterioration that makes it difficult for the anamnesis to be performed properly, and their chronic diseases and their treatments can possibly mask the usual manifestations of an acute disease [16]. Undernutrition is a pathologic state that is usually not diagnosed in patients who present to the ED. Although the importance of detecting non-acute problems in the ER is recognized, undernutrition is not reflected in the guidelines as one of them [17].

The aim of this study was to investigate the percentage of the population ≥70 y of age who present to the ED and are undernourished or at risk for undernutrition, analyze their risk factors, and determine their relationship with the frequency of visits to EDs and income.

Research design and methods

We performed a cross-sectional study of 288 outpatients ≥70 y of age who were attended to at the Emergency Department of the University Clinical Hospital of Valladolid over a 5-mo period and who were classified for their care at triage level III (this level includes urgent but hemodynamically stable diseases with potential life risk that probably requires complementary tests or treatments) [18]. The study was approved by the local clinical research ethics committee.

We excluded patients who were <70 y of age, classified for their care with a different level of triage or with traumatic accidents, and had advanced cancers or severe cognitive deterioration.

We collected information on the following:

- the main reason why the patient visited the ER;
- clinical examination and laboratory data;
- patient's degree of self-sufficiency;
- patient's cardiovascular risk factors, chronic diseases, and treatments;
- the number of visits to the ER during the previous year; and
- hospital LOS and mortality.

Classification of nutritional status was carried out by the Mini Nutritional Assessment (MNA) test [19], both screening score or MNA-Short Form (SF) (where <12 indicates risk for undernutrition and ≥12, normal nutritional status), and the total score (where <17 indicates undernutrition; 17–23.5 risk for undernutrition, and >23.5 normal nutritional status).

The Katz test [20] was used to determine each patient's dependence for basic activities of daily living (BADLs).

Chronic pharmacologic treatments were recorded in addition to the presence of polymedication, defined in the study as taking five or more different drugs per day.

The frequency of ER visits was determined by the number of visits to this service during the previous year.

Anthropometric examination and blood pressure

A Welch Allyn digital blood pressure cuff, FlexiPort Blood Pressure Cuff, was used to measure blood pressure. For weight measurement, the patient was wearing underwear and a scale weighing BARYS PLUS / C (SIBEL S.A., Barcelona, Spain), with a capacity of 200 kg and a sensitivity of 100 g, was used. The determination of height was made with the patient erect, barefoot, and standing with the heels together, with a telescopic height scale, calibrated in cm. BMI, which is the result of the application of the formula weight (in kg) divided by the size squared (in m), was calculated for each patient. The brachial circumference was measured in the middle part of the line that goes from the acromion to the olecranon, in cm, using an inextensible and flexible metric tape. The circumference of the calf was measured in the most prominent part, in cm, using an inextensible and flexible tape measure.

Analytical tests

Hemoglobin, hematocrit, mean corpuscular volume, leukocytes, and platelets were determined in a total blood sample and were processed and analyzed in the Emergency Laboratory XN 1000 (Sysmex, Spain). Biochemical parameters such as creatinine, albumin, and C-reactive protein (CRP) were measured with the c501 module of the COBAS C 6000 device (Roche, Spain).

Statistical analysis

The quantitative variables are expressed as means ± SD and the qualitative ones according to their frequency distribution.

By means of Pearson's χ^2 test, the association of qualitative variables was analyzed. In the case that the number of cells with expected values <5 was greater than 20%, Fisher exact test or the likelihood ratio test was used for variables with more than two categories.

The comparisons of the quantitative values were made using the Student's *t* test or analysis of variance of a factor for independent samples according to whether the number of groups to be compared is two or more.

A multivariate logistic regression analysis was carried out to predict the risk for undernutrition as measured through the MNA test. To dichotomize data for the dependent variable in the logistic regression analysis, we grouped the categories in undernutrition and risk for undernutrition (MNA ≤ 23.5) versus normal nutritional status (MNA > 23.5). The variables found to be statistically significant at level 0.1 in a univariate analysis were included in the multivariate analysis.

The data was analyzed with the SPSS version 20 (IBM, Armonk, NY, USA). $P < 0.05$ were considered statistically significant.

Results

In the population studied, 14.9% of the patients were undernourished; 54.5% were at risk for undernutrition; and 30.6% had a normal nutritional status. From its screening phase (MNA-SF) 63.9% had risk for undernutrition and 36.1% had a normal nutritional status. When comparing the results of the total score of the MNA and its screening (MNA-SF), it was found that, within the group that was at risk for undernutrition according to the complete test of the MNA, 19.7% had a score ≥12 (Table 1).

The mean age of the patients studied was 81.06 ± 6.56 y, with a sex distribution of 50%. Of the patients, 86.1% were able to independently conduct BADLs, 93.4% lived at home, 96.9% had autonomous mobility, and 73.3% lived in urban areas. The most frequent comorbidities were hypertension (78.1%), dyslipidemia (45.1%), and diabetes (32.3%), followed by arrhythmias (30.9%), heart disease of non-ischemic origin (26.4%), anxiety-depressive syndrome (21.2%), benign prostatic hypertrophy (20.5%), cancer (19.8%), and stroke (7.6%). The most frequent reasons for consultation were infections (28.1%), non-surgical abdominal pain (22.6%), cardiac disorders (21.2%), and syncope/dizziness (15.6%). Polymedication was a common finding in this population (72.9%). Of all patients

Table 1
Comparison between the screening score and the total score of the MNA test

MNA		Screening of MNA			*P*-value
		<12	≥12	Total	
<17	n	43	0	43	
	%	100		100	
17–23.5	n	126	31	157	<0.001
	%	80.3	19.7	100	
>23.5	n	15	73	88	
	%	17	83	100	

MNA, Mini Nutritional Assessment.

included in the study, 34.7% required hospital admission and 3.1% died. The mean BMI was 26.14 ± 4.52 kg/m^2. The average number of visits to the ED during the previous year was 1.64 ± 2.10.

Patients with undernutrition according to the MNA test were distributed according to their BMI. As expected, there was a higher percentage of patients with low weight compared with the other groups of nutritional status. However, we also found that 23.3% were overweight and 7% were obese. Regarding the group at risk for undernutrition according to the MNA test, a significant percentage were overweight (38.9%) and obese patients (15.9%; Table 2).

Regarding sociodemographic characteristics (Table 3), undernutrition and risk for undernutrition were age related, being higher in older patients. We found statistically significant differences in dependency, institutionalized and bedridden variables, with a direct relationship with the risk for undernutrition and established undernutrition.

Among chronic diseases (Table 4), patients with history of stroke, non-ischemic heart disease, arrhythmias, and kidney disease had a higher risk for malnutrition. Anxiety–depressive syndrome and hematologic disease seemed to have a direct relationship with a higher proportion of undernutrition and risk for undernutrition. With respect to polymedication, we obtained statistically significant differences with the nutritional status, having a higher risk for undernutrition without an increase in their established undernutrition.

Table 4
Chronic diseases and polymedication

Comorbidities		MNA <17 n (%)	MNA 17–23.5 n (%)	MNA >23.5 n (%)	*P*-value
Stroke	Yes	0 (0)	16 (72.7)	6 (27.3)	
	No	43 (16.2)	141 (53)	82 (30.8)	0.016
Anxiety-depressive syndrome	Yes	16 (26.2)	34 (55.7)	11 (18)	
	No	27 (11.9)	123 (54.2)	77 (33.9)	0.005
Non-ischemic heart disease	Yes	5 (6.6)	49 (64.5)	22 (28.9)	
	No	38 (17.9)	108 (50.9)	66 (31.1)	0.034
Arrhythmias	Yes	8 (9)	59 (66.3)	22 (24.7)	
	No	35 (17.6)	98 (49.2)	66 (33.2)	0.021
Renal disease	Yes	5 (12.2)	30 (73.2)	6 (14.6)	
	No	38 (15.4)	127 (51.4)	82 (33.2)	0.027
Hematologic disease	Yes	8 (24.2)	23 (69.7)	2 (6.1)	
	No	35 (13.7)	134 (52.5)	86 (33.7)	0.001
Polymedication	Yes	28 (13.3)	129 (61.4)	53 (25.2)	
	No	15 (19.2)	28 (35.9)	35 (44.9)	<0.001

MNA, Mini Nutritional Assessment.

Table 5 shows that the worse the nutritional status, the higher the average frequency of ER visits were (from 1.01 ± 1.36 visits in patients with normal nutritional status to 2.35 ± 3.15 visits in those with established undernutrition) and more of them remained as inpatients.

Abnormal biochemical data show, in Table 6, the different relationship with nutritional state.

In the multivariate analysis (Table 7), adjusted for age and sex, we found that the dependent patients (BADL) had 7.61 times greater risk for undernutrition compared with those who were independent. Those with chronic trauma or rheumatoid disease had a 4.41 times higher risk for undernutrition. Those with chronic hematologic disease or microcytosis had 8.87 and 9.17 times

Table 2
Comparison between MNA score and BMI

MNA		BMI (kg/m^2)						*P*-value
		<18.5	18.5–24.9	25–26.9	27–29.9	30	Total	
<17	n	9	21	6	4	3	43	
	%	20.9	48.8	14	9.3	7	100	
17–23.5	n	2	69	19	42	25	157	<0.001
	%	1.3	43.9	12.1	26.8	15.9	100	
>23.5	n	0	23	24	18	23	88	
	%	0	26.1	27.3	20.5	26.1	100	

BMI, body mass index; MNA, Mini Nutritional Assessment.

Table 3
Sociodemographic characteristics and the MNA test

		MNA <17 n (%)	MNA 17–23.5 n (%)	MNA >23.5 n (%)	*P*-value
	70–74	11 (19.6)	19 (33.9)	26 (46.4)	
Age (y)	75–84	14 (9.9)	84 (59.2)	44 (31)	0.001
	≥85	18 (20)	54 (60)	18 (20)	
Independent	Yes	28 (11.3)	134 (54)	86 (34.7)	
	No	15 (37.5)	23 (57.5)	2 (5)	<0.001
Institutionalized	Yes	5 (26.3)	13 (68.4)	1 (5.3)	
	No	38 (14.1)	144 (53.5)	87 (32.3)	0.034
Bedridden	Yes	3 (33.3)	6 (66.7)	0 (0)	
	No	40 (14.3)	151 (54.1)	88 (31.5)	0.025

MNA, Mini Nutritional Assessment.

Table 5
Frequency, destination at discharge, and MNA test

	MNA			
	<17 n (%)	17–23.5 n (%)	23.5 n (%)	*P*-value
Average attendance	2.35 ± 3.15	1.80 ± 2.01	1.01 ± 1.36	<0.001
Yes	17 (17)	62 (62)	21 (21)	0.037
No	26 (13.8)	95 (50.5)	67 (35.6)	

MNA, Mini Nutritional Assessment.

Table 6
Analytical results and MNA test

		MNA			
		<17 n (%)	17–23.5 n (%)	>23.5 n (%)	*P*-value
Hemoglobin (g/dL)	≥12	23 (12.2)	94 (49.7)	72 (38.1)	
	<12	20 (20.2)	63 (63.6)	16 (16.2)	<0.001
Hematocrit (%)	≥38	17 (11)	76 (49)	62 (40)	
	<38	26 (19.5)	81 (60.9)	26 (19.5)	0.001
MCV (fL)	≥80	39 (15.5)	128 (50.8)	85 (33.7)	
	<80	4 (11.1)	29 (80.6)	3 (8.3)	0.002
Albumin (g/dL)	≥3.5	35 (13.8)	134 (52.8)	85 (33.5)	
	<3.5	7 (21.2)	23 (69.7)	3 (9.1)	0.016
CRP (mg/L)	≤5	17 (15.7)	48 (44.4)	43 (39.8)	
	>5	26 (14.5)	109 (60.9)	44 (24.6)	0.014

CRP, C-reactive protein; MCV, mean corpuscular volume; MNA, Mini Nutritional Assessment.

Table 7
Multivariate analysis of the MNA test

		P-value	OR	95% CI	
				Lower	Higher
Age (y)	70–74	0.077			
	75–84	0.104	1.957	0.872	4.394
	>84 y	0.025	2.958	1.15	7.612
Sex (female vs male)		0.938	1.027	0.528	1.995
Independent BALD (no vs yes)		0.009	7.609	1.649	35.108
Chronic trauma/Rheumatic disease (yes vs no)		0.015	4.414	1.341	14.529
Chronic hematologic disease (yes vs no)		0.007	8.867	1.797	43.761
Psychopharmaceutical drugs		0.001	3.32	1.654	6.663
Frequency of visits to emergency department		0.002	1.407	1.139	1.738
BMI		0.001	0.88	0.815	0.951
MCV (<80 vs ≥80 fL)		0.005	9.167	1.961	42.861

BALD, Basic Activity Daily Life; BMI, body mass index; MCV, mean corpuscular volume; MNA, Mini Nutritional Assessment.

higher risk for undernutrition, respectively. Patients on psychotropic drugs treatment had a 3.32 times higher risk for undernutrition. With respect to the frequency of visits, for each unit of increase in the frequency of ER visits, patients had a 41% higher risk for developing undernutrition. For each unit of increase in BMI, patients had a 12% lower risk for undernutrition.

Discussion

After the nutritional status evaluation of the patients in the present study, we found a high percentage of undernutrition, associated with different sociodemographic, clinical, biochemical, and therapeutic factors. On the other hand, the frequency of visits to the ED was higher in patients with undernutrition and those who required admission were more undernourished than those who were home discharged. Similar results have been found in the study of Sánchez Muñoz et al. [21], in patients admitted to the Internal Medicine Service in our hospital and in the multicenter study in Castilla y León published by De Luis et al. [22]. Nonetheless, they had a population with pathologies that required hospitalization.

In the present study, we highlighted the importance of performing the complete score of MNA test. According to the results of the MNA test, a significant number of patients evaluated as normal by the screening test phase were actually at risk for undernutrition. Therefore, although the screening test indicates a normal result, there are patients at risk for undernutrition that may not be detected if the complete test is not performed.

Calvo et al. [23] found that within the MNA-SF group ≥12, which supposes a normal nutritional status, 4% was at risk for undernutrition; thus they had a lower proportion than in the present study (19.7%).

Other studies analyzed the nutritional status of patients on in EDs [17,24,25], but they used the MNA-SF only. Other recent studies evaluated the nutritional status of patients from the ED but used other screening tests, such as Giorgeti et al. [26], who used Nutritional Risk Screening 2002 (NRS-2002); Rabito et al. [27],who used NRS-2002, Short Nutritional Assessment Questionnaire (SNAQ), Malnutrition Screening Tool (MST), and Malnutrition Universal Screening Tool (MUST); or Raupp et al. [28], who used MUST and NRS-2002 with 52% patients undernourished, 38% at risk, and 62% at serious risk for undernutrition, respectively.

Regarding the sociodemographic characteristics, age is a significant nutrition-related factor: The older the patients, the lower adequate nutritional status they presented, with an increase in undernutrition or the risk for undernutrition. In an observational cross-sectional study conducted on hospitalized patients by Fernández López et al. [11], undernutrition and risk for undernutrition increased with age in people >65 y of age. They found with the MNA-SF that 54.65% of patients were at risk for undernutrition and 15.7% were undernourished.

Dependency factors, such as being institutionalized or bedridden, increase the risk for undernutrition or established undernutrition. Similar results were obtained by Calvo et al. [23]: Of patients who lived in nursing homes, 60% were undernourished compared with only 18% of those who lived at home. In their studies, Pereira et al. [17] and Gentile et al. [24] found a higher prevalence of undernutrition in patients who lived at assisted residences.

In the present study, when we compared the results of nutritional status with different BMI groups, we found a significant percentage of patients with undernutrition or at risk for undernutrition with BMI was in the range of overweight and obesity. Thus, high BMI does not necessarily mean that the patient is not undernourished or at risk for undernutrition. BMI measured alone in a patient can generate mistakes.

When we analyzed chronic diseases, we found that patients with a history of stroke, non-ischemic heart disease, arrhythmias, and kidney disease had an increased risk for undernutrition. Regarding stroke, in acute and subacute phase, some studies [29–31] showed a higher percentage of undernutrition. Corrigan et al. [31] found that 4 mo after starting rehabilitation, patients who recovered from a stroke improved their nutritional status. In the present study, patients were in a chronic phase so the findings may be related to family and social factors. In contrast, patients with anxiety–depressive syndrome had an increased risk for undernutrition and established undernutrition. The association between depression and undernutrition has frequently been reported [32–34].

Polymedication is a significant predictor of undernutrition. In the present study, 72.9% of patients were polymedicated. A large cohort study reported by Agostini et al. [35] showed that a great number of medications were associated with increased risk for weight loss in older people. In a study by Chen et al. [34] in Taiwan, it was shown that taking more medications was an independent predictor of poor nutritional status. Gentile et al. [24] found that almost 80% of patients in teir study were taking more than three medications per day.

A remarkable finding of the present study was the statistically significant correlation between the nutritional status of the patients and the frequency of number of visits to the ER per year. We were unable to locate other studies in this regard. However, taking into account the limited number of investigations on nutrition screening in the ER and the high prevalence of undernutrition risk, conducting research and nutrition assessment in EDs becomes relevant.

Conclusions

The results of this study highlight the general factors, including demographic, psychosocial, and medical, that are associated with undernutrition and risk for undernutrition. Age, dependency, polymedication, and frequency of ER visits are factors that correlate with undernutrition and the risk for undernutrition. These results support the clinical importance of using the MNA test in older patients who visit the ER to allow us to establish future strategies for medical and social intervention.

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