ORIGINAL ARTICLE

Nutritional status and laboratory parameters among internal medicine inpatients

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Abstract

Background: Malnutrition is a clinical state resulting in prolonged hospital stay, increase in severity of infections and poor wound healing.

Aims: Our aim was to investigate the prevalence and etiologic factors of malnutrition in medical inpatients.

Study Design: A total of 290 consecutively admitted internal medicine patients from February to May 2012 were included. On admission, demographic data, anthropometric measurements, laboratory parameters and nutritional screening test results were recorded.

Methods: Nutritional risk score-2002 for patients under 65 years old, mini nutritional assessment for older patients and subjective global assessment (SGA) tests performed. Relation of demographic characteristics, laboratory parameters, weight and body mass index (BMI) with nutritional status were evaluated.

Results: Mean age was 61 ± 17 years; 145 patients were male. Among 160 patients < 65 years old, 34 were in malnutrition (21%), 41 (26%) were under risk of malnutrition and 85 (53%) were normal. When they were divided into three groups according to SGA, we found significant difference in hemoglobin, low density lipoprotein (LDL), high density lipoprotein, cholesterol, triglyceride, albumin and protein, weight and BMI. Among 130 patients over 65 years old, 47 patients (37%) were in malnutrition, 41 (31%) were under risk of malnutrition and 42 (32%) were normal. There was significant difference in LDL, cholesterol, albumin, protein, weight and BMI between three groups; each 1 g/dl decrease in serum albumin and age older than 65 years old increased malnutrition risk 5.21 and 1.97 times, respectively.

Conclusion: Malnutrition risk is high among internal medicine inpatients and risk seems to be higher among older patients. Nutritional screening of geriatric patients, close follow-up and providing earlier health care would contribute rehabilitation of chronic diseases and decrease re-admissions.

Key words: Internal medicine inpatients, malnutrition related laboratory parameters, nutritional status

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Introduction

Malnutrition comprises various clinical states resulting from low (protein-energy malnutrition, vitamin and mineral deficiencies) or high (obesity) intake of macronutrients.[1] It is associated with prolonged hospital stay, increase in frequency of re-admissions, increase in frequency and severity of infections, poor wound healing, disturbance in walking, falls and fractures.[2]

Inpatient malnutrition prevalence and consequences have been studied extensively. Prevalence varies according to the

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countries and patient populations. Inpatient malnutrition prevalence was 44% in a study conducted in 1976.[3] Another study reported 44% malnutrition prevalence in 328 inpatients from internal medicine, surgery, orthopedics, and intensive care unit.[4] Yet another study found 46% malnutrition among patients admitted to inpatient clinics for acute disorders.[5]

In this study, our aim was to investigate the prevalence and etiologic factors of malnutrition in Internal Medicine inpatients.

Methods

A total of 290 consecutive patients admitted to the Internal Medicine Clinic at Sakarya Education and Research Hospital from February 2012 to May 2012 have been included in this study. Patients in whom anthropometric measurements or nutrition tests couldn't have been performed, who were pregnant or younger than 18 years were excluded from the study.

The inpatient physician or nurse from the nutrition team evaluated all patients on admission. Patients' age, sex and admission diagnoses were recorded. Height and weight of all patients was measured. Admission laboratory results were obtained from patient charts. No additional test was performed for the study. Nutritional risk screening 2002 (NRS-2002) for patients under 65 years old, mini nutritional assessment (MNA) for older patients and subjective global assessment (SGA) tests for all patients were performed. A NRS-2002 total score ≥ 3 were labeled as malnutrition.[6-8] Patients were grouped as; those with good nutritional status (≥24), those under risk for malnutrition (17-23) or those with significant malnutrition (<17) according to MNA evaluation. After recording the parameters of subjective global evaluation, patients were evaluated in three categories: (a) "Nutritional status good/sufficient," (b) "high risk of malnutrition" and (c) "severe malnutrition."

Concordances between NRS-2002 and SGA in patients under 65 years old and between MNA and SGA in patients above 65 years old were documented.

Patients were divided into two groups as under 65 and above 65 years old. Then the relation of demographic characteristics, laboratory parameters (hemoglobin, lymphocytes, serum low density lipoprotein (LDL), high density lipoprotein (HDL), cholesterol, triglyceride, albumin, and protein), weight and body mass index (BMI) to nutritional status was evaluated.

Patients were divided into two groups as normal nutritional status (SGA-A) and malnutrition (SGA B and C) according to their nutritional status. Then relation between the presence of malnutrition and studied parameters were evaluated.

Kolmogorov-Smirnov test was used to evaluate whether the distribution of variables were normal. Accordingly, it was seen that all variables displayed a normal distribution. Therefore, one-way analyses of variance (ANOVA) were used to compare groups. When ANOVA results were significant, Tukey test or Tamhane were used with regard to the results of Levene homogeneity tests in the paired comparison. The continuous variables were presented as the mean ± standard deviation. Cramer V coefficients was used for determining the concordance between SGA and NRS-2002 or MNA. A multivariate logistic regression model was implemented to determine the

Table 1: Demographic characteristics and laboratory parameters of the patients

Age (years)	60.81±17.01 (18-99)
Age groups	
<65	48.31±11.54 (n=160)
>65	76.18±7.20 (n=130)
Gender	
Male	145 (50)
Female	145 (50)
Admission diagnosis	
Anemia	47 (16.2)
Endocrinology	94 (32.4)
Gastroenterology	39 (13.4)
Oncology	63 (21.7)
Cardiology	13 (4.5)
Infection	13 (4.5)
Nephrology	15 (5.2)
Rheumatology	6 (2.1)
SGA	
Normal	127 (43.8)
Under risk	82 (28.3)
Malnutrition	81 (27.9)
NRS-2002	
Normal	89 (55.6)
Malnutrition	71 (44.4)
MNA	
Normal	46 (35.4)
Under risk	29 (22.3)
Malnutrition	55 (42.3)
Nutritional status (SGA)	
Normal	127 (43.8)
Malnutrition	163 (56.2)
Weight (kg)	67.69±17.18 (35-130)
BMI (kg/m^2)	25.16±6.31 (13.21-47.86)
Hemoglobin (g/dl)	10.3±2.39 (4.1-16.7)
Lymphocyte (n/μL)	1812.76±1481.77 (0-16,800)
LDL (mg/dl)	96.07±43.09 (4-258)
HDL (mg/dl)	37.98±14.9 (6-90)
Triglyceride (mg/dl)	141.83±87.87 (34-540)
Cholesterol (mg/dl)	161.04±53.12 (65-361)
Albumin (g/dl)	3.4±0.68 (1.4-4.9)
Protein (g/dl)	6.13±1.01 (3-12)

Data were shown as mean±SD (minimum-maximum) and *n* (%). NRS-2002=Nutritional risk score-2002; SGA=Subjective global assessment; BMI=Body mass index; LDL=Low density lipoprotein; HDL=High density lipoprotein

hematological parameters and other covariates associated with malnutrition. A $P < 0.05$ was considered significant. Analyses were performed using commercial software (IBM SPSS Statistics 20, SPSS Inc., an IBM Co., Somers, NY, USA).

Ethics statement

This study was conducted according to the guidelines laid down in the declaration of Helsinki and all procedures involving human subjects/patients were approved by the Sakarya University Medicine Faculty Ethics Committee (issue no: B.30.2.SAU.0.20.05.04-050.01.04/5).

Results

A total of 290 patients (mean age 61 ± 17 years; 145 male, 145 male) were included in the study. Demographic characteristics, admission diagnoses, anthropometric measurements, and laboratory parameters are summarized in Table 1.

Table 2: Concordance between SGA and NRS-2002

	SGA		
	A (*n*=85)	B (*n*=41)	C (*n*=34)
NRS-2002			
Normal	80 (94.1)	9 (22.0)	0
Malnutrition	5 (5.9)	32 (78.0)	34 (100.0)

There is a high level of concordance between the NRS-2002 and SGA, and this was statistically significant. Cramer V=0.838, $P<0.001$. NRS-2002=Nutritional risk score-2002; SGA=Subjective global assessment

Table 3: Concordance between SGA and MNA

	SGA		
	A (*n*=42)	B (*n*=41)	C (*n*=47)
MNA			
Normal	39 (92.9)	7 (17.1)	0
Under risk	2 (4.8)	24 (58.5)	3 (6.4)
Malnutrition	1 (2.4)	10 (24.4)	44 (93.6)

There is a high level of concordance between the NRS-2002 and SGA, and this was statistically significant. Cramer V=0.742, $P<0.001$. MNA=Mini nutritional assessment; SGA=Subjective global assessment

Table 4: Comparisons of the hematological and other characteristics between three groups of patients aged <65

	SGA			*P*
	A (*n*=85)	B (*n*=41)	C (*n*=34)	
Age (years)	45.56±12.47	50.83±9.50[a]	52.15±9.67[a]	0.005
Weight (kg)	74.22±20.71	66.2±15.14[a]	59.26±13.37[a]	<0.001
BMI (kg/m^2)	27.4±6.79	24.52±6.31	20.67±4.6[a,b]	<0.001
Hemoglobin (g/dl)	11.14±2.68	10.03±2.21[a]	9.69±2[a]	0.005
Lymphocyte (*n*/μL)	2261.18±1416.49	1456.1±904.17	1988.24±2863.43	0.054
LDL (mg/dl)	111.41±43.92	88.02±41.58[a]	76.32±40.28[a]	<0.001
HDL (mg/dl)	40.71±13.9	37.63±16.87	29.91±12.85[a]	0.002
Triglyceride (mg/dl)	162.65±104.44	152.46±106.6	112.03±59.06[a]	0.039
Cholesterol (mg/dl)	174.54±58.09	152.73±49.97	135.38±52.27[a]	0.002
Albumin (g/dl)	3.87±0.5	3.44±0.58[a]	2.73±0.6[a,b]	<0.001
Protein (g/dl)	6.54±0.71	6.2±1.02	5.44±1.07[a,b]	<0.001

[a]There was statistically significant difference from Group A; [b]There was statistically significant difference from Group B. Data were shown as mean±SD and *n* (%). A=Normal; B=Under risk; C=Malnutrition; SGA=Subjective global assessment; BMI=Body mass index; LDL=Low density lipoprotein; HDL=High density lipoprotein; SD=Standard deviation

Table 5: Comparisons of the hematological and other characteristics between three groups of patients with aged >65

	SGA			*P*
	A (*n*=42)	B (*n*=41)	C (*n*=47)	
Age (years)	75.02±6.70	76.22±7.47	77.19±7.39	0.369
Weight (kg)	74.38±14.43	66.88±11.43[a]	58.03±13.19[a,b]	<0.001
BMI (kg/m^2)	28.68±5.89	25.18±4.82[a]	21.72±4.17[a,b]	<0.001
Hemoglobin (g/dl)	10.04±2.41	9.59±1.94	10.29±2.25	0.340
Lymphocyte (*n*/μL)	1842.86±858.57	1587.8±1211.65	1355.32±914.57	0.076
LDL (mg/dl)	115.55±50.34	86.76±31.61[a]	80.36±29.85[a]	<0.001
HDL (mg/dl)	42.55±14.88	36.17±15.56	36.66±13.49	0.086
Triglyceride (mg/dl)	148.02±90.71	137.07±76.71	115.06±37.6	0.085
Cholesterol (mg/dl)	184.38±54.96	153.46±41.79[a]	148.19±40.24[a]	0.001
Albumin (g/dl)	3.61±0.61	3.17±0.53[a]	3±0.57[a]	<0.001
Protein (mg/dl)	6.45±0.69	5.98±1.29	5.67±0.93[a]	0.002

[a]There was statistically significant difference from Group A; [b]There was statistically significant difference from Group B. Data were shown as mean±SD and *n* (%). A=Normal; B=Under risk; C=Malnutrition; SGA=Subjective global assessment; BMI=Body mass index; LDL=Low density lipoprotein; HDL=High density lipoprotein; SD=Standard deviation

Table 6: Comparisons the hematological and other characteristics between nutritional status groups

	Normal ($n=127$)	Malnutrition ($n=163$)	*P*
Age (years)	55.31±17.66	65.09±15.20	<0.001
Age groups			
<65	89 (65.9)	71 (45.8)	0.001
>65	46 (34.1)	84 (54.2)	
Gender			
Male	73 (57.5)	72 (44.2)	0.025
Female	54 (42.5)	91 (55.8)	
Weight (kg)	74.3±18.8	62.6±13.8	<0.001
BMI (kg/m^2)	27.82±6.50	23.07±5.30	<0.001
SGA			
Normal	127 (100)	0 (0)	<0.001
Under risk	0 (0)	82 (47.7)	
Malnutrition	0 (0)	81 (52.3)	
Lymphocyte ($n/\mu L$)	2122.83±1271.43	1571.16±1589.18	0.002
LDL (mg/dl)	112.77±45.97	83.05±35.75	<0.001
HDL (mg/dl)	41.31±14.19	35.37±14.95	0.001
Triglyceride (mg/dl)	157.81±99.98	129.37±75.12	0.006
Cholesterol (mg/dl)	177.79±57.04	147.98±45.94	<0.001
Albumin (g/dl)	3.78±0.54	3.09±0.61	<0.001
Protein (g/dl)	6.51±0.70	5.83±1.10	<0.001

Data were shown as mean±SD and *n* (%). SGA=Subjective global assessment; BMI=Body mass index; LDL=Low density lipoprotein; HDL=High density lipoprotein; SD=Standard deviation

Table 7: A multivariate logistic regression model of the hematological parameters and other covariates associated with malnutrition

	B	SE of β	*P*	OR	95% CI for OR	
					Lower	Upper
Age >65	0.680	0.314	0.030	1.973	1.067	3.648
Gender (female)	−0.146	0.312	0.641	0.865	0.469	1.594
BMI	−0.122	0.030	<0.001	0.885	0.835	0.938
Hemoglobin	0.032	0.069	0.645	1.032	0.902	1.181
Lymphocyte	0.000	0.000	0.020	1.000	1.000	1.000
LDL	−0.011	0.008	0.152	0.989	0.975	1.004
HDL	−0.010	0.013	0.453	0.990	0.966	1.016
Triglyceride	0.002	0.003	0.349	1.002	0.997	1.007
Cholesterol	0.004	0.007	0.583	1.004	0.990	1.017
Albumin	−1.651	0.375	<0.001	0.192	0.092	0.400
Protein	0.036	0.240	0.880	1.037	0.648	1.660

OR=Odds ratio; CI=Confidence interval; BMI=Body mass index; LDL=Low density lipoprotein; HDL=High density lipoprotein

Concordance between nutritional screening tests NRS-2002, MNA and SGA were shown statistically [Tables 2 and 3].

Evaluation of 160 patients under 65 years old according to SGA revealed that 85 patients (53%) were normal, 41 patients (26%) were under risk of malnutrition and 34 patients were in malnutrition (21%). When these patients were separated into three groups according to SGA, we found statistically significant difference in hemoglobin, serum LDL, HDL, cholesterol, triglyceride, albumin and protein, weight and BMI between three groups [Table 4].

When 130 patients over 65 years old were studied according to SGA, 42 patients (32%) were normal, 41 patients (31%) were under risk of malnutrition development, and 47 patients (37%) were in malnutrition. After separating into three groups, there was statistically significant difference in serum LDL, cholesterol, albumin, protein, weight and BMI between three groups [Table 5].

We compared the hematological and other characteristics between the nutritional status groups. We found statistically significant relation between malnutrition risk and serum LDL, cholesterol, albumin, protein, weight and BMI ($P < 0.05$) [Table 6].

We performed multiple logistic regression analysis of malnutrition and associated parameters in all patients. It revealed that each 1 g/dl decrease in serum albumin increased malnutrition risk 5.21 times; age older than 65 years old increased malnutrition risk 1.97 times [Table 7].

Discussion

Malnutrition is a prevalent clinical disorder especially among inpatients and geriatric population. It has well-proven negative effects on patient morbidity and mortality but is usually underestimated by the clinician and when diagnosed, mostly not appropriately treated.[2,9]

Nutritional risk screening-2002 in general and MNA in elderly are useful tests in the evaluation of malnutrition. Detsky *et al.* developed a method providing good correlation between subjective criteria and objective measurements in 1987.[6] This index, that is, subjective global evaluation is an important method because of simplicity and providing predictive efficacy comparable to objective measurements.[7,10,11] In studies comparing SGA with classical methods, SGA was reported to have 80% positive predictive value.[7] We applied MNA for patients above 65 years old, NRS-2002 for younger patients and SGA for all patients in our study. We statistically evaluated the results of SAG, MNA, and NRS-2002 for standardization purposes. We also studied the data of all patients according to SGA.

In published studies, malnutrition prevalence on admission was reported to be 40% while nutritional status was worsening further in 78% of patients during ongoing admission.[3] In our country, these rates vary between 3.9% and 52% according to the admitting clinic.[12-14] Our study included 290 patients admitted to internal medicine clinic. We found that 127 patients (44%) were in normal nutritional status, 82 patients (28%) were under malnutrition risk, and 81 patients (28%) were in malnutrition. Taking into account that our patients were admitted to Internal Medicine clinic,

our rates of malnutrition were high. This might be related to admission of oncologic patients in late stages of their diseases or admission of already progressed malnutrition cases to our clinic.

Studies on malnutrition prevalence among geriatric patients reported that malnutrition prevalence was 2-32% among "healthy" elderly living in their own homes, 15% among home-bound patients, 23-62% among inpatients and 85% in nursing home residents.[15-17] In a study conducted in 1999, severe malnutrition prevalence was found to be 16% among 369 patients over 70 years old who were admitted to internal medicine clinic and mortality rate has been found to be 2.8 times higher in this group.[6] Our results revealed 68% and 47% malnutrition prevalence among patients over 65 years old and under 65 years old, respectively. We also found that malnutrition risk was 1.97 times higher in patients over 65 years old.

In studies investigating parameters associated with malnutrition risk, Hemoglobin level, lymphocyte count, serum total cholesterol and albumin levels and BMI were studied.[18-21] When we separated patients above and under 65 y/o into three groups according to SGA, we found statistically significant relation between malnutrition risk and serum LDL, cholesterol, albumin, protein, weight and BMI ($P < 0.05$). In addition, we found a significant relation between malnutrition and hemoglobin levels when we further analyzed the parameters in patients under 65 years old ($P < 0.05$).

Albumin is one of the most frequently used parameters in the evaluation of nutritional status. There is a close association between serum albumin levels and mortality among both normal population and patients admitted to hospital.[22-24] In our study, we found that albumin and protein levels were significantly lower in patients with malnutrition compared to patients with normal nutritional status. Moreover, we found that malnutrition risk increased 5.21 times for every 1 gr/dl decrease in serum albumin levels.

Determination of nutritional status and providing nutritional support are the responsibilities of physicians. Malnutrition risk is high in all patients admitted to internal medicine clinic and this risk seems to be higher especially among patients older than 65 years. We suggest nutritional screening of geriatric patients especially with chronic disease. Close follow-up and providing earlier health care would greatly contribute rehabilitation of chronic diseases and decrease re-admission rates in this patient population.

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