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Relationship between Mini Nutritional Assessment Score and Infection in Critical Care Patients

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Abstract

Background: Nutrition and infectious diseases are 2 influential factors. Mini nutritional assessment (MNA) score is one of the indicators for assessing the nutritional status of the patients. The present study aimed to evaluate the relationship between MNA– short form (SF) and the infectious status of patients admitted to the intensive care unit (ICU) of Hazrat-e-Rasoul hospital in Tehran.

Methods: This was a cross-sectional study performed at Hazrat-e-Rasoul hospital in Tehran from 2019 to 2020. Each patient completed the MNA–SF questionnaire. The questionnaire has 6 factors with a score range of 0 to 14, with 12 to 14 indicating "normal nutrition," 8 to 11 indicating "at risk of malnutrition," and 0 to 7 indicating "malnutrition." The patients were monitored for clinical and paraclinical signs and symptoms of infectious disease for the first 14 days after being admitted to the ICU. Then, the relationship between infection level and MNA–SF scores were recorded and the chi-square, independent samples t test, and Pearson correlation test were used.

Results: In this study, 119 patients (60 men and 59 women), with a mean age of 53.82 ± 19.76 years were selected, and 71 (59.67%) of the patients had an infection. Women without infection were significantly more than men (p=0.021). In the assessment of the MNA–SF questionnaire, we found that 62 (52.1%) patients had "normal nutrition" status, 30 (25.2%), and 27 (22.7%) had "at risk for malnutrition" and "malnutrition" status, respectively. MNA–SF scores were significantly different in different age groups (p=0.040). There was a significant relationship between weight loss, mobility, and neuropsychological problems with age (p<0.001). Also, there was a meaningful relationship between nutritional status and infection (p=0.032). The results determined that noninfected cases among the patients with "normal nutrition" status were more than those "at risk for malnutrition" (p=0.007). The results of this study showed that clinical outcomes had a significant relationship with nutritional status (p=0.043).

Conclusion: Based on the present study, good nutritional status can reduce infection and mortality in patients who are admitted to ICU, and the nutritional status assessed with MNA-SF can play an essential role in patients' susceptibility to infection.

Keywords: Mini Nutritional Assessment Score, Malnutrition, Infectious Diseases, Intensive Care Unit

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Introduction

Malnutrition is an acquired disorder that results from inadequate intake of macronutrients (protein, carbohydrates, and fats) or micronutrients (vitam ins, minerals, and trace elements) and disrupts the normal state of body mass in-

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↑What is "already known" in this topic:
Energy protein malnutrition is a significant cause of immune system deficiency and increased vulnerability to infection.

→What this article adds:
This article adds to our previous knowledge that the MNA–SF nutritional assessment tool can be used as a tool to predict the risk of infection in patients admitted to ICUs based on their malnutrition.

dex and organ function. Although malnutrition is the most common cause of infection due to immune system dysfunction, it can cause dysfunction of all body organs by not healing the wound and not closing the fascia, and failing to repair anastomoses (1). Energy protein malnutrition is a significant cause of immune system deficiency and increased vulnerability to infection. For example, acute and chronic malnutrition of protein and energy affects phagocytosis, inflammation, activity and differentiation of T cells, immunoglobulin A and G, and macrophage activity and is effective in increasing the incidence of respiratory, opportunistic, skin, and gastrointestinal infections (2). Numerous studies have estimated the percentage of people at risk of malnutrition from 20% to 70% according to assessing the nutritional status of hospitalized patients (3). Various tools are designed to evaluate the nutritional status of patients. Mini Nutritional Assessment– Short Form (MNA–SF) is one of the most extensive and valid nutritional assessment questionnaires for patients, translated and validated in 20 common languages around the world. MNA–SF evaluates patients' nutritional status over the past 3 months with 90% sensitivity (4). In this questionnaire, the parameters of nutritional status assessment consist of 6 parts; these parameters are loss of appetite, recent weight loss, mobility, recent acute illness, dementia or depression, body mass index (5), or calf circumference measurement (6). The MNA–SF has six criteria with a score range of 0 to 14, with 12 to 14 indicating "normal nutrition," 8 to 11 indicates "at risk for malnutrition," and 0 to 7 indicating "malnutrition" (5).

Some studies have shown a correlation between lower MNA scores and decreased immune function. Studies have shown that lower scores have been associated with worse prognosis, including increased hospitalization time and tripled mortality (3). In Europe and the United States, 40% to 50% of hospitalized patients were malnourished upon admission, especially the elderly (7). Malnutrition is affected by sociopsychological factors and results in the length of hospitalization days (8). Finally, nausea, swallowing, and vomiting are signs of anorexia, which indicate higher nutritional demands (7, 9). Despite the high prevalence of malnutrition, due to the lack of proper nutrition screening, malnutrition remains unknown and untreated (7-10). The purpose of this study was to assess the MNA–SF score and its relationship with infection in patients admitted to the ICU, due to the importance of malnutrition in admitted patients and the lack of studies in this area.

Methods

This was a cross-sectional study performed at Hazrat-e-Rasoul hospital in Tehran for 3 months in 2020. The MNA–SF questionnaire was completed for each patient. The patients were monitored for clinical and paraclinical signs and symptoms of infectious disease for the first 14 days after being admitted to the ICU. Then, the relationship between infection level and MNA–SF scores were recorded and statistically analyzed.

All patients 16 years of age and older admitted to the ICU met the inclusion criteria: the patient had not been hospitalized in different wards of the hospital for more than a week before entering the intensive care unit, the patient had not taken chronic corticosteroids for more least 1 month, the patient did not have acquired immunodeficiency syndrome or diseases of the weakened immune system, the patient had not undergone organ transplants, and in the case of cancer, the patient had not undergone chemotherapy. Patients' nutritional status was assessed once in the ICU within the first 48 hours of admission and then classified into 3 categories depending on the score obtained: normal, at risk for malnutrition, and malnutrition. In this study, in addition to the MNA–SF, nutritional status was evaluated with the Nutrition Risk in the Critically Ill (NUTRIC) score, and the results were compared. Acute Physiology and Chronic Health Evaluation (APACHE II) score and Sequential Organ Failure Assessment (SOFA) score were also used to evaluate clinical conditions. The presence or absence of infection and the number of positive cultures (blood, urine, sputum, ascites fluid, cerebrospinal fluid, etc.) were recorded for patients in 14 days in the ICU. Patient culture data were extracted from their files.

The NUTRIC score is the first tool designed to assess the nutritional risk in patients in critical conditions. In the intensive care unit and measurement, it uses interleukin-6 for evaluation. In the form without interleukin-6, the NUTRIC score is from 0 to 9, with 0 to 4 indicating a low risk of the nutritional index, and a score of 5 to 9 indicating a high risk of a nutritional index in patients admitted to ICUs and the need to start rapid nutritional interventions in these patients. MDCALC software was used to calculate these 3 indicators.

Statistical Analysis

We analyzed the data using SPSS software Version 26. All quantitative variables are presented as mean, standard deviation, frequency, and percentage. Normality was checked by the Kolmogorov-Smirnov test. We also used the chi-square and independent samples t tests. A Pearson correlation test was used to measure the strength and direction of this linear correlation. The significance level in the present study was less than 0.05.

Results

The mean age of the patients was 53.82 ± 19.76 years, and the age range of the patients was 18 to 93 years; 60 people (50.4%) were men, and 59 (49.6%) were women. In Table 1, descriptive data of indicators and scores are evaluated according to age, physiological information, and the presence of linked disorders, laboratory information, and acute circumstances of bodily functioning. Gender information is listed in Table 2. Infection was diagnosed in 71 patients (59.67%). Most patients had pneumonia (n=29 [24.4%]) and urinary tract infection (n=15 [12.6%]). Fever (the most common symptom reported by 67 (56.3%) patients), shivering, hypothermia, hypotension, diarrhea (the least common symptom reported by 7 [5.88%] patients), cough, peritoneal stimulating symptoms, urinary irritation symptoms, decreased level of consciousness, and discharge from catheter insertion were among the clinical symptoms reported by study partici-

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Table 1. Descriptive data of evaluated scores in the studied patients

Variable	Mean ± SD	2	14
MNA* score	10.75±3.42	1	47
APACHE# II score	16.03±10.73	0	!18
SOFA† score	6.01±4.61	1	9
NUTRIC** score	3.82±2.50	3	171
Length of stay (day)	25.97±21.23	2	14

* Mini Nutritional Assessment - Short Form
# Acute Physiology and Chronic Health Evaluation
† Sequential Organ Failure Assessment Score
** Nutrition Risk in Critically ill

Table 2. Descriptive data of evaluated scores in the studied patients across gender

Variable	Gender	N	Mean ± SD	*P* value*
Age (year)	Male	60	54.63±20.32	0.676
	Female	59	53.12±19.06	
Length of stay (day)	Male	60	26.43±22.68	0.615
	Female	59	25.01±23.08	
APACHE# II score	Male	60	16.83±11.60	0.415
	Female	59	15.22±9.82	
SOFA† score	Male	60	6.77±5.07	0.070
	Female	59	5.24±3.98	

* Independent samples t test. Pvalue <0.05 is significant.
# Acute Physiology and Chronic Health Evaluation
† Sequential Organ Failure Assessment Score

pants.

Out of 119 patients, 88 (73.9%) patients were discharged from the ICU, and 31 (26.1%) patients died. One of the parameters studied was the relationship between the patient's treatment outcomes and the length of hospital stay, and the results are reported in Table 3. There was a statistically significant difference between the patient's treatment outcomes and the length of hospital stay ($p<0.001$).

Regarding the nutritional status of the patients based on MNA–SF scores, 52.1% of the patients were nutritionally normal, and 25.2% and 22.7% were "at risk for malnutrition" and "malnutrition," respectively. Scores are provided based on the NUTRIC as well (Table 4).

Leukocytosis was observed in 87 patients, leukopenia in 10 patients, increased CRP in 56 patients, increased PCT in 50 patients and Increased ESR in 50 patients. Also, 44.5% of patients needed mechanical ventilation. Laboratory tests were performed on the culture of body fluids in the patients. The results were reported in the form of hematologic culture, urinary culture, wound secretion culture, respiratory secretion culture, catheter culture, and other secretions (Table 5). There were no statistically significant differences between the 2 groups with/without infection in favor of age (p=0.617).

The NUTRIC score was higher in infected patients, and the MNA–SF score was similarly higher (Table 6). The Pearson test was used to examine the relationship between the MNA–SF and NUTRIC scores, and it was discovered that there was an inverse and significant relationship between these 2 scores (r= –0.221; p=0.016).

Another study parameter was the relationship between patient treatment outcomes and nutritional status and the results are reported in Table 7. The mortality rate was 33.3% in malnourished patients. The difference between clinical outcomes and nutritional status was significant (p=0.043). According to the findings of the 1-way analysis of variance (ANOVA) test, the incidence of discharge from ICU patients increases as nutritional status improves. The difference in mortality, however, was not significant.

The 1-way analysis of variance shows that the nutritional status of the patients based on the MNA–SF is not related to patients' need for mechanical ventilation (p=0.067) (Table 8).

Discussion

This was a cross-sectional study aimed to determine the relationship between mini nutritional assessment and infection in the patients hospitalized in the ICU, and 119

Table 3. Evaluation of the relationship between patient treatment outcomes and length of stay

Variable		Length of stay (day)		*P* value*
		Mean	SD	
Outcome	Discharge	18.65	15.88	<0.001
	Mortality	42.36	26.60	

* Independent samples t test. P value <0.05 is significant.

Table 4. Frequency of the patients in terms of nutritional status based on the MNA–SF and NUTRIC scores

Variable		N (%)
MNA-SF* score	Malnutrition	27 (22.7)
	At risk for malnutrition	30 (25.2)
	Normal	62 (52.1)
NUTRIC** score	Low risk	75 (63)
	High risk	44 (37)

* Mini Nutritional Assessment - Short Form
** Nutrition Risk in critically ill

Table 5. Frequency Distribution of Positive Responses for Body Fluid Culture Tests

Location of culture sample	Positive N (%)
Respiratory secretions	51 (42.9)
Urine	30 (25.2)
Blood	23 (19.3)
wound secretions	9 (7.6)
Other catheters	7 (6.7)
Other secretions	6 (5)

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Table 6. The Relationship between Nutritional Status Score and Infection in Patients hospitalized in the intensive care unit

Variable		Without infection N (%)	With infection N (%)	*P* value*
MNA-SF# score	Malnutrition	8 (29.6)	19 (70.4)	0.032
	At risk for malnutrition	8 (26.7)	22 (73.3)	
	Normal	32 (51.6)	30 (48.4)	
NUTRIC† Score	Low risk	4 (9.10)	31 (41.33)	<0.001
	High risk	32 (51.6)	40 (90.90)	

*Chi-Square. P value <0.05 is significant.
Mini Nutritional Assessment - Short Form
† Nutrition Risk in critically ill

Table 7. Frequency of Clinical Outcomes Based on Nutritional Status in the Patients

MNA-SF score	Mortality N (%)	Discharge N (%)	*P* value*
Malnutrition	9 (33.3)	18 (66.6)	0.043
At risk for malnutrition	9 (30)	21 (70)	
Normal	12 (20.97)	49 (79.03)	

*Chi-Square. P < 0.05 is significant.
Mini Nutritional Assessment - Short Form

Table 8. Frequency Assessment Based on Nutritional Status with Patients' Need for Mechanical Ventilation

Variable		Normal N (%)	At risk for malnutrition N (%)	Malnutrition N (%)	*P* value*
Need for mechanical ventilation	Yes	26 (41.94)	14 (46.67)	12 (44.44)	0.067
	No	36 (58.06)	16 (53.33)	15 (55.56)	

*Chi-Square. P < 0.05 is significant.

patients were evaluated by the census method. Considering that infectious diseases are essential in the prognosis of patients admitted to intensive care units and nutrition can play a role in infection control and related aspects in these patients (11-14), we designed this study to find the relationship of interest. In ICU, patients with different diseases and different severities are admitted. Recent studies have shown that the incidence of malnutrition in these patients is different from those admitted to other wards (15, 16). Patients in the ICU have systemic inflammatory reactions as a result of their critical circumstances (17, 18). In such situations, metabolism increases and catabolism increases, fat reserves decrease, and muscle mass decreases as a result of reduced calories and protein content (19). Therefore, one of the main problems of the patients in the ICU is malnutrition. Nosocomial infections, on the other hand, are one of the most important variables affecting mortality, increasing hospitalization length, and expenditures in ICUs (20).

In the present study, the infection was diagnosed in 59.67% of the patients—24.4% and 12.6% of the infections were related to pneumonia and urinary tract infection, respectively. Also, there was no statistically significant relationship between different age groups and infection rates. In the study of Mohammad et al (2002), the incidence rate of nosocomial infection in the ICU was estimated to be 18.7 infections per 1000 patient-day hospitalizations (21). Also, the most common types of infections were related to lung and urinary tract infections. The results of this study were consistent with the present study. However, in this study, only the age factor was associated with infection, which is inconsistent with the results of this study. Kermani et al showed that the rate of infection in the intensive care unit was more than 60%, and the incidence of respiratory infections was higher than other infections (22).

Mojtahedzadeh et al also reported that the most common cause of infection in the intensive care unit was respiratory and urinary tract infections (23). Recently, in a study by Hedayat Yaghoobi et al, it was observed that the incidence of pneumonia among 1806 patients hospitalized in ICUs was 55%, followed by urinary tract infection (24). The results of these studies overlap with the results of the present study. While in another study, the highest rate of infection (41%) was related to a urinary catheter (25), which was not consistent with the results of the present study. Since ICU patients use respiratory devices extensively, the increase in respiratory infection in these wards is not far from expected. The findings of this study showed that the prevalence of infection in men (70%) was more than in women (49.2%). Other studies confirm the findings of this study (23, 26). The prevalence of blood culture (19.3%), urine culture (25.2%), wound secretion culture (7.6%), respiratory secretion culture (42.9%), catheter culture (6.7%), and culture of other regions (5%) was reported.

The most clinical symptoms were fever (56.3%) and hypotension (41.2%). The results of Moridi et al showed that the prevalence of fever in the patients hospitalized in the ICU was 32.9% (27). In this case, the incidence of fever was 32% in Belgium (28). The disparity in study results could be because ICUs in Iran have fewer resources and manpower than those in industrialized nations, and the low prevalence of fever in patients could signal the ward's staff's efforts. Leukocytosis had the greatest prevalence of 73.1 % in this study. Other studies have shown similar results to the present study (29, 30), the cause of which can be stated that infections, especially pulmonary infections, are the most common causes of leukocytosis. In the present study, radiological symptoms of computed tomography scan had the highest frequency (40.3%).

The results showed that based on MNA–SF questionnaire scores, 52.1% of the patients were nutritionally nor-

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mal, and 25.2% and 22.7% were at risk for malnutrition and malnutrition, respectively. The prevalence of malnutrition using this technique ranged from 0.4% to 41%, and the prevalence of malnutrition risk ranged from 7% to 67% (29), which is consistent with the current study. The prevalence of malnutrition in a study by Niazi et al was 52%, of which 28% had malnutrition and 10% were at risk for malnutrition (31). About 30.4% of the patients were at risk for malnutrition, and 43.5% had malnutrition (32). Based on the NUTRIC score, the frequency of low and high risk of the nutritional index in patients admitted to the ICU was reported to be 0 to 4 at low risk of the nutritional index and 5 to 9 at high risk of the nutritional index in this study. Based on the NUTRIC score, 37% of the patients were in the high-risk range. The results of this tool categorize patients into 2 groups: low risk and high risk, which are utilized to identify the needs of the patients. Furthermore, this study discovered that the risk of nutritional problems differed by age group and that these variations were substantial. Salah et al (33) found that anthropometric indices dropped with age, and biomechanical mechanisms of nutrition balance were more complex. In addition, as people get older, their body's nutritional needs diminish due to decreased mobility and physical functions, and their nutritional status declines (34).

This study showed that the risk of infection in malnourished patients was significantly higher than the patients with normal nutrition. The results of a systematic review with the same tool showed that malnutrition patients are more at risk for mortality than the patients with normal nutrition and have a lower quality of life (35). Patients with more malnutrition than patients with normal nutrition are at risk for complications and manifestations after surgery, such as wound infection and recurrent pain (36). Also, the results of other studies show that there is a significant relationship between energy intake in patients hospitalized in ICUs and infection (37-39). Almost all the results of previous studies were consistent with the present study. Also, the results of this study showed that the type of infection and the number of positive cultures in the patients had no significant relationship with their nutritional conditions. Also, the results of this study showed that in the patients with normal nutritional status, the discharge rate was much better than the patients "at risk for malnutrition" and "malnutrition."

The death rate in malnourished patients was 33.3 % in this study. The mortality rate of cancer patients was significantly correlated with malnutrition (40), and the mean and standard deviation of the approximate mortality rate in the hospital was 16.10 03.73 in the present study considering the approximate mortality rate in the hospital using the APACHE II score. Varghese et al showed that the mean APACHE II score in the patients in the ICU was 19.89 ± 4.89 (41). The results of this study were consistent with the present study. Nik et al also showed that the mean score of APACHE II in the ICU was 0.04 ± 83.92. These findings did not match those of the current study, which can be explained by the fact that only patients with severe brain damage who were admitted to the ICU were examined. The APACHE II score is the most important tool of the scoring system in providing significant differential ability when predicting ICU-related mortality (42). Coronavirus disease 2019 (COVID-19) and nutritional status are now being explored, and due to its global severity, it is critical to pay attention to nutrition status to prevent COVID-19 as infectious disease (43, 44).

Study Limitations

In future studies, the effect of confounding factors on patients' nutritional status, such as systemic disorders, can be studied in advanced statistical modeling to analyze the association between infection and the nutritional status of patients, which was not assessed in this study. Given the impact of infectious diseases on patient mortality, a study such as this is essential to assess patients' nutritional health as well as the rate of future patient mortality utilizing the MNA–SF. If a study can intervene in the nutritional status of patients to examine the relationship between the factors evaluated by nutrition and the rate of infection, it will be more certain in proposing appropriate nutrition assessment tools.

Conclusion

Based on the findings of this and other studies, it appears that implementing screening programs, assessing nutritional status using approved methods at the time of admission of infectious disease patients, and implanting standard nutritional care programs based on the patients' status is essential in infectious disease treatment plans and should be considered by all members of the patient's treatment team. In patients admitted to ICUs, the MNA-SF nutritional evaluation tool can be used to predict the risk of infection.

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Ethical Considerations

The research followed the tenets of the Declaration of Helsinki. The Ethics Committee of Iran University of Medical Sciences approved this study. The institutional ethical committee at Iran University of Medical Sciences approved all study protocols (IR.IUMS.FMD.REC.1399.399). This study was extracted from a medical thesis by code 16072.

Conflict of Interests

The authors declare that they have no competing interests.

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