ORIGINAL ARTICLE

COMPARATIVE EVALUATION OF NUTRITIONAL STATUS SCORE IN ICU-HOSPITALIZED PATIENTS INDICATES HIGHER NUTRITIONAL RISK AMONG POST CABG SUBJECTS: A CROSS-SECTIONAL STUDY IN THE NORTH OF IRAN

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Objectives: The current cross-sectional study intended to provide a comparative evaluation of nutritional status in the intensive care unit (ICU)-hospitalized patients according to the reasons for admission.

Methodology: A total of 258 patients hospitalized for >24-hour in the ICU between February 2020- July 2021 were included. The subjects were categorized into five categories: burned injury (n=27), COVID-19 or other respiratory disorders (n=64), post coronary artery bypass graft surgery (post-CABG) (n=50), trauma (n=57), and miscellaneous causes (n=60). A modified Nutrition Risk in Critically Ill (mNUTRIC) score was applied to explore the nutritional status of the patients.

Results: On average, the patients were 58± 16 years old that 46% (n=119) of them were females. The mean± SD of mNUTRIC score among patients with burned 2±1 and COVID-19 or other respiratory disorders 2±1 tended to be significantly lower than the others, including post-CABG 3±0 and patients with miscellaneous causes 3±2 (p-value=0.001). According to mNUTRIC score classifications, the majority of those who were transferred to ICU with burn or COVID-19 or other respiratory disorders were at low nutritional risk (mNUTRIC score:0-<3) (66.70%, and 67.20%, respectively); whereas relatively all post CABG subjects were at intermediate nutritional risk (mNUTRIC score:3-<5) (n= 48, 96.00%). A greater proportion of subjects in the miscellaneous category (n=12, 20.00%) were at high nutritional risk (mNUTRIC score:5-9) (p-value <0.001).

Conclusion: It was revealed that approximately all post CABG and those admitted to ICU with miscellaneous causes were at a higher risk for impaired nutritional status and may require more in-depth evaluation for providing earlier nutritional support.

Keywords: Malnutrition, Nutritional support, Critically ill, Burn, SARS-COV2

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INTRODUCTION

Malnutrition is a condition in which a lack or imbalance of energy, protein, and other micronutrient consumption could lead to altered metabolism, organ dysfunction, and body mass loss.[1,2] This condition is considered an expected outcome in hospitalized patients, affecting approximately 20 to 50 percent. Of note, the majority of the patients are suffering from malnutrition when admitted, and in most of them, this condition deteriorates during hospitalization.[3-6] The high prevalence of malnutrition within severely ill patients is in association with unfavorable outcomes, prolonged hospital stay, nosocomial infection, worse functional conditions upon discharge, and increased mortality.[5] Therefore, impaired nutritional status and malnutrition are considered the most critical nutrition-related problems among various critically ill patients, particularly those admitted to the intensive care unit (ICU).[3,7,8] Critically ill patients are often admitted to the ICU in a very hypotensive status and then are prescribed a significant amount of intravenous liquids, causing fast weight gain and swelling. As a result, anthropometric scales like body mass index (BMI) and tissue fold thickness become imprecise.[9]

In this respect, there are many assessment tools to evaluate nutritional risks in the hospital setting consisting of a variety of criteria such as anthropometrics data, functional assessments, the severity of the disease, nutritional intake, and physical examinations, that many of them cannot be applied to ICU patients since they are usually non-communicable in the critical settings (being on mechanical life supports) and unable to provide details.[9] Also, since quick protein loss in critically ill subjects mainly occurs as a result of a pro-inflammatory state and severe catabolism leading to the release of cytokines and hormones, a nutrition scoring system that contains variables associated with their current metabolic system is of importance.[9,10] Rosa et al. established and validated the NUTRIC score as an initial tool for assessing nutritional risks, particularly for the ICU hospitalized individuals, identifying those in need of aggressive and critical nutritional support.[11] NUTRIC score is an easy and functional tool based on variables including age, Sequential Organ Failure Assessment score (SOFA score), Acute Physiology and Chronic Health Evaluation (APACHE II) score, underlying comorbidities, number of ICU admission days, and interleukin level 6.[12] One limitation of this rating system is the measure of the interleukin-6 (IL-6) that is not consistently available in ICU; therefore, it was suggested to determine the nutritional state of ICU patients where measuring IL-6 is unavailable, with another system called modified NUTRIC (mNUTRIC) score that is a more practical scale to measure in the clinical setting.[3] Overall, the high prevalence of malnutrition in the ICU hospitalized subjects has been documented to impose considerable clinical and economic effects such as an increase in nosocomial infections, which consequently lead to an increment in the length of hospitalization. Besides, an established strong correlation has been reported between nutritional adequacy and mortality during 28 days among subjects with high NUTRIC scores.[1,13-15]

However, to the best of our knowledge, there is limited evidence on the nutritional status of patients in Iranian medical centers according to the reason for admission. Exploring the nutritional status of critically ill patients at ICU could help prioritize the nutrition-related interventions for the ICU admitted individuals. Hence, the current cross-sectional study intended to provide a comparative evaluation of nutritional status scores in ICU-hospitalized patients according to the reasons for admission in educational-medical centers of Rasht city in the north of Iran.

METHODOLOGY

In the present cross-sectional study, adult patients (≥18 years) who have been hospitalized for more than 24 hours in the ICU of educational-medical centers of Rasht, Iran, from February 2020, to July 2021 were enrolled. The exclusion criteria include discharging or deceased in less than a day (24 hours) of admission to ICU. It is worth mentioning that patients who were brought out from other hospitals' ICUs or were readmitted to the same hospital ICU in their hospital stay period, were also excluded from the study. In addition, pregnant women and those with brain death were also excluded.

Demographic and clinical information was collected from patients' records as well as through interviews with supervisors by an expert nutritionist of the team.

Due to the lack of consciousness of ICU patients, informed consent was acquired from the patient's companions or family following explaining the purpose of the investigation. Also, they were assured that all information obtained from the included patients would be kept confidential. The research design was accepted by the cardiovascular diseases research center of University of Medical Sciences (research number=98100705). The present study was in line with the Helsinki Declaration guidelines version 2013. Also, the ethics institution of approved the protocol of the study with the ethical number: IR.GUMS.REC.1398.474.

For nutritional assessment, a modified Nutrition Risk in Critically Ill (mNUTRIC) was used, including all NUTRIC score variables other than IL-6, like age, APACHE score 2, SOFA score, the number of comorbid diseases, number of days of transfer from hospitalization upon ICU admission.

Patients under the age of 50 were given a score of zero, the age group between 50 and under 75 years were given a score of 1, and the age group of 75 years and above were given a score of 2. Also, for the Apache 2 score, which indicates the severity of the disease and should be evaluated within 24 hours after the arrival of the ICU patient, a score between 0 and 71 was provided (including parameters such as mean arterial pressure (mmHg), rectal temperature (C°), heart (HR) and respiratory rate (RR), arterial PH, HCO_3, serum K and Na (mEq/l), serum Cr (meq/dl), hematocrit (HRCT), Total lymphocyte count (TLC) (10^3/cc) and glasgow coma score (GCS). Patients achieving scores less than 15, 15 to less than 20, 20 to less than 28, and 28 and above were given 0, 1, 2, and 3, respectively.

SOFA score examines the function of six main body systems, which includes variables such as mean systolic pressure, serum creatinine (mg/dl) or 24-hour urine volume (ml/day), blood platelets (103 / µL), Bilirubin (mg/dl), GCS, PaO2FiO2 or SaO2 / FiO2 in mmHg. If the acquired points were less than six, the patient was given a 0 score; patients with 6 to less than 10 and 10 or more points were given scores of 1 and 2, respectively.

Moreover, if the number of days the patient was transferred from the admission to the ICU was less than 24 hours, a score of zero and otherwise, a score of one was calculated for him/her. Moreover, in case of absence or having only one comorbidity, 0 scores were considered. Furthermore, one score was calculated if the patient suffers from 2 or more comorbidities. The highest score, regardless of blood interleukin level, would be 9. The validity of this questionnaire was investigated in prior studies.[3,5,12]

Low nutritional risk was considered as an mNUTRIC score: 0-<3, intermediate nutritional risk was described as mNUTRIC score: 3-<5, and high nutritional risk was defined as an mNUTRIC score: 5-9).

Statistical analysis: Applying Kolmogorov–Smirnov test, the normality distribution of data was determined. The distribution of categorical variables was compared by applying chi-square. In addition, analysis of variance (ANOVA) and the Bonferroni post-hoc t-test was conducted to compare the continuous variables on the basis of the reasons for admission to ICU. The studied population was categorized into seven groups, including burned injury, COVID-19 or other respiratory disorders, post-coronary artery bypass graft surgery (CABG), trauma or fractures, and miscellaneous causes including general surgery, penicillin allergy, acute toxicity, cerebrovascular event, or brain trauma, end-stage gastrointestinal or renal cancers. A p- value of less than 0.05 was set as the statistical significance level. Statistical analyses were conducted using SPSS 21 (IBM Armonk, NW, US).

RESULTS

A total of 258 patients (46.1% (n=119) females) with a mean age of 58 (16) years who were transferred to ICU, on average within 4 days of admission to the hospital, were included in the current study. Demographic and clinical features of the study participants are displayed in Tables 1 and 2, overall and according to the reasons for admission to ICU, respectively. More than half of the patients had a history of cardiovascular diseases, and about one-fourth were suffering from diabetes mellitus. Moreover, approximately 48% of the studied population reported a past medical history of immune system dysfunction, hearing or a visual impairment, respiratory, neuromuscular renal or thyroid disorders (Table 1).

Further, the mean (SD) of BMI of the included subjects was about 26.47± 4.38 kg/m^2, and the majority were overweight (BMI 25-29.9 kg/m^2) (47.30%, n=122). The proportion of underweight (BMI<18.5 kg/m^2) and obese (BMI>30 kg/m^2) patients were approximated as 3.9% (n=10) and 17.80% (n=46), respectively. In addition, the mean± SD of APACHE II and SOFA scores of the whole population were about 11±6 and 3±3 at the time of ICU admission. On overage, the NUTRIC score of the subjects was estimated as 3±1. Overall, proportions of patients were at low (mNUTRIC score: 0-<3) or intermediate nutritional risk (mNUTRIC score: 3-<5) (about 43.40% (n=112) and 47.30% (n=122), respectively); whereas a minority of patients (9.30%, n=24) were estimated to be at high nutritional risk (mNUTRIC score: 5-9) based on the mNUTRIC scores algorithm (Table 1).

Table 1: Demographic and clinical features of the study participants

Demographic data	**Summary Statistics**
Age (years)	58±16
Gender	
Men	139 (53.90)
Women	119(46.10)
Past medical history	
Cardiovascular Diseases	158 (61.20)
Diabetes	66 (25.60)
Gastrointestinal Diseases	39 (15.10)
Other types of diseases	124 (48.10)
Drug Abuse	27 (10.50)
Anthropometric data	
Mid Arm Circumference (cm)	28.64±7.07
Body Mass Index (kg/m2)	26.47±4.38
BMI classification	
Underweight	10 (3.90)
Normal weight	80 (31.00)
Overweight	122 (47.30)
Obese	46 (17.80)
Clinical Data	
Days from hospital to ICU admission	4±7
APACHE II score	11±6
SOFA score	3±3
Serum albumin (g/dL)	3.60±0.73
Total protein (g/dL)	6.18±0.87
mNUTRIC Score	3±1
mNUTRIC score classification	
Low nutritional risk (0-<3)	112 (43.40)
Intermediate nutritional risk (3-<5)	122 (47.30)
High nutritional risk	24 (9.30)

Then, on the basis of the reasons for admission to ICU, the studied population were categorized into seven groups including burned patients (n=27, 10.50%), subjects with COVID-19 or other respiratory disorders (n=64, 24.80%), post CABG patients (n=50, 19.40%), individuals with trauma or fractures (n=57, 22.10%), and patients with miscellaneous causes (n=60, 23.300%) including patients with general surgery (n=14), penicillin allergy (n=1), acute toxicity (n=8), cerebrovascular event or brain trauma (n=28), and end-stage gastrointestinal or renal cancers (n=9). The patients' characteristics, including demographic, anthropometric, and clinical data, are compared accordingly. Significant between-group differences were noted regarding age, comorbidities, anthropometric data, days from hospital to ICU admission, serum albumin and total protein, APACHE II, SOFA, and mNUTRIC scores (p-value <0.001) (Table 2).

Overall, the majority of ICU admitted subjects, regardless of the reasons for ICU admission, were indicated to be between 50 to 75 years and had APACHE II and SOFA scores of less than 15 and 6, respectively. Also, it was shown that all CABG patients were classified into groups of APACHE II score of less than 15 and SOFA score of lower than 6, which could predict fewer mortality rates. On the flip side, the majority of burned subjects had an APACHE II score of greater than 28; while those in the miscellaneous group of ICU admitted patients were more likely to have SOFA score greater than 10, which might predict higher mortality rates (p-value <0.001) (Table 2).

Patients with COVID-19 or other respiratory disorders were more likely to be underweight, while burned and post CABG subjects were shown to be more overweight. On the other hand, the prevalence of obesity among patients who were admitted to ICU due to trauma and fracture was greater than the others (p-value <0.001) (Table 2).

Regarding other components of the mNUTRIC score, post-CABG group tended to be older, included a greater frequency of men, had a longer time from hospital to ICU admission, lower APACHE II and SOFA scores, and higher mid-arm circumference. Further, burned patients were shown to have significantly higher serum albumin levels than COVID-19 or other respiratory disorders, post-CABG and miscellaneous causes groups. Besides, burned and post CABG groups demonstrated a significantly greater concentration of serum total protein than patients with COVID-19 or other respiratory disorders and subjects admitted to ICU because of miscellaneous causes (p-value <0.001).

Further, comparing the ICU admitted patients on the basis of the reasons for admission showed that the average nutritional risk scores among burned patients (mean (SD)=2 (1)) and COVID-19 or other respiratory disorders (mean (SD)=2 (1)) tended to be significantly lower than the other groups including post CABG subjects (mean (SD)=3 (0) and patients with miscellaneous causes for ICU admission (mean±SD=3±2) (P-value=0.001). Consistently, according to mNUTRIC score classifications, the majority of those who were transferred to ICU due to burn injury or COVID-19 or other respiratory disorders were shown to be at low nutritional risk (66.70%, and 67.20%, respectively); whereas relatively all post-CABG were noted to be at intermediate nutritional risk (n= 48, 96.00%). On the other hand, a greater proportion of subjects in the miscellaneous category of ICU admission (n=12, 20.0%) were shown to be at high nutritional risk according to mNUTRIC score compared to other patients (p-value <0.001) (Table 3).

Table 2: Comparisons of the patients demographic, anthropometric and clinical characteristics in ICU-hospitalized patients according to the reasons for admission in a cross-sectional study in the north of Iran

	Reason for ICU admission					P-value
	Burned patients	COVID-19 or other respiratory disorders	Post CABG	Trauma and fracture	Miscellaneous causes	
Total (N)	**27**	**64**	**50**	**57**	**60**	-
Demographic data						
Age (years)	52 [a]±14	56±16	63 [a]±9	59±18	58±18	0.041
Gender						
Men	16 (59.30)	26 (40.60)	31 (54.40)	35 (58.30)	31 (62.00)	0.156
Women	11 (40.70)	38 (59.40)	26 (45.60)	25 (41.70)	19 (38.00)	

Past medical history						
Cardiovascular Diseases	7 (25.90)	35 (54.70)	50 (100)	28 (49.10)	38 (63.30)	<0.001
Diabetes	2 (7.40)	7 (10.90)	7 (14.00)	13 (22.80)	10 (16.70)	0.297
Gastrointestinal Diseases	8 (29.60)	14 (21.90)	14 (28.00)	15 (26.30)	15(25.00)	0.928
Other type of diseases	7 (25.90)	49 (76.60 %)	18 (36.00)	20 (35.10)	30 (50.00)	<0.001
Drug Abuse	1 (3.70)	6 (9.40)	6 (12.00)	3 (5.30)	11 (18.30)	0.129
Anthropometric data						
Mid Arm Circumference (cm)	27.11±7.26	25.95± 4.79	32.48± 9.94	29.00±5.90	28.67± 5.79	<0.001
Body Mass Index (kg/m2)	26.69±4.93	25.42±5.10	26.99±2.92	26.92±4.44	26.62±4.21	0.277
BMI category						
Underweight	0	7 (10.90)	1 (2. 00)	1 (1.80)	1 (1.70)	0.028
Normal weight	9 (33.30)	24 (37.50)	10 (20.00)	18 (31.60)	19 (31.7)	
Overweight	14 (51.90)	22 (34.40)	33 (66.00)	24 (42.10)	29 (48.30)	
Obese	4 (14.80)	11 (17.20)	6 (12.00)	14 (24.60)	11 (18.30)	
Clinical Data						
Days from hospital to ICU admission	1±2	0±2	13±8	3±6	2±3	<0.001
APACHE II score	10±8	10±6	8±3	13±6	13±6	<0.001
SOFA score	3±3	3±3	1±2	4±3	4±3	<0.001
Serum albumin (g/dL)	4.05±0.68	3.24±0.64	3.56±0.43	3.89±0.90	3.55±0.68	<0.001
Total protein (g/dL)	6.60±0.62	5.89±1.02	6.44±0.55	6.25±0.72	6.02±1.01	<0.001
Number of Comorbidities						
0-1	14 (51.90)	10 (15.60)	1 (2.00)	20 (35.10)	13 (21.70)	<0.001
≥2	13 (48.10)	54 (84.40)	49 (98.00)	37 (64.90)	47 (78.30)	
Age Category						
<50	9 (33.30)	21 (32.80)	2 (4.00)	19 (33.30)	18 (30.00)	<0.001
50-<75	16 (59.30)	34(53.10)	43(86.00)	26 (45.60)	27(45.00)	
>75	2 (7.40)	9 (14.10)	5 (10.00)	12 (21.10)	15 (25.00)	
APACHE II score Category						
<15	20 (74.10)	50 (78.10)	50(100)	32 (56.10)	38 (63.30)	<0.001
15-<20	4 (14.80)	10 (15.60)	0	19 (33.30)	16 (26.70)	
20-28	2 (7.40)	4 (6.30)	0	6 (10.50)	5 (8.30)	
≥28	1 (3.70)	0	0	0	1 (1.70)	
SOFA score Category						
<6	25 (92.60)	55 (85.90)	50 (100)	42 (73.70)	41 (68.30)	<0.001
6-<10	1 (3.70)	8 (12.50)	0	14 (24.60)	14 (23.30)	
>10	1 (3.70)	1 (1.60)	0	1 (1.80)	5 (8.30)	
Days from hospital to ICU admission category						
0-<1	17 (63.00)	57 (89.10)	0	30 (52.60)	34 (56.70)	<0.001
≥1	10 (37.00)	7 (10.90)	50 (100)	27 (47.4)	26 (43.30)	

APACHE, Acute Physiology and Chronic Health Evaluation; CABG, Coronary artery bypass graft surgery; ICU, intensive care unit; SD, Standard Deviation

Table 3: Comparing mNUTRIC score findings in ICU-hospitalized patients according to the reasons for admission in a cross-sectional study in the north of Iran

	Reason for ICU admission					P value
	Burned patients	**COVID-19 or other respiratory disorders**	**Post CABG**	**Trauma and fracture**	**Miscellaneous causes**	
mNUTRIC Score	2±1	2±1	3±0	3±2	3±2	0.001
Low nutritional risk (0-<3)	18(66.70)	43 (67.20)	2 (4.00)	26 (45.60)	23 (38.30)	<0.001
Intermediate nutritional risk (3-<5)	7 (25.90)	17 (26.60)	48 (96.00)	25 (43.90)	25 (41.70)	
High nutritional risk (5-9)	2 (7.40)	4 (6.30)	0	6 (10.50)	12 (20.00)	

DISCUSSION

The current study investigating the nutritional state of critically ill patients using mNutric score showed that overall, the majority of ICU admitted patients, regardless of the reason of hospitalization, were at low or intermediate nutritional risk (mNUTRIC score up to 5), and only a minority of patients (9.3%) were considered as the high nutritional risk group (mNUTRIC score: 5-9).

It is worth noting that ICU patients' nutritional status worsens quickly due to protein and energy loss even if they are brought into a well-nourished condition.[10] The

nutritional status of ICU patients is affected by acute and chronic hunger, which causes catabolic procedures like loss of body mass and dysfunction of one or more organs.[13,16,17]

According to the previous literature, the prevalence of malnutrition in critically ill patients requiring ICU admissions differs between 38% to 78% depending on the used nutritional screening tool and heterogeneous definition of malnutrition.[18] The mean of mNUTRIC score in this study population was estimated less than Heyland et al. study (the original study of NUTRIC score), and that might be because of the younger population of the current study compared to that original validation survey (58 vs. 65 years).[16] In another study, Zheng et al. depicted that 36.90% of patients in the cardiothoracic surgery recovery unit were found to be at high nutritional risk via mNUTRIC score assessment.[19] In addition, earlier studies have reported up to 80% malnutrition risk in critically ill patients in Iran independently associated with unfavorable clinical outcomes.[20] In a cross-sectional study in Isfahan in 2019, it was shown that most patients at high nutritional risk do not receive enough energy and subsequently suffer from malnutrition.[6] In contrast to our findings, Osooli et al. in thas study revealed a prevalence of 52.70% high nutritional risk based on NUTRIC score in ICU patients of a medical center in Isfahan.[6] Also, similar studies on Indian and Portuguese ICU patients reported that about 42.50% and 48.60% of MV patients were at nutritional risk with a NUTRIC score of $\geq$5.[5,17] Moreover, a prospective study performed in Pakistan hospitals in 2018 found that 55% of patients in need of mechanical ventilation (MV) transferred to the ICU were exposed to nutritional risk, and their nutritional value increased directly with increasing hospital length and mortality.[15] Within that research, Ishtiaq et al., reported that 45% of their subjects were found to be at high nutritional risk based on mNUTRIC score results.[15] Meanwhile, a number of single-center surveys evaluated the nutritional status of ICU admitted patients with specific critically ill conditions.[6,15]

Exploring the nutritional status of critically ill patients at ICU could be helpful in prioritizing the nutrition related interventions for the ICU admitted individuals. Besides, people who are living in the north of Iran appeared to have some special dietary habits and lifestyle based on the cultural background and geographical location.[21] The reasons for ICU hospitalizations might be a determinant factor in the observed differences in the prevalence of impaired nutritional status among patients with various medical conditions. The present multicenter study was conducted on critically ill patients admitted to several university-affiliated hospitals due to different reasons comprising COVID-19 infection and severe respiratory diseases, burn injuries, post CABG, trauma, and other miscellaneous causes. Overall, it was indicated that approximately all post-CABG patients, as well as those who were admitted to ICU due to miscellaneous causes including general surgery, penicillin allergy, acute toxicity, cerebrovascular event or brain trauma, end-stage gastrointestinal or renal cancers were at higher risk for impaired nutritional status may require more in-depth evaluation for providing early nutritional support. Patients in the current study had a mean age of 58 years and were transferred to ICU, on average, during four days of admission to the hospital. More than half of the study population reported to have a previous history of cardiovascular disorders, and one-third were suffering from DM. In the study by Lin et al., in Taiwan, patients had an average age of 63.9 years, with hypertension and CVD as the most prevalent comorbidities. Also, the mean of ICU and hospital stay for all patients was 5.1 and 20.7 days, respectively.[22] In the Ishtiaq et al. survey, ICU admitted patients' mean age was 55.85 years, and the most common comorbidities were hypertension and DM.[15] In another prior study, patients had a mean age of 57.42 years, and the duration of hospital/ICU stay was reported as 12.14/10.30 days.[6]

The significance of illness severity and inflammation has been well established in screening malnutrition.[23] Nutritional risk assessment tools such as the NUTRIC score evaluate not only the nutritional state but also consider the severity of the disease by assessing the APACHE Ⅱ score. Moreover, the NUTRIC scoring system takes into consideration the SOFA score to estimate organ dysfunction levels and the mortality risk. This study showed that although most of the studied ICU patients, regardless of the reasons for ICU admission, had APACHE II and SOFA scores less than 15 and 6, respectively, the majority of burned subjects had APACHE II scores of greater than 28. Those in the miscellaneous group of ICU admitted patients were more likely to have a SOFA score greater than 10, which might predict higher mortality rates. Previous studies have well recognized that severe burn injuries could cause systemic inflammatory response syndrome, damage to distant organs, and long-term sequel as a result of systemic immune reactions, which can last for months.[22] In addition, trauma immediately induces inflammation and damage associated with molecular patterns (DAMPs) via injured and necrotic tissues boosting the immune system to engage immune cells in the acute phase.[24]

Concerning the different categories of ICU admitted patients, the present study found that the average nutritional risk scores among burned patients and COVID-19 or other respiratory disorders tended to be significantly lower than the post CABG subjects and those with miscellaneous causes for ICU admission such as trauma. Post CABG group tended to be older, had a longer time from hospital to ICU admission, had lower APACHE II and SOFA scores, and had higher mid-arm circumference. Besides, burned and post CABG groups were found to have significantly higher serum total protein than patients with COVID-19 or other respiratory disorders and subjects admitted with miscellaneous causes. Likewise, Zheng et al. evaluating the prognostic value of mNUTRIC score for individuals who underwent cardiothoracic surgery implied that 36.9% of their population were at high nutritional risk.[19] Cardio-thoracic surgery can lead to surgical trauma, resulting in delayed nutritional support therapy.[19] Also, the fast deterioration caused by surgical stress increase in catabolism, in addition to post-surgery complications, can lead to calorie and protein loss.[19,22] Of note, trauma patients are in a hyper-metabolic condition with even higher than standard nutritional requirements.[20] However, contrary to our findings, a recent study carried out in Wuhan, China assessing the nutritional risk of critically ill COVID-19 patients a high nutritional risk (≥5 points) was observed in 61% of their population.[14] One explanation for the discrepancies between studies regarding the prevalence of high nutritional risk in COVID-19 patients may be a long time from the onset of COVID-19 until admission to the ICU (median: 14 days, IQR: 10–18) in Zhang et al. survey, which in this period, heightened catabolism and inadequate nutritional consumption, caused by the disease, might lead to even worse nutritional status.[14]

One of the main findings of the present study indicating a low overall prevalence of high nutritional risk regardless of the reason of hospitalization might be related to the availability of dietitians' services in almost all of the evaluated university hospitals. In this regard, the lower distribution of impaired nutritional status among burned patients and those with COVID-19 or other respiratory disorders may be related to the fact that these patients are among the well-known groups needing nutritional support as a vital component of medical care and, thus, received more appropriate and timely nutritional interventions. Further, since burn injury could result in a sustainable hyper- metabolic state and exacerbate metabolic rates catabolic activities, it can consequently lead to wasting muscles and ultimately cachexia.[25]

Applying the modified-NUTRIC score as a specific instrument for nutritional assessment in the ICU to explore the nutrition status of the patients was among the strengths of the current study. This instrument seems to be cost-effective, quickly completed, and applicable in the ICU setting since it includes factors available in the hospitals' medical documents, other than the pro-inflammatory marker, IL-6, which is not usually assessed in the medical care settings. Besides, categorizing the ICU-admitted patients into subgroups based on their medical conditions might further our knowledge regarding the nutrition-related interventions for the ICU admitted individuals.

However, there are also a number of limitations with this research. First of all, the researchers were not able to evaluate supplements use applying the mNUTRIC score as this instrument could only explore the macronutrients and energy adequacy. In addition, using additional assessment tools and comparing the findings might have been more useful in providing a comprehensive understanding of the patients' nutritional status. Furthermore, since the present research has a cross-sectional design, this issue might affect the generalizability of the observed findings.

CONCLUSION

The current study investigating the nutritional state of critically ill patients using mNutric score revealed that overall, the majority of ICU admitted patients, regardless of the reason of hospitalization, were at low or intermediate nutritional risk. The reasons for ICU hospitalizations might be a determinant factor in the observed differences in the prevalence of impaired nutritional status among patients with various medical conditions. The present multicenter research indicated that approximately all post-CABG and those who were admitted to ICU due to miscellaneous causes, including general surgery, penicillin allergy, acute toxicity, cerebrovascular event or brain trauma, end-stage gastrointestinal or renal cancers, were at higher risk for impaired nutritional status. Thus, the physicians and health care professionals concerning these patients should be aware that they may require more in-depth evaluation for providing early nutritional support.

AUTHORS' CONTRIBUTION

MH and MMR: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. MH, ZG, AZV, EP, HAB, and MMR: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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REFERENCES

1. Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. Clin Nutr. 2008;27(1):5-15.
2. Saunders J, Smith T. Malnutrition: causes and consequences. Clin Med (Northfield Il). 2010;10(6):624.
3. de Vries MC, Koekkoek WK, Opdam MH, van Blokland D, van Zanten AR. Nutritional assessment of critically ill patients: validation of the modified NUTRIC score. Eur J Clin Nutr. 2018;72(3):428-35.
4. Jeong DH, Hong S-B, Lim C-M, Koh Y, Seo J, Kim Y, et al. Comparison of accuracy of NUTRIC and modified NUTRIC scores in predicting 28-day mortality in patients with sepsis: a single center retrospective study. Nutrients. 2018;10(7):911.
5. Mendes R, Policarpo S, Fortuna P, Alves M, Virella D, Heyland DK, et al. Nutritional risk assessment and cultural validation of the modified NUTRIC score in critically ill patients—a multicenter prospective cohort study. J Crit Care. 2017;37:45-9.
6. Osooli F, Abbas S, Farsaei S, Adibi P. Identifying critically ill patients at risk of malnutrition and underfeeding: a prospective study at an academic hospital. Adv Pharm Bull. 2019;9(2):314.
7. Shilan A, Kasmaei P, Farmanbar R, Shakiba M, Mahdaviroushan M, Zareban I, et al. Factors predicting nutritional behaviors related to gastric cancer: A model-guided study. Drug Invent Today. 2018;10(6):936-41.
8. Ghorbani Z, Pourshams A, Fazeltabar Malekshah A, Sharafkhah M, Poustchi H, Hekmatdoost A. Major Dietary Protein Sources in Relation to Pancreatic Cancer: a Large Prospective Study. Arch Iran Med. 2016;19 4:248-56.
9. Mukhopadhyay A, Henry J, Ong V, Leong CS-F, Teh AL, van Dam RM, et al. Association of modified NUTRIC score with 28-day mortality in critically ill patients. Clin Nutr. 2017;36(4):1143-8.
10. Kondrup J. Nutritional-risk scoring systems in the intensive care unit. Curr Opin Clin Nutr Metab Care. 2014;17(2):177-82.
11. Rosa M, Heyland DK, Fernandes D, Rabito EI, Oliveira ML, Marcadenti A. Translation and adaptation of the NUTRIC Score to identify critically ill patients who benefit the most from nutrition therapy. Clin Nutr ESPEN. 2016;14:31-6.
12. McClave SA, Taylor BE, Martindale RG, Warren MM, Johnson DR, Braunschweig C, et al. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (ASPEN). JPEN J Parenter Enteral Nutr. 2016;40(2):159-211.
13. Rahman A, Hasan RM, Agarwala R, Martin C, Day AG, Heyland DK. Identifying critically-ill patients who will benefit most from nutritional therapy: further validation of the "modified NUTRIC" nutritional risk assessment tool. Clin Nutr. 2016;35(1):158-62.
14. Zhang P, He Z, Yu G, Peng D, Feng Y, Ling J, et al. The modified NUTRIC score can be used for nutritional risk assessment as well as prognosis prediction in critically ill COVID-19 patients. Clin Nutr. 2021;40(2):534-41.
15. Ishtiaq W, Yousaf M, Bano S, Mujahid AM, Akhtar A. Modified nutrition risk in critically ill (mNUTRIC) score to assess nutritional risk in mechanically ventilated patients: a prospective observational study from the Pakistani population. Cureus. 2018;10(12):e3786.
16. Heyland DK, Dhaliwal R, Jiang X, Day AG. Identifying critically ill patients who benefit the most from nutrition therapy: the development and initial validation of a novel risk assessment tool. Critical Care. 2011;15(6):1-11.
17. Kalaiselvan M, Renuka M, Arunkumar A. Use of nutrition risk in critically ill (NUTRIC) score to assess nutritional risk in mechanically ventilated patients: a prospective observational study. Indian J Crit Care Med. 2017;21(5):253.
18. Lew CCH, Yandell R, Fraser RJ, Chua AP, Chong MFF, Miller M. Association between malnutrition and clinical outcomes in the intensive care unit: a systematic review. JPEN J Parenter Enteral Nutr. 2017;41(5):744-58.
19. Zheng C, Xie K, Li XK, Wang GM, Luo J, Zhang C, et al. The prognostic value of modified NUTRIC score for Patients in cardiothoracic surgery recovery unit: a retrospective cohort study. J Hum Nutr Diet. 2021;34(6):926-34.
20. Kimiaei-Asadi H, Tavakolitalab A. The assessment of the malnutrition in traumatic ICU patients in Iran. Electron Physician. 2017;9(6):4689.
21. Salari A, Mahdavi-Roshan M, Hasandokht T, Gholipour M, Soltanipour S, Nagshbandi M, et al. Nutritional intake, depressive symptoms and vitamin D status in hypertensive patients in the north of Iran: A case-control study. Hipertens Riesgo Vasc. 2017;34(2):65-71.
22. Lin P-Y, Yen Y-T, Lam C-T, Li K-C, Lu M-J, Hsu H-S. Use of modified-NUTRIC score to assess nutritional risk in surgical intensive care unit. J Chin Med Assoc. 2021;84(9):860-4.
23. Jensen GL, Compher C, Sullivan DH, Mullin GE. Recognizing malnutrition in adults: definitions and characteristics, screening, assessment, and team approach. JPEN J Parenter Enteral Nutr. 2013;37(6):802-7.
24. Rani M, Nicholson SE, Zhang Q, Schwacha MG. Damage-associated molecular patterns (DAMPs) released after burn are associated with inflammation and monocyte activation. Burns. 2017;43(2):297-303.
25. Clark A, Imran J, Madni T, Wolf SE. Nutrition and metabolism in burn patients. Burns Trauma. 2017;5(1):11.

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