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Evaluation of clinical outcomes with the modified nutritional risk score in critically ill patients

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ABSTRACT

Aims: Our aim in this study was to evaluate the effectiveness of the modified nutrition risk score (mNUTRIC) score in predicting clinical outcomes and mortality in patients admitted to intensive care units (ICUs).

Methods: This study was designed as a prospective observational cohort study. It was conducted in patients admitted to the Anesthesiology and Reanimation ICUs of Pamukkale University Hospital. The primary outcome measure of this study was the comparison of mNUTRIC scores at days 2, 7, and 12 between survivors and non-survivors. Secondary outcome measures included the effectiveness of predicting the necessity for invasive mechanical ventilation (IMV), hemodialysis, and vasopressor or inotropic support. Additionally, the study examined the impact of nutritional adequacy (categorized as hypocaloric or hypercaloric) and protein intake levels (classified as low, medium and high) on mortality among patients. Student's T test or Mann-Whitney U test was used for comparisons involving continuous variables, and the Chi-square test was used for categorical variables.

Results: The mNUTRIC scores of 176 patients who participated in the study were meticulously assessed. In this context, mNUTRIC scores were computed for the entirety of the patient cohort (n=176) on the second day for 91 patients on the seventh day, and for forty-six patients on the twelfth day on the second day the APACHE II, SOFA, and mNUTRIC scores exhibited significantly elevated values in patients who succumbed to their conditions (22.60±7.94, 6.81±3.03, and 5.00±2.03) in contrast to those who survived (16.99±5.05, 3.94±2.26, and 3.32±1.48, all p<0.001). On the seventh day these scores persisted at heightened levels in deceased patients (24.38±7.07, 6.82±3.52, and 5.00±1.61) relative to survivors (18.06±4.70, 3.85±2.10, and 3.50±1.58, all p<0.001). On the twelfth day the APACHE II, SOFA, and mNUTRIC scores recorded were 25.61±7.18, 7.00±3.57, and 5.52±1.81 for patients who did not survive, whereas survivors had scores of 18.70±5.88, 4.39±1.75, and 3.39±2.02 (p=0.001, p=0.008, p<0.001, respectively).

Conclusion: Statistically significant differences were observed in the APACHE II, SOFA, and mNUTRIC scores on days 2, 7, and 12 between surviving and deceased patients. However, it was observed that nutritional adequacy and protein intake were not determinants that directly affected the mortality risk in critically ill patients with high mNUTRIC scores.

Keywords: mNUTRIC, intensive care unit, mortality, morbidity, scoring system

INTRODUCTION

Nutritional deficiencies are common in critically ill patients in intensive care units (ICUs). Malnutrition rates range from 39% to 50%. This difference in the malnutrition rates of patients is influenced by patient demographics and screening methodologies used for evaluation.[1] Even patients with good nutritional status prior to intensive care unit (ICU) admission can experience significant declines in their nutrition during their stay in the intensive care unit. The acute phase response seen in critical illnesses triggers catabolism and a series of reactions, leading to a hypermetabolic state, which can initiate malnutrition or exacerbate an existing condition, thereby increasing mortality. This effect is particularly pronounced in elderly patients.[2] Research indicates that malnutrition is associated with accelerated protein loss, muscle mass reduction, sarcopenia, frailty, inadequate protein intake, and nutritional imbalances.[3] Research in the literature states that malnutrition increases health care costs and prolongs hospital stays. They also revealed that it also caused an increase in complication and mortality rates. Consequently, the prompt recognition and appropriate execution of nutritional risk management strategies among patients in the ICU is imperative for enhancing patient outcomes.[4]

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Critical care scoring systems are instrumental in assessing the severity of illness and in determining the risk of mortality. Such systems are routinely employed to facilitate clinical decision-making processes within the intensive care setting.[5,6] The acute physiology and chronic health evaluation II (APACHE II) and sequential organ failure assessment (SOFA) scoring systems are frequently utilized in intensive care unit (ICU) populations to assess the severity of illness and to project potential mortality risk.[6,7] The APACHE II scoring system is a comprehensive evaluation tool that examines critical physiological indicators including but not limited to temperature, heart rate, respiratory rate, blood pressure, and arterial pH levels. In the computation of the aggregate score, it additionally considers the patient's age and pre-existing health conditions.[8,9] The SOFA score systematically assesses 6 organ systems, which include respiratory, coagulation, hepatic, cardiovascular, central nervous system, and renal functions. This evaluation is contingent upon distinct clinical and laboratory metrics. It is utilized to quantify the severity of organ dysfunction and to prognosticate disease outcomes, especially among individuals diagnosed with sepsis.[10,11] These evaluative frameworks, commonly employed within critical care settings, are integral in the determination of disease severity and the assessment of organ impairment. Nevertheless, these frameworks inadequately address the nutritional status of the patient population. Therefore, alternative methodologies are imperative to comprehensively assess nutritional vulnerabilities. In order to mitigate this constraint, Heyland and his research team developed the nutritional risk score (NUTRIC) specifically designed for patients in critical condition. NUTRIC integrates pre-hospitalization nutritional status, inflammation markers (such as interleukin-6 and the number of comorbidities), and disease severity scores. With this method, the assessment of nutritional risk in critically patients was provided.[12] The use of interleukin-6 (IL-6), which is not routinely measured in many ICU, is a disadvantage of the NUTRIC score. For this reason, Heyland and his team proposed that IL-6 should be excluded from the calculation when it is not present, and they called the calculation of this score the modified NUTRIC score (mNUTRIC). The metric score has been shown to be useful for clinical use in several studies.[13,14]

Our aim in this study was to evaluate the effectiveness of the mNUTRIC score in predicting clinical outcomes and mortality in patients admitted to intensive care. Our hypothesis, it is considered that the mNUTRIC measured will be as effective a tool for predicting clinical outcomes as the APACHE II and SOFA scores commonly used in the clinic.

METHODS

This study was planned as a prospective observational cohort study in patients admitted to the Anesthesiology and Reanimation ICU of Pamukkale University Hospital. Ethical approval was obtained from the Pamukkale University Non-interventional Clinical Researches Ethics Committee (Date: 29.09.2023, Decision No: 426637). The study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

All patients over 18 years of age who were admitted to critical care units and agreed to take part in the research were included. Exclusion criteria were as follows: patients who were discharged from the ICU within 48 hours or exitus, trauma patients, postoperative patients, patients admitted to the ICU due to intoxication or suicide, patients who were taken over after being followed up in other ICU, patients with recurrent ICU admissions, and patients who refused to take part in the study.

The patients were followed up for 28 days after being admitted to the ICU. During this period, vital parameters (mean arterial pressure, body temperature, heart rate, oxygenation status, respiratory rate) and biochemical values (arterial blood pH, PaO_2, venous blood bicarbonate, sodium, potassium, creatinine, leukocyte, hematocrit, platelet, bilirubin) were documented and APACHE II and SOFA scores were calculated. Albumin, total protein, CRP and PRC values were also recorded to assess nutritional status.

Body-mass index (BMI) was calculated by recording demographic information (age, gender), ICU hospitalization diagnosis, comorbidities, height and body weight of the patients. In addition, glasgow coma scores (GCS) were assessed at admission and patients were scored between 3-15 points according to eye opening, motor response and verbal response. In this score low values indicate high neurologic deficit; 15-14 points indicate mild, 13-9 points moderate and 8-3 points severe damage.[15]

When determining the acute physiology score in APACHE II scoring, the parameters measured within the first 24 hours after admission to the ICU are used. In subsequent measurements, the worst value in the last 24 hours is taken as basis. Chronic health status is scored between 0-5, taking into consideration the patient's health status in the last six months. Physiological variables include mean arterial pressure, body temperature, heart rate, partial arterial oxygen pressure (PaO_2), respiratory rate, arterial blood pH and bicarbonate, sodium, potassium, serum creatinine, leukocytes, hematocrit and blood glucose level. These variables are scored between 0-4. In addition, the patient's age is included in the assessment by scoring between 0-6. GCS is added to these variables and the total APACHE II score is calculated as a maximum of 71.[16]

Originally developed to assess sepsis-related organ dysfunction, the SOFA score has been validated over time for use in non-septic patient populations. The SOFA includes six variables assessing respiratory, coagulation, hepatic, cardiovascular, renal and neurologic systems. Each variable is scored between 0 and 4, with a maximum total score of 24.[17]

During the follow-up of the patients, their needs for intensive care support treatments were recorded. Treatments such as hemodialysis, vasopressor/inotrope support, invasive mechanical ventilation (IMV) support and the number of days these treatments were applied were tracked. In addition, the duration of the patients' stay in ICU and post- ICU outcomes (deceased/living) were documented.

The mNUTRIC scores of the patients were calculated based on age, comorbidities, length of hospital stay before ICU admission, APACHE II score, and SOFA score. A score of 0-2 was given for age (0 points for individuals under 50 years, 1 point for those between 50 and 75 years, and 2 points for those aged 75 and above). 0-1 for number of comorbidities, 0-1 for time spent in hospital before ICU admission, 0-3 for APACHE II score and 0-2 for SOFA score. The mNUTRIC score was obtained with the sum of these scores. mNUTRIC score was evaluated on the 2nd, 7th and 12th days of ICU hospitalization. Score between 0-4 points was considered as a low mNUTRIC score. Whereas a score between 5-9 points was considered as a high mNUTRIC score and indicated a high risk of malnutrition, worse clinical outcomes.[12]

Nutritional support to be administered to patients was calculated according to the intensive care clinical nutrition guideline updated by ESPEN in 2023.[18]

Every patient admitted to the intensive care unit was considered at risk of malnutrition. When the digestive system was functional, oral and enteral nutrition were initiated as the first options. For patients in whom enteral feeding was not possible, parenteral nutrition was started within the first 48 hours. Calorie requirement was determined as 25 kcal/kg/day based on actual body weight in patients with BMI <25 kg/m² and ideal body weight in patients with BMI >25 kg/m². Protein intake was planned as 1.3 g/kg/day. Nutritional support was applied unchanged by the study team. Nutritional adequacy was calculated as the ratio of total calories taken to total calories prescribed (nutritional adequacy = calories taken / calories prescribed). Accordingly, patients were classified as hypocaloric (<80% nutritional adequacy) and hypercaloric (>80% nutritional adequacy). Furthermore, protein intake was categorized as low (below 1.2 g/kg/day), median (between 1.2 and 1.5 g/kg/day), and high (above 1.5 g/kg/day).

The primary outcome measure of this study was the comparison of mNUTRIC scores at days 2, 7, and 12 between survivors and non-survivors. Secondary outcome measures included the effectiveness of the mNUTRIC score in predicting the necessity for IMV, hemodialysis, and vasopressor or inotropic support. Additionally, the study examined the impact of nutritional adequacy (categorized as hypocaloric or hypercaloric) and protein intake levels (classified as low or high) on mortality among patients with elevated mNUTRIC scores.

Statistical Analysis

The research data were analyzed using the SPSS version 21.0 statistical software. Descriptive statistics were reported using frequency (n), percentage (%), mean, standard deviation (SD), median, and the minimum and maximum values. The Chi-square test was employed to assess differences between categorical variables. In the comparison of continuous variables in independent groups, student's T test and Mann-Whitney U test were used if they did not comply with parametric assumptions. p values less than 0.05 were considered significant. Sensitivity and specificity analyses were performed to evaluate whether a variable had diagnostic or exclusionary properties.

RESULTS

The 616 patients were enrolled in the study; however, 440 patients were excluded based on predetermined exclusion criteria. The reasons for exclusion included: 281 patients who were undergoing postoperative follow-up, 79 patients admitted to the ICU as a result of traffic accidents, 10 patients treated for poisoning or suicide attempts, 52 patients who were either discharged or deceased within the first 48 hours of admission to the ICU, 8 patients transferred from other ICU and 10 patients who declined to provide informed consent.

The mNUTRIC scores of of 176 patients included in the study were evaluated. In this context, mNUTRIC scores were calculated for all patients (n=176) On the second day 91 patients, on the seventh day and 46 patients on the twelfth day (**Figure 1**).

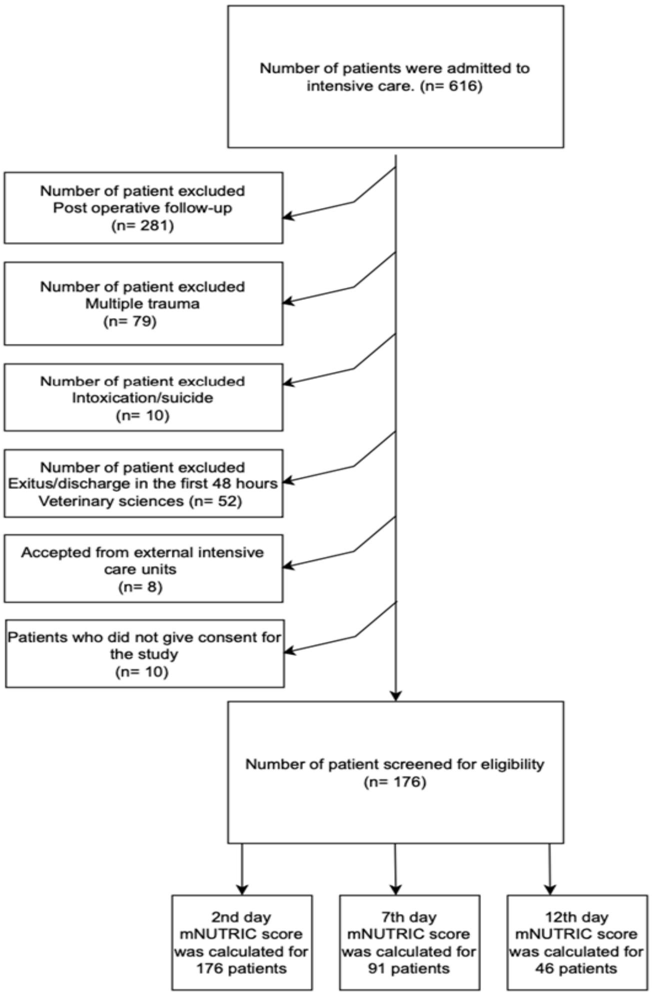

Figure 1. Flow chart

Demographic and hospitalization characteristics of patients in the ICU were evaluated (**Table 1**). A total of 176 patients participated in the study, comprising 95 males (54.0%) and 81 females (46.0%) (p=0.475). The age of the patients was mean 68.34±14.04 years, and the BMI was 27.38±7.57 kg/m². Among the patients, 3.4% (n=6) had no comorbidities, 29.5% (n=52) had one comorbidity, and 67.0% (n=118) had two or more comorbidities (p<0.001).

Table 1. Demographic data and intensive care unit hospitalization characteristics of patients

Variables		n (%)
Gender	Male	95 (54.0)
	Female	81 (46.0)
Number of comorbidities	0	6 (3.4)
	1	52 (29.5)
	2 or more	118 (67.0)
ICU hospitalization	Respiratory	99 (56.3)
	Cardiovascular	10 (5.7)
	Gastrointestinal	8 (4.5)
	Urogenital	9 (5.1)
	Endocrine	3 (1.7)
	Neurological	9 (5.1)
	Malignancy	12 (6.8)
	Hematological	0 (.0)
	Sepsis	26 (14.8)
Hemodialysis	Treatment	51 (29.0)
	Not treatment	125 (71.0)
Vasopressor inotropes	Treatment	94(53,4)
	Not treatment	82(46,6)
ICU status	Died	77 (43.8)
	Living	99 (56.3)
		Median±SD
Age		68.34±14.04
Length (m)		1.66±.08
Body weight (kg)		75.26±20.62
BMI		27.38±7.57
Number of days ICU		10.46±8.13
Number of days IMV		3.89±7.93

ICU: Intensive care unit, BMI: Body-mass index, IMV: Invasive mechanical ventilation

The most prevalent diagnosis leading to ICU admission was respiratory system diseases, accounting for 56.3% (n=99) of cases, followed by sepsis (14.8%, n=26), malignancy (6.8%, n=12), and cardiovascular system diseases (5.7%, n=10) ($p<0.001$). Gastrointestinal (4.5%, n=8), urogenital (5.1%, n=9), endocrine (1.7%, n=3), and neurological diseases (5.1%, n=9) were less common reasons for admission, while no patients were admitted due to hematological conditions.

When the need for intensive care support therapies was analyzed, 29.0% (n=51) of the patients received hemodialysis treatment, while 71.0% (n=125) did not ($p=0.002$). Additionally, 53.4% (n=94) of the patients received vasopressor/inotrope support, whereas 46.6% (n=82) did not ($p<0.001$). The number of days spent under IMV support was 3.89±7.93 days ($p=0.015$).

When the status of the patients after intensive care was analyzed, it was observed that 43.8% (n=77) of the patients died, while 56.3% (n=99) survived ($p=0.029$). The total duration of ICU stay was 10.46±8.13 days.

The scores of the scoring systems were evaluated in living and deceased patients. On the second day, the APACHE II score was 22.60±7.94 in deceased patients and 16.99±5.05 in living patients ($p<0.001$), the SOFA score was 6.81±3.03 in deceased patients and 3.94±2.26 in living patients ($p<0.001$), and the mNUTRIC score was 5.00±2.03 in deceased patients and 3.32±1.48 in living patients ($p<0.001$). On the seventh day the APACHE II score was 24.38±7.07 in deceased patients and 18.06±4.70 in living patients ($p<0.001$), the SOFA score was 6.82±3.52 in deceased patients and 3.85±2.10 in living patients ($p<0.001$), and the mNUTRIC score was 5.00±1.61 in deceased patients and 3.50±1.58 in living patients ($p<0.001$). On the twelfth day the APACHE II score was 25.61±7.18 in deceased patients and 18.70±5.88 in living patients ($p=0.001$), the SOFA score was 7.00±3.57 in deceased patients and 4.39±1.75 in living patients ($p=0.008$) and the mNUTRIC score was 5.52±1.81 in deceased patients and 3.3 9±2.02 for living patients ($p<0.001$) (Table 2).

Table 2. Comparison of intensive care scoring scores of deceased and living patients

	Died (n=77)	Living (n=99)	p
APACHE 2 2nd day	22.60±7.94	16.99±5.05	<0.001
SOFA 2nd day	6.81±3.03	3.94±2.26	<0.001
mNUTRIC 2nd day	5.00±2.03	3.32±1.48	<0.001
APACHE 2 7th day	24.38±7.07	18.06±4.70	<0.001*
SOFA 7th day	6.82±3.52	3.85±2.10	<0.001
mNUTRIC 7th day	5.00±1.61	3.50±1.58	<0.001
APACHE 2 12th day	25.61±7.18	18.70±5.88	0.001
SOFA 12th day	7.00±3.57	4.39±1.75	0.008
mNUTRIC 12th day	5.52±1.81	3.39±2.02	<0.001*

APACHE II: Acute physiology and chronic health evaluation II, SOFA: Sequential organ failure assessment, mNUTRIC: Modified nutrition risk score

ROC analysis was employed to assess the impact of mNUTRIC scores in forecasting mortality on days 2, 7, and 12 (Figure 2). Based on the analysis, the cut-off value was determined as 4.5 for the three time points. On the second day mNUTRIC score showed a predictive value for mortality with 60.9% sensitivity and 65.2% specificity (AUC=0.716; 95% CI: 0.564-0.867; $p=0.012$ On the seventh day the score showed 69.6% sensitivity and 60.9% specificity (AUC=0.673; 95% CI: 0.517-0.828; $p=0.044$). On the twelfth day the predictive power was found at 73.9% sensitivity and 60.9% specificity (AUC=0.770; 95% CI: 0.636-0.905; $p=0.002$).

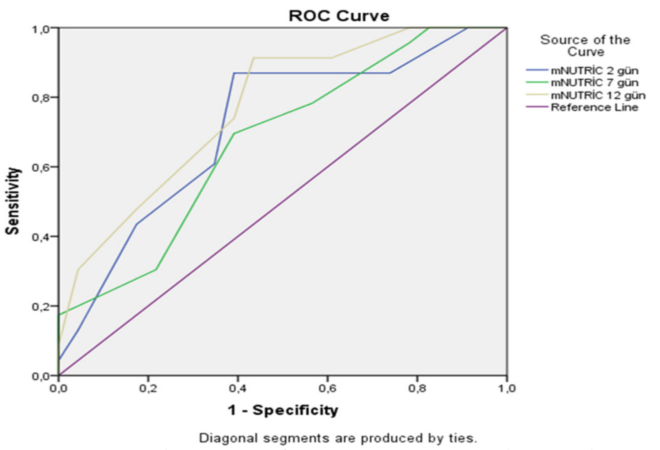

Figure 2. ROC analysis: power of mNUTRIC scores to predict mortality

ROC: Receiver operating characteristic, mNUTRIC: Modified nutrition risk score

The predictive values of mNUTRIC scores in predicting the need for hemodialysis, vasopressor/inotrope support and IMV support were compared (Table 3). In predicting the need for hemodialysis support, the mNUTRIC scores demonstrated the following performance metrics: the sensitivity of the mNUTRIC score On the second day was 66.7% with a specificity of 73.6% (p<0.001); On the seventh day the sensitivity was 69.0% and the specificity was 66.1% (p=0.002); and on the twelfth day the sensitivity increased to 77.8% while the specificity decreased to 57.1% (p=0.020).

Regarding the prediction of vasopressor or inotropic support, the mNUTRIC score exhibited a sensitivity of 52.1% and a specificity of 78.0% On the second day (p<0.001); On the seventh day the sensitivity was 59.3% with a specificity of 75.7% (p=0.001); and on the twelfth day the sensitivity rose to 67.7% while the specificity was reported at 66.7% (p=0.027).

In predicting the need for IMV support, the sensitivity of the mNUTRIC score on the second day was 55.3% with a specificity of 78.0% (p<0.001); On the seventh day the sensitivity increased to 64.4% with a specificity of 73.9% (p<0.001); and on the twelfth day the sensitivity was 67.7% while the specificity was 66.7% (p=0.027).

In our study, we evaluated the relationship between nutritional adequacy and mortality among patients with elevated mNUTRIC scores (Table 4). The analysis revealed no statistically significant association between nutritional adequacy and mortality in this patient population with high mNUTRIC scores. On the second day among patients with elevated mNUTRIC scores, 76.2% of those who received hypocaloric nutrition and 80.0% of those who received hypercaloric nutrition died (p=1.000). On the seventh day the mortality rate was 73.7% in patients with hypocaloric nutrition and 75.0% in those with hypercaloric nutrition (p=1.000). On the twelfth day the mortality rate was 63.6% in patients with hypocaloric nutrition and 62.5% in those with hypercaloric nutrition (p=1.000).

Table 4. The relationship between nutritional adequacy and mortality in patients with elevated mNUTRIC score

			ICU status				
			Died		Living		
			n	%	n	%	p
mNUTRIC 2nd day	Nutritional adequacy	Hypocaloric	16	76.2	5	23.8	1.000
		Hypercaloric	12	80.0	3	20.0	
mNUTRIC 7th day	Nutritional adequacy	Hypocaloric	14	73.7	5	26.3	1.000
		Hypercaloric	6	75.0	2	25.0	
mNUTRIC 12th day	Nutritional adequacy	Hypocaloric	7	63.6	4	36.4	1.000
		Hypercaloric	5	62.5	3	37.5	

mNUTRIC: Modified nutrition risk score, ICU: Intensive care unit

The relationship between protein intake and mortality among patients with elevated mNUTRIC scores was assessed (Table 5). The analysis indicated that there was no statistically significant association between protein intake and mortality in this cohort of patients with high mNUTRIC scores.

For mNUTRIC score of 2: Among patients with low protein intake, 24 (80.0%) died and 6 (20.0%) survived. In the

Table 3. Predictive values of mNUTRIC scores in predicting the need for hemodialysis, vasopressors/inotropes and IMV support

Hemodialysis		**Received treatmentn (%)**	**Did not receive treatment n (%)**	**OR**	**Sensitivity (%)**	**Specificity (%)**	**p**
mNUTRIC 2nd day	Low	17 (15.6)	92 (84.4)	5.576 (2.755-11.285)	66.7	73.6	<0.001
	High	34 (50.7)	33 (49.3)				
mNUTRIC 7th day	Low	9 (18.0)	41 (82.0)	4.339 (1.684-11.177)	69.0	66.1	0.002
	High	20 (48.8)	21 (51.2)				
mNUTRIC 12th day	Low	4 (20.0)	16 (80.0)	4.667 (1.222-17818)	77.8	57.1	0.020
	High	14 (53.8)	12 (46.2)				
Vasopressor inotrope				**OR**	**Sensitivity**	**OR**	**p**
mNUTRIC 2nd day	Low	45(41.3)	64(58.7)	3.872 (1.999-7.500)	52.1	78.0	<0.001
	High	49(73.1)	18(26.9)				
mNUTRIC 7th day	Low	22(44.0)	28(56.0)	4.525 (1.791-11.431)	59.3	75.7	0.001
	High	32(78.0)	9(22.0)				
mNUTRIC 12th day	Low	10 (50.0)	10(50.0)	4.200 (1.132-15.586)	67.7	66.7	0.027
	High	21(80.8)	5(19.2)				
IMV				**OR**	**Sensitivity**	**OR**	**p**
mNUTRIC 2nd day	Low	38 (34.9)	71(65.1)	4.391 (2.281-8.453)	55.3	78.0	<0.001
	High	47(70.1)	20(29.9)				
mNUTRIC 7th day	Low	16(32.0)	34(68.0)	5.135 (2.093-12.601)	64.4	73.9	<0.001
	High	29 (70.7)	12(29.3)				
mNUTRIC 12th day	Low	10(50.0)	10 (50.0)	4.200 (1.132-15.586)	67.7	66.7	0.027
	High	21 (80.8)	5(19.2)				

mNUTRIC: Modified nutrition risk score, IMV: Invasive mechanical ventilation

Table 5. The relationship between protein intake and mortality in patients with a high mNUTRIC score

			Post-ICU status				
			Died		Living		
			n	%	n	%	p
mNUTRIC 2	Amount of protein taken	Low	24	80.0	6	20.0	0.773
		Medium	2	66.7	1	33.3	
		High	2	66.7	1	33.3	
mNUTRIC 7	Amount of protein taken	Low	19	76	6	24	0.196
		Medium	0	0	1	100	
		High	1	100	0	0	
mNUTRIC 12	Amount of protein taken	Low	11	68.8	5	31.3	0.121
		Medium	0	0	2	100	
		High	12	63.2	7	36.8	

mNUTRIC: Modified nutrition risk score, ICU: Intensive care unit

medium protein intake group, 2 patients (66.7%) died and 1 (33.3%) survived. Similarly, in the high protein intake group, 2 patients (66.7%) died and 1 (33.3%) survived (p=0.773).

For mNUTRIC score of 7: In the low protein intake group, 19 patients (76.0%) died and 6 (24.0%) survived. The medium group saw 1 patient (100%) survive, while in the high group, 1 patient (100%) died (p=0.196).

For mNUTRIC score of 12: The low protein intake group had 11 patients (68.8%) who died and 5 (31.3%) who survived. In the medium group, all 2 patients (100%) survived. In the high protein intake group, 12 patients (63.2%) died and 7 (36.8%) survived (p=0.121).

These findings indicate varied mortality rates across different protein intake levels, with no statistically significant associations.

DISCUSSION

In this study, we evaluated clinical outcomes using the mNUTRIC score in critically ill patients. APACHE II, SOFA, and mNUTRIC mNUTRIC scores on days 2, 7, and 12 were significantly higher in deceased patients. ROC analysis results revealed that mNUTRIC scores had significant predictive value in predicting mortality, especially on the 12th day. Furthermore, this scoring system was effective in predicting the need for IMV, hemodialysis, and vasopressor or inotropic support. The mNUTRIC score has been validated as a reliable method for assessing the risk of mortality in critically ill patients and for predicting the requirement for intensive care support. However, it has been determined that nutritional adequacy and protein intake are not factors that directly determine the mortality risk in patients with a high mNUTRIC score.

When Kumar and others compared mNUTRIC, APACHE II, and SOFA scores, they found similar results in predicting mortality and intensive care prognosis. However, it has been stated that the NUTRIC score is superior to others due to its potential to improve nutritional competence and clinical outcomes.[19] Hai and colleagues noted that the mNUTRIC score shows similar results with other scores in sepsis patients and can be described as an independent predictor of sepsis.[20] In studies aimed at determining the optimal time to apply the metric score, Park et al.[1] 2. and 7. they compared the day's scores. 7. they found that the day mNUTRIC score performed better at predicting the 28-day mortality rate. In our study, patients 2., 7. and 12. according to the day data, mNUTRIC, APACHE II and SOFA scores were calculated, and all scores were found to be significant in predicting mortality. In addition, it was seen that these scores of deceased patients showed higher values. These results support that the mNUTRIC score is an important tool both in clinical evaluation and prognosis prediction.

In our study, the intensive care mortality rate was determined as 43.8% in patients. According to the results of the ROC analysis, the cut-off value of the NUTRIC score was calculated as 4.5 and rounded to 5 in accordance with the original study. In our study, the 12th day NUTRIC score was found to have the highest sensitivity in predicting mortality. However, all mNUTRIC scores were found to be significant in assessing mortality. In the literature, it is seen that the recommended cut-off values for the mNUTRIC score vary depending on patient outcome. For example, in one study with a mean age of 55.7, the cut-off value was determined as 4, while in another study with a mortality rate of 19%, the cut-off value was determined as 6.[19,21]

It is thought that these differences may be related to changes in patient average ages and mortality rates.

In our study, no statistically significant differences were observed between deceased and surviving patients concerning age, gender, height, body weight, BMI, number of comorbidities, and the diagnosis leading to ICU admission. Similarly, a study conducted by Mukhopadhyay et al.[22] in Singapore reported no significant differences in the mNUTRIC score relative to age, gender, BMI, and concomitant diseases. Although demographic characteristics and dietary habits may vary, both studies yielded comparable results.

Wang et al.'s[23] study on the mNUTRIC score has shown that patients at nutritional risk have a longer hospital stay, frequent use of mechanical ventilation, a high risk of acute renal failure, and a significant increase in 28-day mortality. Verma and colleagues found that the mNUTRIC score was associated with the stage of disease and the need for hemodialysis in patients with chronic renal failure.[24] In our study, it was observed that 51 out of 176 patients required hemodialysis and this requirement was higher in deceased patients. The predictive values of mNUTRIC scores in predicting the need for hemodialysis were determined to be the highest sensitivity in the 12th day score. Furthermore, it was determined that all mNUTRIC scores served as statistically significant indicators of the requirement for hemodialysis.

In a forward-looking investigation undertaken by Mahmoodpoor et al.[25] In Iran, the mNUTRIC score emerged as a robust indicator of mortality within the Intensive Care Unit (ICU) and the necessity for vasopressor intervention. Moreover, a heightened mNUTRIC score demonstrated a statistically significant association with the utilization of vasopressors extending beyond a duration of three days. In the course of our investigation, it was noted that 94 individuals out of a cohort of 176 necessitated the administration of vasopressors or inotropes, with this requirement being markedly more prevalent among patients who succumbed. Upon conducting an analysis of the predictive values of mNUTRIC scores concerning the requisites for vasopressor and inotrope administration, it was determined that the greatest sensitivity corresponded with the score obtained on the 12th day. Furthermore, it was determined that all mNUTRIC scores served as substantial predictors of the necessity for vasopressor and inotrope administration.

The research conducted by Mendes et al.[26] in Portugal demonstrated that an elevated mNUTRIC score was associated with an extended duration of stay in the intensive care unit, a lengthened period of mechanical ventilation, and an increased incidence of mortality within a 28-day timeframe. In a comparative analysis executed by De Vries et al.,[27] the mNUTRIC scoring system demonstrated superior efficacy in forecasting 28-day mortality; nevertheless, a definitive correlation was not established between the mNUTRIC score and the length of mechanical ventilation. In our study, 85 out of 176 patients required IMV, and the duration of IMV was significantly greater among those who died. Additionally, it was determined that mNUTRIC scores provided sufficient predictive value for the need for IMV, with the highest sensitivity observed in the score recorded on the twelfth day. The fact that all patients in the study by de Vries et al.[27] were under IMV may have limited their ability to evaluate this relationship comprehensively.

In the literature, no significant relationship has been established between nutritional adequacy and mortality in patients with low mNUTRIC scores. However, Chourdakis et al.[28] reported that nutritional support may enhance clinical outcomes in patients with low mNUTRIC scores. In our study, patients were categorized based on calorie and protein intake into hypocaloric/hypercaloric and mNUTRIC 2 Amount of protein taken as low, medium, and high protein supplementation groups.

Nevertheless, no statistically significant differences were found between deceased and surviving patients regarding these parameters. Within our ICU, nutritional adequacy was calculated at 74.46%, with a mean protein intake of 0.77 g/kg/day. The absence of statistical differences may be attributed to the limited sample size.

Limitations

Our study has several limitations. Firstly, the fact that it was conducted at a single center may restrict the generalizability of the findings. In addition, the relatively small sample size may have led to the failure to detect some statistical differences between subgroups. In addition, patients' nutritional support was only monitored, but no intervention was performed. Finally, although the study used the mNUTRIC score for nutritional status and risk assessment, other potentially influential parameters were not analyzed in detail.

CONCLUSION

In this study, clinical outcomes were assessed using the mNUTRIC in critically ill patients. It was found that there were statistically significant differences in the mean APACHE II, SOFA, and mNUTRIC scores on days 2, 7, and 12 between deceased and surviving patients. ROC analysis results revealed that mNUTRIC scores have a significant predictive power in predicting mortality, while also being an effective tool in predicting the need for IMV hemodialysis and vasopressor/inotrope support. However, it was found that nutritional adequacy and protein intake were not factors that directly influenced the mortality risk in critically ill patients with high mNUTRIC scores. These findings elucidate that the mNUTRIC score serves as a reliable instrument for assessing both the mortality risk and the necessity for intensive care supportive interventions in patients with critical illness.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Pamukkale University Non-interventional Clinical Researches Ethics Committee (Date: 29.09.2023, Decision No: 426637).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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