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ORIGINAL ARTICLE

Evaluating the modified NUTRIC score as a prognostic tool in the intensive care unit for COVID-19 patients

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ABSTRACT

Objective: The modified NUTRIC Score (mNUTRIC) score is a screening test designed for evaluating patients in intensive care units. In this study, our aim is to assess the ability of this test to predict mortality, length of hospital stay, and the need for mechanical ventilation in COVID-19 patients in the intensive care units.

Materials and Methods: In our retrospective study, we evaluated 67 patients admitted to our COVID-19 intensive care unit between October and November 2020. We analyzed their entry scores and conducted general follow-up assessments.

Results: In our study, we found that mortality assessment revealed a significant association between older age ($p<0.001$), the need for mechanical ventilation ($p=0.001$), and the presence of dysphagia ($p<0.001$) in patients who did not survive.

Statistically significant findings indicate that patients classified as having high mNUTRIC scores had higher rates of 28-day mortality, the need for mechanical ventilation, and the presence of dysphagia compared to those classified as having low nutritional scores. When patients with neurodegenerative diseases were evaluated as a separate group, no significant association was found between high nutritional scores and mortality, the need for mechanical ventilation, or length of hospital stay.

Conclusion: The evaluation of nutritional risk in patients being monitored in intensive care is an important step in patient management. The modified NUTRIC score is a preferable assessment test due to its ease of use.

Keywords: COVID-19, mNUTRIC Score, Critically ill, Intensive care, malnutrition, neurodegenerative diseases.

INTRODUCTION

The COVID-19 pandemic has had a significant impact on healthcare systems worldwide, particularly in the management of critically ill patients. In severe cases, COVID-19 can lead to acute respiratory distress syndrome (ARDS) and multiorgan dysfunction, necessitating intensive care unit (ICU) admission. Understanding the characteristics and clinical course of COVID-19 patients in the ICU is crucial for optimizing their care and improving outcomes [1, 2].

The Nutrition Risk in the Critically Ill (NUTRIC) score was developed to identify patients who are at higher nutritional risk and are likely to benefit from early and aggressive nutritional interventions. It incorporates several parameters that are associated with nutritional status and illness severity. The components of the NUTRIC score include age, severity of illness (as measured by the Acute Physiology and Chronic Health Evaluation II score (APACHE II), Sequential Organ Failure Assessment

Table 1. Evaluation of the modified NUTRIC score

Components	Scoring system			
	0	1	2	3
Age (years)	<50	50–75	≥75	
APACHE II *	<15	15–20	20–28	≥28
SOFA **	6	6–10	≥10	
Number of comorbidities	0–1	≥2		
Length of stay in hospital before admit-tance to ICU ***	<1 day	≥1 day		

Low mNUTRIC score 0-4 points, high mNUTRIC score 5-9 points.

* Acute Physiology and Chronic Health Evaluation II; ** Sequential Organ Function Assessment; *** Intensive Care Unit.

(SOFA), the presence of comorbidities, days of mechanical ventilation, and the presence of sepsis. Each parameter is assigned a specific score, and the sum of these scores determines the NUTRIC score for an individual patient. Higher NUTRIC scores indicate a greater risk of malnutrition and poorer clinical outcomes [3]. The modified nutric score is the IL-6 value subtracted from its original form. It was validated by Rahman et al. since IL-6 measurement is not possible in every intensive care unit and is an expensive examination, the modified NUTRIC score has been developed. According to this scoring system, 0-4 is defined as a low score and 5-9 as a high score [4] (Table 1).

The COVID-19 pandemic has posed significant challenges for healthcare systems worldwide, particularly in intensive care units (ICU) where critically ill patients require comprehensive care. Identifying prognostic tools that can aid in assessing disease severity and predicting outcomes is crucial for optimizing patient management. This article aims to explore the potential utility of the mNUTRIC score in the ICU setting specifically for COVID-19 patients.

MATERIALS AND METHODS

In our study, patients hospitalized in our covid intensive care unit during October and November 2020 were evaluated with their intensive care entry APACHE II, GCS, SOFA scores and general follow-up retrospectively. Approvel for this retrospective study granted by Ankara City Hospital, No. 1 Clinical Research Ethics Committee Presidency E. board-E1-21-1573 03/03/2021. Patients who died within 24 hours after ICU admission and who had negative PCR tests were excluded. A total of 67 patients were evaluated. All patients' PCR tests were positive, and 53 patients (79.1%) had covid pneumonia. Fifteen patients had neurodegenerative neurological diseases (%22.7), 10 patients had dementia and 5 patients had Parkinson's disease. Patients' age, gender, comorbid diseases, laboratory values, APACHE II, GCS, SOFA scores within the first 24 hours of admittance to ICU were obtained from hospital records.

Statistics

All statistical analyzes were performed using The Statistical Package for the Social Sciences (SPSS) 21.0 for Windows (SPSS, Inc.; Chicago, USA). Descriptive values are stated as number (n) and percentage (%) for categorical values, mean (standard deviation,SD) for numeric values if they are normally distributed, and median (interquartile range,IQR or minimum-maximum) if not normally distributed. Pearson chi-square and Fisher tests were used to comparing categorical variables. Whether the continuous variables fit the normal distribution was evaluated with Kolmogorov-Smirnov and Shapiro-Wilk tests. Parametric tests for numerical variables with a normal distribution (paired sample t-test and t-test in independent groups), and for numerical variables that do not fit the normal distribution, comparisons were made using Mann-Whitney U test. The relationship between the variables was evaluated with Spearman and Pearson correlation tests. The statistical significance level was accepted as $p<0.05$ in all comparisons.

RESULTS

A total of 67 critically ill COVID-19 patients were included. The mean age of the patients was 71.7 (standard deviation, SD=10.74). Out of the total 67 patients involved in the study, 31 individuals

(46.3%) were female, while the remaining 36 (53.7%) were male. Other systemic disease was present in 83.6% (n=56) of the patient. The most common comorbid diseases are hypertension 50.7% (n=34), diabetes mellitus (DM) 41.8% (n=28) and neurodegenerative diseases 22.8% (n=15). Among the patients with neurodegenerative disease, 10 were diagnosed with intermediate-stage Alzheimer's disease, and 5 were diagnosed with intermediate-stage Parkinson's disease. The median value of the length of stay in the intensive care unit is 11 days (IQR= 5-21), and 58.2% (n=39) of the patients were connected to mechanical ventilator (MV).

During the assessment of 28- day mortality, it was observed that out of 67 patients, 41 (61.2%) were exitus. A comparison of the patients revealed significant findings related to mortality. It was noted that patients with exitus were older (p<0.001), required mechanical ventilation (p=0.001), and had dysphagia (p<0.001). Moreover, patients with exitus displayed elevated levels of various laboratory parameters, including white blood cell count (p=0.034), C-reactive protein (p=0.001), procalcitonin (p=0.001), interleukin-6 (p=0.001), blood urea nitrogen (p=0.021), and creatinine (p=0.022). Conversely, levels of hemoglobin (p=0.010), platelets (p=0.005), total

Table 2. Mortality Variables

Patient variables	Survival	Non survival	P value
Age*	65.8 (13.3)	75.2 (8.6)	**<0.001**
Sex			
Female	12 (46.2)	19 (46.3)	0.99
Male	14 (53.8)	22 (53.7)	
Pneumonia			
Yes	22 (85.6)	31 (75.6)	0.38
None	4 (15.4)	10 (24.4)	
Dysphagia			
Yes	11 (42.3)	36 (91.2)	**<0.001**
None	15 (57.7)	5 (8.8	
Comorbid Diseases			
Yes	22 (84.6)	34 (82.9)	0.86
None	4 (15.4)	7 (17.1)	
Mechanical Ventilator			
Yes	8 (30.8)	31 (75.6)	**0.001**
None	18 (69.2)	10 (24.4)	
Hemoglobin *	11.9 (2.7)	10.4 (2.1)	**0.010**
Hematocrit *	37.4 (7.8)	33.9 (6.5)	0.058
MCV*	90.2 (8.2)	92.5 (7.3)	0.32
White blood cell**	9.3 (7.9-14.8)	13.7 (9.6-15.5)	**0.034**
Lymphocyte **	0.8 (0.6-1.3)	0.6 (0.4-1.2)	0.16
Platelet count**	245.500 (199.750-340.500)	172.000 (116.500-262.500)	**0.005**
CRP**	0.029 (0.01-0.07)	0.08 (0.035-0.17)	**0.001**
Procalcitonin **	0.15 (0.05-0.42)	0.9 (0.12-3.4)	**0.001**
IL- 6**	17.9 (7.3-39.8)	57.4 (22.4-204.8)	**0.001**
Ferritin**	434 (151.8-962)	841 (346.5-1355)	0.089
Total protein*	53.5 (8.6)	47.8 (7.2)	**0.006**
Albumine*	29.8 (6.9)	25.7 (5.8)	**0.018**
BUN**	57.5 (31.8-103.8)	94 (60-140)	**0.021**
Creatinine**	0.80 (0.58-0.99)	1.25 (0.7-2.1)	**0.022**
Length of stay**	10 (4.8-20)	11 (5.5-22.5)	0.50

* MEAN (standard deviation); ** MEDIAN (IQR).

protein (p=0.019), and albumin (p=0.018) were found to be low (Table 2). The median APACHE II score of patients with exitus was 15 (interquartile range [IQR] 11-23), the median SOFA score was 6 (IQR 4-9.25), and the median GCS score was 15 (IQR 10.75-15) (Table 3).

A total of 67 patients were included in the study. Out of these patients, 62.7% (n=42) had low mNUTRIC scores, ranging from 0 to 4, while 37.3% (n=25) had high mNUTRIC scores, ranging from 5 to 9. The median mNUTRIC score was 4 (IQR: 3-6, min-max: 1-9). The mean age of patients with high mNUTRIC scores was 77.7 years and those with low scores were 68.1. Advanced age was statistically significant in terms of the mNUTRIC score (p<0.001). The median mNUTRIC score was calculated as 6 (IQR=3-7) in patients with dysphagia, and the median mNUTRIC score was 3 (IQR=2-4) in patients without dysphagia. The mNUTRIC score was significantly higher in patients with dysphagia (p<0.001). Median mNUTRIC score was calculated as 6 (IQR=3-7) in patients with MV, and median mNUTRIC score was calculated as 3 (IQR=2-4) in patients without MV. The mNUTRIC score was significantly higher in patients with MV (p<0.001). Patients evaluated in terms of 28-day mortality, mortality was observed in 50% of patients with a low mNUTRIC score (0-4), while mortality was observed in 80% of patients with a high mNUTRIC score (5-9). Mortality was significantly higher in patients with a high mNUTRIC score (p=0.015). When laboratory results were evaluated, a significant correlation was found between low hemoglobin (p =0.001), hematocrit (p=0.003), white blood cell count (p=0.014) and high nutric score. In addition, a significant correlation was found between high blood urine nitrogen (p<0.001), creatinine (p= 0.004), procalcitonin (p= 0.002) and IL-6 levels (p=0.008) and high mNUTRIC score. Total protein (p= 0.006) and albumin levels (p= 0.003) were found to be significantly lower in patients with high nutric scores (Table 4).

DISCUSSION

The assessment of nutritional status is becoming increasingly crucial for monitoring patients in the intensive care unit and predicting the progression of their disease. The most recent guideline published by the European Society for Clinical Nutrition and Metabolism (ESPEN) thoroughly examined and emphasized the evaluation of diverse assessment tools employed to assess the malnutrition status of patients [5]. Notably, the guideline highlighted the absence of a universally recognized gold standard in this regard. Furthermore, the guidelines provided by the American Society for Parenteral and Enteral Nutrition (ASPEN) and the Society for Critical Care Medicine (SCCM) emphasized the significance of utilizing specific nutritional screening tools, namely the Nutrition Risk Screening 2002 (NRS2002) and NUTRIC scores, for critically ill patients [6, 7]. Although assessments such as the malnutrition universal screening tool (MUST) and NRS2002 play a crucial role in evaluating nutritional status, their practical application is limited due to the absence of comprehensive nutritional history prior to admission to the intensive care unit and the challenges associated with monitoring weight and measuring muscle volume in these patients [8]. In light of these limitations, the mNUTRIC risk assessment tool emerges as a valuable alternative due to its user-friendly nature and ease of implementation.

According to Rahman et al. patients with a mNUTRIC score of 5 or higher were defined as high scores. Studies have shown that patients with high scores in intensive care follow-up have a worse clinical course and need more effective nutrition regulation [4].

Our study included 67 critically ill patients diagnosed with COVID-19. Among them, 62.7% (n=42) had low nutric scores ranging from 0 to 4, while 37.3% (n=25) exhibited high nutric scores ranging from 5 to 9. Notably, patients with higher Nutric scores were found to be older, had dysphagia, and had a higher likelihood of requiring mechanical ventilation. Furthermore, these patients had a significantly higher mortality rate compared to those with lower nutric scores.

The investigation conducted by Li et al. supported our findings, revealing a significant increase in the mortality rate among COVID-19 patients with high mNUTRIC scores (p<0.001) [9]. Similarly, the study conducted by Zhang et al. demonstrated a strong statistical correlation between a high mNUTRIC score, advanced age, and mortality [10]. Additionally, the research conducted by Osuna Padilla et al., which involved 112 COVID-19 patients requiring mechanical ventilators, showed a significant increase in the mortality rate (p=0.03)

Table 3. APACHE II, SOFA, and GCS Scores And Mortality Rates

Score	Survivals (n=26)	Non-survivals (n=41)	P value
APACHE II score, median (IQR) *	11.5 (8.5-15.8)	15 (11-23)	0.032
SOFA score, median (IQR) **	2 (2-6)	6 (4-10)	<0.001
GCS score, median (IQR) ***	15 (14.8-15)	15 (11-15)	0.093

IQR: interquartile range.

* Acute Physiology and Chronic Health Evaluation II; ** Sequential Organ Function Assessment; *** Glasgow Coma Scale.

Table 4. General Characteristics Of Patients With Low And High mNUTRIC Scores

Patient variables	Low mNUTRIC Score (0-4)	High mNUTRIC Score (5-9)	P value
Age*	68.1 (10.3)	77.7 (8.7)	<0.001
Sex			
Female	19 (45.2)	12 (48)	0.83
Male	23 (54.8)	13 (52)	
Neurological Disease			
Yes	10 (24.4)	5 (20)	0.68
None	31 (75.6)	20 (80)	
Comorbid Diseases			
Yes	32 (76.2)	24 (96)	0.034
None	10 (23.8)	1 (4)	
Dysphagia			
Yes	23 (54.8)	24 (96)	<0.001
None	19 (45.2)	1 (4)	
Mechanical Ventilator			
Yes	18 (42.9)	21 (84)	0.001
None	24 (57.1)	4 (16)	
Nutrition			
Oral	25 (59.5)	3 (12)	<0.001
NG	17 (40.5)	21 (84)	
Hemoglobin *	11.8 (2.5)	9.7 (1.8)	0.001
Hematocrit *	37.3 (7.2)	31.7 (5.7)	0.003
White Blood Cell**	10.3 (8.2-14.3)	14.1 (9.4-18.9)	0.014
Lymphocyte **	0.7 (0.4-1.1)	1.1 (0.4-1.5)	0.23
Platelet count **	242.500 (161.000-340.000)	162.000 (114.500-218.000)	0.001
CRP**	0.04 (0.02-0.11)	0.08 (0.03-0.16)	0.14
Procalcitonin **	0.15 (0.07-0.65)	1.3 (0.25-2.34)	0.002
IL-6**	22.4 (8.6-67.3)	67.2 (23-278)	0.008
Total protein*	52.4 (8.2)	46.2 (6.8)	0.006
Albumine*	29 (6)	24.4 (6.4)	0.003
BUN**	64 (35.7-94.3)	124 (65-195)	<0.001
Creatinine **	0.8 (0.6-1.3)	1.4 (0.8-2.7)	0.004
Length of stay**	11.5 (5-21)	9 (4-29)	0.77
28- day mortality			
Ex	21(50)	20 (80)	0.015
None	21(50)	5 (20)	

* MEAN (standard deviation); ** MEDIAN (IQR).

[11]. These collective findings underline the crucial role of the mNUTRIC score as a reliable prognostic indicator for critically ill COVID-19 patients [12, 13].

In our study, when examining the correlation between the requirement for mechanical ventilation and a high mNUTRIC score, it was observed that patients with elevated scores had a greater need for mechanical ventilation. This observation may be attributed to the fact that 79% of the patients included in our study were diagnosed with COVID-19 pneumonia, which potentially necessitated an increased reliance on mechanical ventilators (p=0.001). Furthermore, Özbilgin et al. conducted a study that also highlighted the association between the incidence of pneumonia and a high mNUTRIC score [14].

The incidence of neurological disorders appears to be on the rise in individuals affected by COVID-19 infection. Consequently, the neurological assessment holds significant importance in the monitoring of patients in COVID-19 intensive care settings [15, 16]. In our study, a total of 15 patients (22.8%; n=15) presented with neurodegenerative diseases. Among these patients, 10 were diagnosed with intermediate-stage Alzheimer's disease, while 5 were diagnosed with intermediate-stage Parkinson's disease. Given the heightened risk of nutritional deficiencies in patients with a history of neurodegenerative disorders, we employed the mNUTRIC score to assess these individuals. However, we did not observe a significant association between a high mNUTRIC score and 28-day mortality, hospital length of stay, or the need for mechanical ventilation in this particular patient subgroup (Table 5). Notably, a literature review highlighted a correlation between a high nutric score and 28-day mortality in the neurology intensive care unit [10]. However, limited literature exists on the application of the nutric score in the context of neurodegenerative diseases. Therefore, we propose that prospective studies be conducted to provide further insights into this area of research.

When comparing the findings from the study by Kucuk et al. and our own study, both studies demonstrated significant associations between various laboratory markers and high mNUTRIC scores in critically ill patients. The consistent findings of elevated inflammatory markers (such as IL-6 and procalcitonin) and impaired nutritional markers (such as albumin) in patients with high mNUTRIC scores across different studies highlight the importance of these biomarkers in assessing the nutritional status and disease severity of critically ill patients. These findings provide valuable insights into the potential use of these markers in risk stratification and clinical management in the context of critical care [17].

In our study, when evaluating the length of stay, no statistically significant correlation was found between high mNUTRIC scores. In the literature, studies conducted in non-COVID intensive care units have demonstrated a positive linear relationship between high mNUTRIC scores and length of stay, whereas in COVID intensive care units, it has been observed to be inversely proportional [18]. This suggests that higher mNUTRIC scores may be associated with shorter lengths of stay. This may be due to the high mortality rate of infections due to COVID-19. These contrasting findings emphasize the importance of further research to understand the factors influencing the length of stay in COVID-19 patients [17, 19, 20].

Our study's primary limitation is the small sample size, potentially impacting the generalizability of our findings. Nonetheless, the dedicated follow-up by a specialized team during the challenging pandemic period strengthens our research. Another constraint is the absence of alternative nutritional assessment tests. Our study significantly

Table 5. Evaluation of patients with neurodegenerative diseases

Patient	Low mNUTRIC (0-4)	High mNUTRIC (5-9)	p value
Lenght of stay, median (IQR)	20.5 (8.8-30.5)	14 (6.5-23)	0.36
Mechanical Ventilator, n(%)			
Yes	3 (30)	3 (60)	0.33
None	7 (70)	2 (40)	
Mortality, n (%)			
Survival	6 (60)	1 (20)	0.28
Ex	4 (40)	4 (80)	

contributes to the literature by demonstrating the efficacy of the mNUTRIC score and guiding future evaluations with larger patient cohorts. However, the limited sample size may compromise statistical power and general applicability, while reliance on a fixed team introduces potential bias. To enhance validity, future research should include larger samples and a broader range of nutritional assessment tools.

CONCLUSION

The mNUTRIC score serves as a valuable assessment tool in predicting 28-day mortality and the need for mechanical ventilation in critically ill patients, particularly when anthropometric measurements are not feasible. Consequently, conducting studies with larger patient cohorts would be more suitable for evaluating neurodegenerative diseases. This approach can help overcome limitations associated with smaller sample sizes and enhance the generalizability and reliability of findings. However, it is important to acknowledge potential biases that may arise from variations in patient characteristics and treatment protocols across different study settings. Future research should aim to address these limitations and provide more robust evidence on the utility of the mNUTRIC score in neurodegenerative disease evaluation.

Author contribution

Study conception and design: GTG and HB; data collection: GTG and NKŞ; analysis and interpretation of results: GTG and YH; draft manuscript preparation: GTG, NKŞ, LY and HB. All authors reviewed the results and approved the final version of the manuscript.

Ethical approval

The study was approved by the Ankara City Hospital, Clinical Research Ethics Committee No. 1 (Protocol no. E1-21-1573).

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Conflict of interest

The authors declare that there is no conflict of interest.

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