Submitted: 24 July, 2024 Accepted: 20 November, 2024 Published: 08 April, 2025 DOI:10.22514/sv.2025.057

Open Access
Signa Vitae

ORIGINAL RESEARCH

Comparison of mNutric score and NRS-2002 screening tools in neurosurgery intensive care units

Şule Göktürk[1,]*, Yasin Göktürk[1], Aslı Gizem Çapar[2], Eda Başmısırlı[2], Yusuf Aykemat[2], Neriman İnanç[2]

[1]Department of Neurosurgery, Kayseri City Hospital, University of Health Sciences, 38080 Kayseri, Turkey
[2]Department of Nutrition and Dietetics, Nuh Naci Yazgan University, 38170 Kayseri, Turkey

***Correspondence**
suleGOKTURK@outlook.com
(Şule Göktürk)

Abstract

Background: Typically, the Nutritional Risk Screening-2002 (NRS-2002) is employed to detect the risk of malnutrition in inpatients, including those in the intensive care unit (ICU). Meanwhile, the Nutrition Risk in the Critically ill (Nutric) Score and also the modified form of it (mNutric Score) are specifically used to screen and predict mortality among ICU patients. The main aim of this study was to perform a comparative analysis between the m Nutric Score and NRS-2002 in order to early and accurately assess the risk of malnutrition in the ICU. Additionally, the study purposed to provide insights into the prospective application of nutritional screening tools. **Methods**: This cross-sectional study was carried out on 101 patients aged 18 years and older in the Neurosurgery ICU in the province of Kayseri, Turkey, between June and September 2022. The anthropometric measurements and biochemical findings of the patients were examined. The risk of malnutrition was determined using the NRS-2002 and mNutric score and compared with each other. **Results**: When nutritional risk screening results were examined, no distinction was found among groups for mNutric Score ($p < 0.05$) or NRS-2002 levels ($p > 0.05$). Significant differences were observed between Acute Physiology and Chronic Health Evaluation (APACHE) II, Glasgow coma score (GCS), Sequential Organ Failure Assessment (SOFA) scores, and blood albumin levels when comparing patients in different mNutric Score risk groups ($p < 0.05$). Additionally, Receiver Operating Characteristic (ROC) analysis and overall findings highlighted a divergence between mNutric Score and NRS-2002, indicating limited agreement in assessing nutritional risk. **Conclusions**: This study revealed that the mNutric Score and NRS-2002 demonstrated limited compatibility when assessing the nutritional risks of patients in the neurology ICU. In the ICU population, the use of mNutric Score be a more unique scale to detect nutritional risk and status of the ICU patients.

Keywords

Neurosurgery intensive care unit; mNutric score; NRS-2002

1. Introduction

Critical illness is marked by inflammation and neuroendocrine induced stress releases, leading to a catabolic reaction and a decline in nutritional well-being [1]. In recent years, new findings have indicated that different levels of inflammation play a crucial role in the development of malnutrition and offset the impact of nutritional intervention in critical illness. Moreover, inpatients prone to malnutrition tend to benefit more from nutritional intervention in contrast to those with a low risk [2]. Therefore, it is important to screen patients in the ICU for the risk of malnutrition [3]. In a neurosurgical intensive care unit, each patient has unique nutritional needs based on their specific condition. Those with severe head injuries require heightened attention and intensive care. Accurately assessing the nutritional requirements of these patients is challenging for healthcare staff. Implementing a best-practice standard, such as a guideline, could support healthcare staff in making informed nutritional decisions [4, 5]. It is known that NRS-2002, which is used as a screening tool in the hospital environment, developed by Kondrup *et al.* [6] in 2003, is useful in identifying the majority of patients who would have a positive impact from a nutritional treatment. However, Ata Ur-Rehman *et al.* [7] reported that the typical nutritional assessment criteria and the tools used for screening may be ineffective in revealing the nutritional risk, generally in patients undergoing mechanical ventilation. In similar fashion, Heyland *et al.* [8] developed the Nutrition Risk in the Critically Ill (Nutric) score in 2011 to enable more precise screening, acknowledging that not all ICU patients face identical nutritional risks. In this scoring, they used metabolic status, comorbid diseases, decreased caloric consumption, body mass index (BMI) and prognostic markers. In the following years, studies have shown that the Nutric score is helpful in recognizing severely ill patients who may benefit more from aggressive the nutritional intervention [2, 9]. However, Rahman *et al*. [10] contributed to the buildout of the modified Nutric score (mNutric), which includes all the variables while interleukin-6 (IL-6) was not taken into account because IL-6 used as an inflammatory marker is not routinely checked in every patient in the ICU and Jeong *et al*. [11] stated that the use of IL-6 level, which is a part of the nutritional evaluation, may be unnecessary even in patients with septicemia. Previous studies indicated that there is a strong positive relationship between adequate nutrition and some have established that there was no notable distinction between the Nutric and mNutric scores in predicting mortality [10, 11]. Couple studies also stated that the mNutric Score could be a suitable instrument for evaluating the nutritional risk and predicting the prognosis of coronavirus 19 (COVID-19) at ICU inpatients [12, 13]. However, apart from the contradictions in the studies in the literature, the recommendations for the use of the Nutric score in intensive care patients are also different in merican Association for Parenteral and Enteral Nutrition (ASPEN) and European Society of Clinical Nutrition and Metabolism (ESPEN) guidelines [14, 15]. As in many countries [2], in our country, since 2016, the Ministry of Health has mandated the use of NRS-2002 in determining the risk of malnutrition in hospitalized patients, including ICU, but in some hospitals only a small number of hospitals for research purposes.

The primary objective of this study was to conduct a comparative analysis of the mNutric Score with NRS-2002 in the early and accurate determination of malnutrition risk in the ICU and to shed light on the nutritional screening tools used in the future by determining its effects in estimating 28-day mortality.

2. Method

2.1 Study design

Ethics committee approval for this study is taken from Nuh Naci Yazgan University Scientific Research and Publication Ethics Committee (Date: 10 February 2022, Decision No: 2022/6553). This study with a cross-sectional design was carried out on 101 patients aged 18 years and older, to compare the nutritional screening tools NRS-2002 with the mNutric score in determining the risk of malnutrition in intensive care patients. It was performed on inpatients in the Neurosurgery ICU of the Ministry of Health City Hospital in the province of Kayseri, located in the Central Anatolian Region of Turkey, between June and September 2022.

In this clinic, approximately 600 patients are treated annually and patients are referred directly Commencing at the emergency department to the Neurosurgery ICU. Patient diagnoses are generally brain tumor, traumatic brain hemorrhages and acute injuries. The sample of the study was determined based on literature knowledge [16] and calculated using TURCOSA Statistical Software (Created in 2014, Turcosa Ltd. Co., Kayseri, Turkey), with an estimated effect size of 0.279, a sample size of 101, a power of 0.8 (beta set at 0.2), and an alpha level of 0.05. The inclusion criteria for the patients were being admitted to the neurosurgery intensive care unit, being seen within the first 24 hours and being older than 18 years of age. Patients who have been hospitalized in the intensive care unit for more than 24 hours and those under 18 years of age were not included in the study. To minimize selection bias, a random sample of 101 patients was chosen from a total of 600 intensive care unit patients. Random selection was utilized to enhance the representativeness of the sample, aiming to reduce potential biases related to patient characteristics or clinical status.

2.2 Data collection

Acute Physiology and Chronic Health Assessment II (APACHE II) and Sequential Organ Failure Assessment Score (SOFA) and Glasgow Coma Score (GCS) were calculated within the first 24 hours of hospitalization by the specialist physician. The findings of the patients such as age, gender, diagnosis, residence period of the ICU, hospital stay, nutrition, anthropometric measurements and some biochemical findings in the patient registry system were examined.

2.3 Evaluation of nutritional status

The Nutritional Risk Score-2002 has been validated in case-controlled studies in hospitalized patients and is shown among the tests that can be used by ESPEN to screen inpatients and to select patients who can benefit from nutritional support in line with the data obtained. The Nutritional Risk Screening Test-2002 was designed by Kondrup *et al*. [6] to screen for malnutrition risk in inpatients. The scoring system consists of two parameters as "nutritional status" and "severity of the patient" and provides scoring as "no problem", "mild", "moderate" and "severe". Each section is scored on a scale of 0–3. Furthermore, for patients aged over 70 years, one point is added. After all scores are added, patients with a total score of $\geq$3 is indicative of being at risk of malnutrition, and it is recommended to conduct a nutritional evaluation for these patients [17].

The mNutric score, which was developed to determine malnutrition and mortality specific to intensive care patients, is a screening tool that does not use IL-6 values, an indicator of inflammation. In this screening tool; the patient's age, number of comorbidities, number of days from hospital to ICU admission, APACHE II and SOFA scores are taken into account. According to the scores obtained, patients with mNutric score $\geq$5 were classified as high-risk, and those with mNutric score $<$5 were classified as low nutritional risk [8, 10].

2.4 Biochemical findings

Fasting blood glucose (FBG), Blood urea nitrogen (BUN), creatinine, estimated glomerular filtration rate (eGFR), Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), albumin, Ca, Na and K taken after an overnight fast in patients values were measured in Kayseri City Hospital Biochemistry Laboratories and the reference values of this laboratory were taken into consideration.

2.5 Anthropometric measurements

When possible, height and body weight measurements were made by the nurse when the patients were hospitalized to the ICU. The statements of their relatives or themselves were taken into account in patients who could not be done, and BMI were calculated from these values. The BMI levels of the patients were classified according to the World Health Organization (WHO) classification [18].

2.6 Statistical analysis

The information obtained from the study participants underwent analysis using the Statistical Package for Social Sciences for Windows (SPSS 22.0), a statistical software application developed by IBM in the USA (Armonk, NY). Homogeneity of the data was tested with the Shappiro Wilk Test and descriptive statistics were given as mean with standard deviation (SD) and median with SD and median with Interquartile Range (IQR). Fisher's exact test or chi-square test was used for nominal data. Student's *t* test was utilized for comparison binary data with homogenous numerical data, and Mann Whitney U test was used for binary groups not normally distributed. The compatibility between the scales was evaluated by ROC analysis. The relationship between the biochemical findings of the patients and the mNutric score and NRS-2002 was determined by Pearson correlation. Statistical significance level was accepted as 95%.

3. Results

In this study conducted with 101 patients in the neurology intensive care clinic, it was seen that the median age of the patients was 68 (52.50–77.50), and the patients' ages did not show a significant contrast between the people who lost no statistically significant their lives and those who did not ($p > 0.05$). Besides, when parameters such as gender, BMI and number of comorbidities were examined, no statistically notable distinction was identified between individuals who survived and those who did not ($p > 0.05$). On the contrary, it was noted that there was a statistically significant contrast between the two groups, regarding both albumin and C reactive protein (CRP) levels ($p < 0.05$). When the comparison of the groups formed according to survival status was continued, it was observed that there was a noteworthy contrast between the groups concerning of APACHE, SOFA and GCS scores, which are the scales directly related to ICU survival ($p < 0.05$). When the screening test results revealing the nutritional risk were examined, it was found that there was noticeable difference between the groups regarding mNutric Score levels ($p < 0.05$), and there was no discrepancy between the groups in terms of NRS-2002 levels ($p > 0.05$) (Table 1).

The patients were categorized based on the NRS-2002 test results, it was observed that the number of patients in the "No Risk" group was 90, and the total of cases in the "With Risk" group was 11 (Table 1). While statistically noteworthy variances were noticed between these patient groups regarding APACHE II and GCS levels ($p < 0.05$), No statistically notable contrast was identified regarding SOFA scores, blood albumin and CRP levels ($p > 0.05$) (Table 2). On the other hand, when intensive Patients were classified based on their mNutric Score results, 77 patients were in the "Low Nutritional Risk" group and 24 patients were in the "High Nutritional Risk" group (Table 1). When some results of patients in different risk groups were compared according to mNutric Score classification, statistically significant differences were observed between APACHE II and GCS levels as well as SOFA scores and blood albumin levels (similar to NRS 2002) ($p < 0.05$) (Table 1).

In the ROC analysis conducted by accepting that patients with mNutric Score results at "High Nutritional Risk" are at nutritional risk, the sensitivity of the NRS-2002 test was 87.5% and the selectivity was 16.9% against mNutric Score. In addition, the positive predictive value of the test against mNutric Score was 24.7%. It was observed that the negative predictive value was 81.3 and finally, the positive likelihood ratio of the test was 1.053 and the negative likelihood ratio was 0.740 (Area Under Curve (AUC) = 0.4453), (Table 3, Fig. 1).

4. Discussion

One hundred one (101) patients, 58.4% of whom were over 65 years of age, aged 68 (52.50–77.50) participated in this study, which was executed with patients who were inpatient at the neurology intensive care department of Kayseri City Hospital with severe diagnoses such as acute trauma. When non-survivors and survivors were grouped in the study, throughout the investigation, no statistically meaningful diversity was detected between the groups in relation to potential confounding factors such as age, gender, and BMI ($p > 0.05$). Anticipated outcomes suggest that a statistically significant disparity is likely to emerge among the groups concerning the dependable and credible APACHE II, SOFA, and GCS scores [19, 20], which serve as valid indicators for assessing immediate survival potential ($p < 0.05$). Upon evaluation of the study results, it was clear that a statistically significant divergence was observed between the blood albumin and CRP levels of the survivors and non-survivors ($p < 0.05$). In a review using the data of many studies conducted amongst patients in the ICU in 2013, it was indicated that blood CRP levels in general are an important test for reflecting infection and especially sepsis for intensive care, and it should be used because it is cost-effective [21]. The results obtained in our study were also compatible with the literature, and the CRP levels of non-survivor patients 181.5 (49.95–276.50) mg/dL were higher than those of survivor patients 101 (9.35–208.00) mg/dL and were statistically different ($p < 0.05$). Hypoalbuminemia, outlined as serum albumin <35 g/L is common in the ICU (82% in certain adult groups) [22, 23]. Dubois *et al.* [24] investigated the proposition that providing daily serum albumin supplementation to individuals experiencing hypoalbuminemia would yield enhanced outcomes. In this solitary-site, open-label, initial investigation, a group of 100 patients exhibiting serum albumin concentrations under 31 g/dL were randomly assigned. They were either administered 300 mL of 20% albumin solution on the first day, followed by 200 mL of 20% albumin solution on each successive day, or no albumin therapy was applied. Their findings indicated that the mean delta SOFA score was more significant in the albumin

TABLE 1. Findings of neurology intensive care unit patients according to their survival.

Variables	Total n (%) 101 (100.0)	Survivors n (%) 56 (55.4)	Non-Survivors n (%) 45 (44.6)	Statistic	*p*
Age (yr), medium (IQR)	68 (52.50–77.50)	68 (47.00–78.50)	71 (60.25–77.00)	1.470	0.142
Age, categorized					
<65 yr	42 (41.6)	20 (47.61)	22 (52.38)	1.783	0.182
≥65 yr	59 (58.4)	23 (38.98)	36 (61.02)		
Gender					
Male	61 (60.4)	26 (42.6)	35 (57.4)	0.233	0.630
Female	40 (39.6)	19 (47.5)	21 (52.5)		
BMI, median (IQR) (kg/m^2)	25.95 (23.87–28.04)	25.18 (23.22–27.71)	26.07 (24.29–29.10)	1.220	0.222
BMI, categorized					
Underweight	18 (18.0)	9 (20.5)	9 (16.1)	0.724	0.867
Normal	50 (50.0)	20 (45.5)	30 (53.6)		
Overweight-Obese	32 (32.0)	15 (34.1)	17 (30.4)		
Number of Comorbidities, median (IQR)	1 (0–2)	1 (0–2)	1 (0–2)	0.444	0.657
Number of comorbidities, categorized					
0–1	64 (63.4)	34 (53.1)	30 (46.9)	0.137	0.712
2 or more	37 (36.6)	15 (40.5)	22 (59.5)		
Albumin, mean ± SD (g/L)	30 (23.5–35)	29 (23.25–32)	31 (24–39.5)	−2.015	0.044
CRP, median (IQR) (mg/dL)	157 (30.6–234.5)	101 (9.35–208.00)	181.50 (49.95–276.50)	2.480	0.013
APACHE II, median (IQR)	18 (11–27)	16 (11–23)	21.5 (12–30.5)	2.415	0.016
SOFA, mean ± SD	4.88 ± 3.39	3.06 ± 3.20	6.33 ± 2.80	2.811	0.005
GCS, median (IQR)	6 (3–13.5)	10 (5–15)	4 (3–8)	−3.976	<0.001
NRS-2002, median (IQR)	1 (0–1)	1 (0–1)	1 (0–1)	0.471	0.638
NRS-2002, categorized					
No Risk	90 (89.1)	39 (43.3)	51 (56.7)	0.499	0.480
With Risk	11 (10.9)	6 (54.5)	5 (45.5)		
mNutric Score, median (IQR)**	3 (1.5–4)	2 (1–3)	3.5 (2–5)	3.591	<0.001
mNutric Score, categorized					
Low Nutritional Risk (≤4)	77 (76.3)	39 (50.6)	38 (49.4)	4.873	0.027
High Nutritional Risk (≥5)	24 (23.7)	6 (25.0)	18 (75.0)		

***Mean and Standard deviation (SD), Median and the interquartile range (IQR). BMI: body mass index; APACHE II: Acute Physiology and Chronic Health Assessment II; SOFA: Sequential Organ Failure Assessment; mNutric: modified Nutrition Risk in the Critically ill; CRP: C reactive protein; GCS: Glasgow Coma Score; NRS-2002: Nutritional Risk Screening-2002.*

cohort in contrast to the control group (3.1 *vs.* 1.4; $p = 0.03$) from days 1 to 7. This led to the inference that the introduction of albumin supplementation contributes to the amelioration of organ dysfunction [24]. Lower serum albumin levels have identified as a significant unique indicator of mortality in a number of ICU inpatient populations [25]. The results of our study also showed that the blood albumin levels of the patients who died in the neurology intensive care unit were lower (31 (24–39.5) g/L) and were compatible consistent with previous studies regarding the importance of blood albumin levels follow-up.

When survivor and non-survivor patients were classified based on NRS-2002 and mNutric Score results, difference has been found between the groups regarding NRS-2002 levels or classes ($p > 0.05$), but statistically noteworthy distinctions were seen in terms of mNutric Score and levels ($p < 0.05$). Although this is thought to be largely due to the use of APACHE II and SOFA scores in the calculation of

TABLE 2. APACHE II, SOFA, GCS, Albumin and CRP levels of intensive care unit patients separated based on NRS-2002 and mNutric score risk classifications.

Variables	NRS-2002		Statistic	*p*	mNutric Score		Statistic	*p*
	No Risk (n = 90)	With Risk (n = 11)			Low Nutritional Risk (n = 77)	High Nutritional Risk (n = 24)		
Albumin, mean ± SD	30.00 ± 7.83	29.04 ± 8.44	0.380	0.705	30.90 ± 8.13	26.67 ± 5.97	2.353	0.021
CRP, median (IQR)	148.00 (30.97–229.50)	162.00 (21.10–266)	−0.218	0.827	131.00 (30.00–245.50)	158 (43.10–211.00)	−0.028	0.978
APACHE II, median (IQR)	17 (11–25)	29 (20–35)	−2.761	0.006	16 (11–23.5)	24 (26.5–33.75)	−2.852	0.004
SOFA, median (IQR)	5 (1.75–8)	6 (4–9)	−1.474	0.141	4 (1.5–6)	7 (5–8.75)	−2.811	0.005
GCS, median (IQR)	6.5 (3–14)	3 (3–7)	1.982	0.048	8 (3–14)	3.5 (3–7)	−2.434	0.015

mNutric: modified Nutrition Risk in the Critically ill; SD: standard deviation; IQR: interquartile range; APACHE II: Acute Physiology and Chronic Health Assessment II; SOFA: Sequential Organ Failure Assessment Score; NRS-2002: Nutritional Risk Screening-2002; CRP: C reactive protein; GCS: Glasgow Coma Score.

TABLE 3. Cross classification of mNutric score and NRS-2002 screening tools.

	mNutric Score		
NRS-2002	Low Nutritional Risk n (%)	High Nutritional Risk n (%)	Total n (%)
Patients with No Risk (n)	69 (68.31)	21 (20.79)	90 (89.10)
Patients with Risk (n)	8 (7.92)	3 (2.97)	11 (10.89)
Total (n)	77 (76.23)	24 (23.76)	101 (100.0)
Sensitivity (%)	87.5		
Specificity (%)	16.9		
Positive Predictive Value (%)	24.7		
Negative Predictive Value (%)	81.3		
Positive Likelihood Ratio	1.053		
Negative Likelihood Ratio	0.740		

mNutric: modified Nutrition Risk in the Critically ill; NRS-2002: Nutritional Risk Screening-2002.

the mNutric Score screening tool at first sight; when the results of Han Lew *et al*. [26] prospective cohort research on the relationship between 28-day hospitalization mortality in intensive care and malnutrition was also taken into account which proved clear evidence on an independent mortality-malnutrition relationship, it can also be thought that the use of mNutric Score may be more useful in detecting and intervening nutritional risk.

When the patients were classified based on both NRS 2002 and mNutric Score risk results, APACHE II and GCS parameters were found to be between "No Risk" and "With Risk" groups for NRS-2002; for mNutric Score, notable differences were observed between "Low Nutritional Risk" and "High Nutritional Risk" groups in albumin, APACHE II, SOFA and GCS parameters ($p < 0.05$). Although these significant differences between mNutric Score risk classes are thought to be largely due to the calculation of the score, a significant difference in blood albumin levels between different risk groups has shown that mNutric Score can increase patient focus in the nutritional treatment of albumin, which is one of the main focuses of nutritional intervention in the ICU ($p < 0.05$).

Our findings indicated that the mNutric Score evaluated more patients as nutritional risk (23.7%), and in particular, the NRS-2002 test revealed 21 of those 24 patients not risky. Interestingly, 8 of 11 patients evaluated as with Risk by NRS-2002 were not found to be at High Nutritional Risk by the mNutric Score screening tool. Since the mNutric Score evaluated more patients as risky, an ROC analysis was performed with the assumption that the patients with the m Nutric Score test as "High Nutritional Risk" were at nutritional risk and it was observed that the NRS-2002 screening tools' have sensitivity, specificity, positive predictive value negative predictive value, positive likelihood value and negative likelihood values were 87.5%, 16.0%, 24.7%, 81.3%, 1.053 and 0.740, respectively. A study in which the mNutric Score and NRS-2002 screening tools were used to predict mortality in isolates or combi-

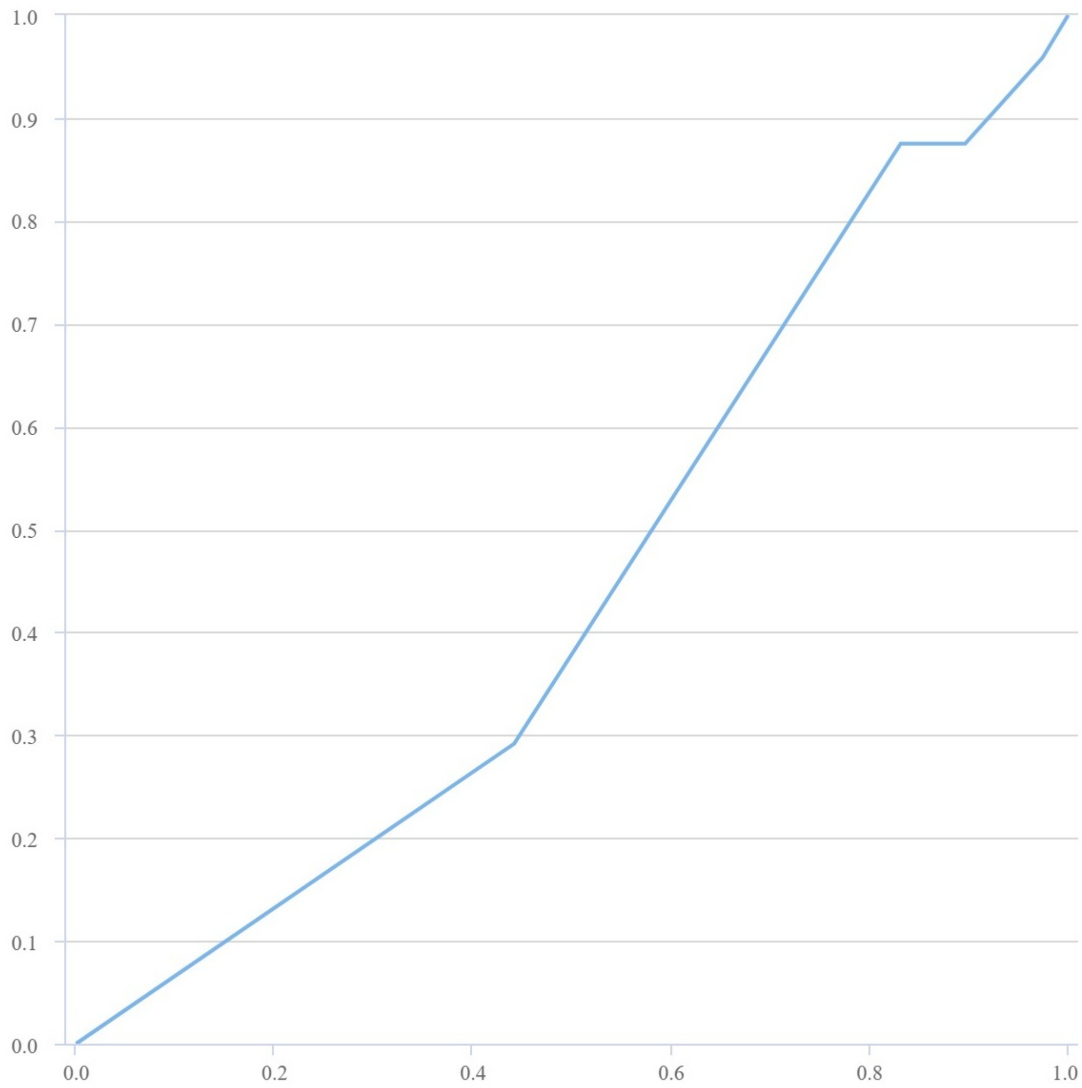

FIGURE 1. Selectivity and sensitivity of the NRS-2002 versus mNutric score.

nations in Critically Ill patients was conducted for 2 years between 2017 and 2018 at Brazil. This prospective cohort study included 384 ICU patients and was screened by a trained nutritionist with mNutric Score and NRS-2002 within 72 hours of ICU admission. According to the results of the study, the relative risk of mortality in patients with high nutritional risk (mNutric Score >5) was found to be 3.01 ($p < 0.001$) in terms of mNutric Score screening, while relative risk (RR) was found in combination with NRS-2002 scanning tool (mNutric Score >5, NRS-2002 >5). value was found to be 2.29 ($p < 0.001$). The researchers also made the assumption that both tests can be used in isolation or in combination to predict 28-day mortality based on their results, but they stated that mNutric Score gives better results in intensive care patients [27]. In another study, İleri *et al*. [28] with a similar purpose tested the ability of the NRS-2002 and mNutric Score tests to predict mortality in ICU inpatients for hematological malignancies. In that study, researchers observed that patients with high NRS-2002 scores were at elevated likelihood of death in the ICU, while high mNutric scores were not associated with ICU mortality. When the literature results are evaluated together with our study data, it is revealed that both screening tools can predict the risk of patient mortality as well as reveal the nutritional risk, but they are not compatible with each other. In our study, the number and distribution of patients found to be risky by mNutric Score and NRS-2002 were different, mNutric Score results and averages differed between surviving participants and participants who did not survive ($p < 0.05$), while a similar difference could not be observed for NRS-2002 ($p > 0.05$). In another study, assessed the effects of the mNutric and NRS-2002 scores on ICU mortality and their link to macronutrient deficiency. Conducted in Burdur Public Hospital (2019–2021), it included 311 ICU patients. High nutritional risk was observed in 20.9% (NRS-2002) and 62.7% (mNutric) of patients. An mNutric score ≥5 was associated with a threefold higher mortality risk ($p < 0.001$), while an NRS-2002 score ≥5 doubled the risk ($p = 0.002$). High mNutric scores correlated significantly with low calorie intake but not protein ($p = 0.058$). Thus, the mNutric score effectively predicted 28-day survival, whereas the NRS-2002 did not which shows more parallels with our study [29].

In a study evaluated the validity of the mNutric and NRS-2002 scores in Iranian ICU patients, where the Malnutrition Universal Screening Tool (MUST) tool is commonly used. In

440 patients, both mNutric and NRS-2002 were significantly linked with longer length of stay, prolonged mechanical ventilation, and 28-day mortality (all $p < 0.001$), while MUST showed no significant association with these outcomes ($p > 0.05$). The mNutric had the highest predictive accuracy for 28-day mortality (AUC = 0.806), followed by NRS-2002 (AUC = 0.695) and MUST (AUC = 0.551). Higher energy adequacy lowered 28-day mortality in patients with high mNutric scores but not in those with low scores. Thus, mNutric may be a valid tool for identifying ICU patients who could benefit from intensive nutrition therapy in Iran [30]. Our ROC analysis, which was conducted by classifying patients with mNutric Score results in the "High Nutritional Risk" category as being at nutritional risk, revealed notable findings regarding the agreement between the NRS-2002 and mNutric Score. The sensitivity of the NRS-2002 test was found to be 87.5%, indicating a relatively high ability to correctly identify patients at nutritional risk. However, the selectivity was much lower at 16.9%, suggesting that the NRS-2002 test had limited accuracy in correctly identifying patients who were not at risk when compared to the mNutric Score. Furthermore, the positive predictive value (PPV) of the NRS-2002 test was 81.3%, meaning that when the NRS-2002 test identified a patient as being at nutritional risk, there was a relatively high probability that they indeed were at risk according to the mNutric Score. On the other hand, the negative predictive value (NPV) was 24.7%, indicating that the test had a lower capacity to correctly rule out patients who were not at risk. The positive likelihood ratio (LR+) was 1.053, which is a modest increase in the likelihood of a patient being at nutritional risk when the NRS-2002 test is positive. In contrast, the negative likelihood ratio (LR−) was 0.740, suggesting that a negative NRS-2002 result only slightly decreased the probability of nutritional risk. The area under the curve (AUC) of 0.4453 further reflects the limited agreement between the two scales, indicating that the NRS-2002 test does not strongly correlate with the mNutric Score in identifying patients at nutritional risk. This low AUC suggests that while the NRS-2002 test provides some useful information, its performance in identifying nutritional risk relative to the mNutric Score is modest at best and the two scales show limited concordance.

5. Limitations of the Study

APACHE II, GCS and SOFA scores used in the study were recorded in the first 24 hours of hospitalization. However, in patients receiving long-term intensive care treatment, especially in neurosurgery patients, these values may change within days or even hours. Similarly, in patients hospitalized for a long time, Albumin values may also decrease. These unstable values constitute the main limitation of the study. In addition, it would not be correct to generalize because it was conducted in a single center and included only patients in the Level 3 Neurosurgery Intensive Care Unit.

6. Conclusions

As a result, in this study, it was seen that the mNutric Score and NRS-2002 were not very compatible in evaluating the nutritional risks of the patients in the neurology intensive care unit. The mNutric scoring system could serve as a more effective tool for assessing nutritional risk and predicting outcomes in ICU patients. Implementing mNutric as a screening tool in neurological ICUs would involve routine assessments upon admission and at regular intervals, enabling timely, targeted nutritional interventions to improve patient outcomes.

AVAILABILITY OF DATA AND MATERIALS

The data produced for this study was collected and used only for the purpose of conducting this study and has not been published in any other database or elsewhere.

AUTHOR CONTRIBUTIONS

Nİ and ŞG—detailing the work; project preparation, data collection. YG—contributed to the collection of data. YA—made the statistical analysis and contributed for writing the paper. AGÇ and EB—made the English proof reading of the scientific paper in the project.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics committee approval for this study is taken from Nuh Naci Yazgan University Scientific Research and Publication Ethics Committee (Date: 10 February 2022, Decision No: 2022/6553). Consent for participation was obtained from all subjects.

ACKNOWLEDGMENT

Not applicable.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Mukhopadhyay A, Henry J, Ong V, Leong CS, Teh AL, van Dam RM, *et al*. Association of modified NUTRIC score with 28-day mortality in critically ill patients. Clinical Nutrition. 2017; 36: 1143–1148.

[2] Lin PY, Yen YT, Lam CT, Li KC, Lu MJ, Hsu HS. Use of modified-NUTRIC score to assess nutritional risk in surgical intensive care unit. Journal of the Chinese Medical Association. 2021; 84: 860–864.

[3] Adam S. Standardization of nutritional support: are protocols useful? Intensive and Critical Care Nursing. 2000; 16: 283–289.

[4] Natsch S, van der Meer JW. The role of clinical guidelines, policies and stewardship. Journal of Hospital Infection. 2003; 53: 172–176.

[5] Ojo O. Enteral feeding for nutritional support in critically ill patients. British Journal of Nursing. 2017; 26: 666–669.

[6] Kondrup J, Rasmussen HH, Hamberg O, Stanga Z; Ad Hoc ESPEN Working Group. Nutritional risk screening (NRS 2002): a new method

based on an analysis of controlled clinical trials. Clinical Nutrition. 2003; 22: 321–336.

[7] Ata Ur-Rehman HM, 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: e3786.

[8] 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: R268.

[9] Lomivorotov VV, Efremov SM, Boboshko VA, Nikolaev DA, Vedernikov PE, Deryagin MN, *et al*. Prognostic value of nutritional screening tools for patients scheduled for cardiac surgery. Interdisciplinary CardioVascular and Thoracic Surgery. 2013; 16: 612–618.

[10] 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. Clinical Nutrition. 2016; 35: 158–162.

[11] Jeong DH, Hong SB, Lim CM, 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: 911.

[12] 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. Clinical Nutrition. 2021; 40: 534–541.

[13] Liberti A, Piacentino E, Umbrello M, Muttini S. Comparison between Nutric Score and modified nutric score to assess ICU mortality in critically ill patients with COVID-19. Clinical Nutrition ESPEN. 2021; 44: 479–482.

[14] McClave SA, Taylor BE, Martindale RG, Warren MM, Johnson DR, Braunschweig C, *et al*. Society of Critical Care Medicine; American Society for Parenteral and Enteral Nutrition. 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 (A.S.P.E.N.). Journal of Parenteral and Enteral Nutrition. 2016; 40: 159–211.

[15] Singer P, Blaser AR, Berger MM, Alhazzani W, Calder PC, Casaer MP, *et al*. ESPEN guideline on clinical nutrition in the intensive care unit. Clinical Nutrition. 2019; 38: 48–79.

[16] Gonzalez MC, Bielemann RM, Kruschardt PP, Orlandi SP. Complementarity of NUTRIC score and Subjective Global Assessment for predicting 28-day mortality in critically ill patients. Clinical Nutrition. 2019; 38: 2846–2850.

[17] Akmansu M, Kurt G, Demircan V, Senturk E. Results of chordoma patients treated by different approaches in a single institution. Turkish Neurosurgery. 2020; 30: 366–370.

[18] Weir CB, Jan A. BMI classification percentile and cut off points. StatPearls: Treasure Island (FL). 2024.

[19] Iino C, Shimoyama T, Igarashi T, Aihara T, Ishii K, Sakamoto J, *et al*. Usefulness of the Glasgow-Blatchford score to predict 1-week mortality in patients with esophageal variceal bleeding. European Journal of Gastroenterology & Hepatology. 2017; 29: 547–551.

[20] Beigmohammadi MT, Amoozadeh L, Rezaei Motlagh F, Rahimi M, Maghsoudloo M, Jafarnejad B, *et al*. Mortality predictive value of APACHE II and SOFA Scores in COVID-19 patients in the intensive care unit. Canadian Respiratory Journal. 2022; 2022: 5129314.

[21] Lelubre C, Anselin S, Zouaoui Boudjeltia K, Biston P, Piagnerelli M. Interpretation of C-reactive protein concentrations in critically ill patients. BioMed Research International. 2013; 2013: 124021.

[22] Gatta A, Verardo A, Bolognesi M. Hypoalbuminemia. Internal and Emergency Medicine. 2012; 7: S193–S199.

[23] Ñamendys-Silva SA, González-Herrera MO, Texcocano-Becerra J, Herrera-Gómez A. Hypoalbuminemia in critically ill patients with cancer: incidence and mortality. The American Journal of Hospice & Palliative Care. 2011; 28: 253–257.

[24] Dubois MJ, Orellana-Jimenez C, Melot C, De Backer D, Berre J, Leeman M, *et al*. Albumin administration improves organ function in critically ill hypoalbuminemic patients: a prospective, randomized, controlled, pilot study. Critical Care Medicine. 2006; 34: 2536–2540.

[25] Kendall H, Abreu E, Cheng AL. Serum albumin trend is a predictor of mortality in ICU patients with sepsis. Biological Research for Nursing. 2019; 21: 237–244.

[26] Lew CCH, Wong GJY, Cheung KP, Chua AP, Chong MFF, Miller M. Association between malnutrition and 28-day mortality and intensive care length-of-stay in the critically ill: a prospective cohort study. Nutrients. 2017; 10: 10.

[27] Machado Dos Reis A, Marchetti J, Forte Dos Santos A, Franzosi OS, Steemburgo T. NUTRIC Score: isolated and combined use with the NRS-2002 to predict hospital mortality in critically ill patients. Journal of Parenteral and Enteral Nutrition. 2020; 44: 1250–1256.

[28] İleri İ, Özsürekci C, Halil MG, Gündoğan K. NRS-2002 and mNUTRIC score: could we predict mortality of hematological malignancy patients in the ICU? Nutrition in Clinical Practice. 2022; 37: 1199–1205.

[29] Gulsoy KY, Orhan S. The relationship between mortality and the Modified Nutrition Risk in Critically Ill (mNUTRIC) and Nutritional Risk Screening 2002 (NRS-2002) Scores in the intensive care unit. Journal of College of Physicians and Surgeons Pakistan. 2022; 32: 848–854.

[30] Majari K, Imani H, Hosseini S, Amirsavadkouhi A, Ardehali SH, Khalooeifard R. Comparison of Modified NUTRIC, NRS-2002, and MUST Scores in Iranian critically ill patients admitted to intensive care units: a prospective cohort study. Journal of Parenteral and Enteral Nutrition. 2021; 45: 1504–1513.

How to cite this article: Şule Göktürk, Yasin Göktürk, Aslı Gizem Çapar, Eda Başmısırlı, Yusuf Aykemat, Neriman İnanç. Comparison of mNutric score and NRS-2002 screening tools in neurosurgery intensive care units. Signa Vitae. 2025; 21(4): 103-110. doi: 10.22514/sv.2025.057.