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Use of NUTrition Risk in the Critically Ill and Modified NUTrition Risk in the Critically Ill with C-Reactive Protein Scores as a Prognostic Indicator in COVID-19 Patients

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ABSTRACT

Objective: This study aimed to investigate the applicability of the NUTrition Risk in the Critically Ill and modified NUTrition Risk in the Critically Ill with C-reactive protein scores for assessing nutritional risks and predicting outcomes of these critically ill coronavirus disease 2019 patients.
Methods: This retrospective study included 246 adult patients admitted to the intensive care unit between March 15, 2020, and August 15, 2021, diagnosed with coronavirus disease 2019 which was confirmed with real-time-polymerase chain reaction, and who received invasive mechanical ventilation. Treatments in the intensive care unit and clinical outcomes of the patients were recorded. The nutritional risk for each patient was assessed using both the NUTrition Risk in the Critically Ill and the modified NUTrition Risk in the Critically Ill with C-reactive protein scores. If the NUTrition Risk in the Critically Ill and modified NUTrition Risk in the Critically Ill with C-reactive protein scores were ≥6, and the nutritional risk was considered to be high.
Results: The median age was 68 (21-93) years, and 61% of them were male. The median duration of invasive mechanical ventilation was 9 (1-62) days, the median length of stay in intensive care unit was 15 (1-65) days, and the mortality rate in 28 days was 77.2%. Most of the patients had low nutritional risk according to NUTrition Risk in the Critically Ill score (75.2%) and modified NUTrition Risk in the Critically Ill with C-reactive protein score (69.1%). High NUTrition Risk in the Critically Ill and modified NUTrition Risk in the Critically Ill with C-reactive protein scores were not significantly associated with the duration of invasive mechanical ventilation, length of stay in intensive care unit, and mortality at 28 days.
Conclusion: It was shown that NUTrition Risk in the Critically Ill and modified NUTrition Risk in the Critically Ill with C-reactive protein scores were not correlated with the duration of invasive mechanical ventilation, length of stay in intensive care unit, and 28-day mortality in critically ill coronavirus-19 patients. NUTrition Risk in the Critically Ill score was not an appropriate nutrition risk assessment tool as a prognostic marker in patients with severe acute respiratory syndrome coronavirus 2 infection, which is correlated to interleukin-6 and C-reactive protein levels.

Keywords: Intensive care, nutrition, NUTRIC score, modify NUTRIC score, prognosis

INTRODUCTION

The nutritional status of patients in the intensive care unit (ICU) is affected not only by chronic and acute starvation but also by the severity of the underlying pathophysiological conditions leading to ICU admission. Malnutrition is associated with poor outcomes such as wound healing, high hospital-acquired infection rates, and increased mortality in critically ill patients.[1-3] Nutritional therapy can improve malnutrition-related outcomes in these patients.[1] However, when and how to implement nutrition therapy is still controversial.[1,3] Validated scoring systems are needed to determine the likelihood that ICU patients will benefit most from nutritional support. Therefore, it is recommended to use variables related to current metabolic status instead of traditional screening tools (body mass index, weight loss, etc.) to assess nutritional risk in the ICU.[4-6] There are many assessment tools such as Nutritional Risk Screening (NRS-2002), Malnutrition Universal Screening Tool (MUST), and Mini Nutritional Assessment (MNA) to measure nutritional risk.[2,3] Unfortunately, these tests have not been validated specifically for patients followed in the ICU. Heyland et al[4] presented a new screening tool called NUTrition Risk in the Critically Ill (NUTRIC) score, which was

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validated for ICU patients. Although the NUTRIC score is based on variables such as acute inflammation and severity of underlying disease, measurement of interleukin (IL)-6 levels is not routinely obtained in critical care clinical practice. Therefore, the NUTRIC score was later validated without the use of IL-6, yielding the modified NUTRIC (mNUTRIC) score. Rahman et al[7] demonstrated the validity of an mNUTRIC score that included all variables except the IL-6 level. In addition, there are publications in the literature showing the effectiveness of using C-reactive protein (CRP), which is measured more widely, instead of IL-6 values in nutritional risk assessment in ICUs.[6,8] On the other hand, ESPEN guidelines suggest that all patients who stay in the ICU for longer than 48 hours are at risk of malnutrition and that we should consider all critically ill patients as malnourished until a special scoring system is developed.[2]

Coronovirus disease 2019 (COVID-19) is a respiratory illness caused by the severe acute respiratory syndrome coronavirus 2. It can cause a range of symptoms, from mild to severe, and can lead to death. Severe COVID-19 can lead to malnutrition, which can further worsen the patient's condition.[9,10] Therefore, management and prevention of malnutrition should be considered in the treatment of COVID-19 patients.[10-12] However, the clinical evidence for the association between nutritional risk assessment tools and clinical outcomes in patients with COVID-19 is limited.[10,13] In addition, the number of studies are insufficient to suggest that NUTRIC and the modified NUTRIC, calculated without including IL-6, the score can be used as a suitable tool in critically ill COVID-19 patients.[12-16] Besides, a study evaluating the prognostic efficiency of NUTRIC score calculated with CRP, which has prognostic importance in terms of infection conditions that are frequently followed during critically ill patients with a diagnosis of COVID-19, also has not been found in the literature.

We aimed to investigate the applicability of the NUTRIC and modified NUTRIC with C-reactive protein scores for assessing nutritional risks and predicting outcomes and 28-day mortality of critically ill COVID-19 patients undergoing invasive mechanical ventilation.

Main Points

- The mNUTRIC-CRP score can provide insights into the nutritional status of the patients diagnosed with COVID-19, especially when IL-6 measurements are not available.
- Patients with higher NUTRIC and mNUTRIC-CRP scores had a higher prevalence of hypertension, heart failure, and chronic kidney disease. These results highlight the importance of considering nutritional status in the management of critically ill patients with comorbidities.
- The association between nutritional risk scores and clinical outcomes in COVID-19 patients remains controversial.

METHODS

Ethical Considerations

This retrospective study was given approval by the Clinical Research Ethics Committee of Bursa City Hospital (September 1, 2021, No: 2021-15/10).

Study Participant and Protocol

Patients above 18 years of age who were admitted to Bursa City Hospital, Anesthesiology Intensive Care Units between March 15, 2020, and August 15, 2021, were diagnosed with COVID-19 which was confirmed with real-time-polymerase chain reaction (RT-CPR) and patients who received invasive mechanical ventilation (IMV) and treated longer than 24 hours were enrolled in this retrospective study. Patients whose IL-6 level was not measured, whose hospital stay was <24 hours, who were not performing IMV, and who were pregnant were excluded.

Data Collection

Demographic data, comorbidities, the time between the onset of COVID-19-related symptoms and admission to the hospital and ICU, Acute Physiological and Chronic Health Assessment (APACHE) score II, Glasgow coma score (GCS), Sequential Organ Failure Assessment (SOFA) score, laboratory data (urea, creatinine, hemoglobin, CRP, aspartate aminotransferase, alanine aminotransferase, bilirubin, and IL-6), ICU, and hospitalization length of stay (LOS) were recorded. Treatments (vasopressor, renal replacement therapies [RRT] s, etc.) and complications that developed in the ICU period (acute respiratory distress syndrome [ARDS], shock, acute myocardial infarction, and acute hepatic or renal failure) also were recorded. The 28-day mortality rate was calculated.

The nutritional risk for each patient was assessed using both the NUTRIC and the mNUTRIC-CRP score. Laboratory data and individual health status characteristics were used for both score assessments. The NUTRIC score was calculated using age, APACHE II, and SOFA scores, number of comorbidities, number of days from admission to hospital admission, and serum IL-6 value within the first 72 hours after admission to the ICU. The NUTRIC score, modified with CRP, was calculated by using CRP values within the first 5 days after admission to the ICU. Modified NUTRIC-CRP score was performed according to the cut off value found as a result of the analysis of the CRP results. If the NUTRIC score was ≥6 and the mNUTRIC-CRP score was ≥6 the nutritional risk was considered to be high. If the NUTRIC score was <6 and the mNUTRIC-CRP score was <6, the nutritional

risk was considered to be low. Both scores were compared in terms of ICU-LOS and predictability of mortality.

Statistical Analysis

The data were analyzed with the statistical software IBM Statistical Package for the Social Sciences Statistics for Windows version 20.0 (IBM SPSS Corp., Armonk, NY, USA). The descriptive statistics were presented as number (n), percentage (%), and median (minimum–maximum). The normal distribution of the data of numerical variables was evaluated using the Shapiro–Wilk normality test. Comparisons between groups were performed using Student's *t*-test for variables with normal distribution and Mann–Whitney *U* test for variables not showing normal distribution. The relationship between categorical data was evaluated using chi-square test statistics. Multivariate logistical regression was conducted to identify independent risk factors. The accuracy of each independent predictor was determined by each Area Under the receiver operating characteristic (ROC) Curve (AUC). A *P*-value of <.05 was considered statistically significant.

RESULTS

Patient Population and Characteristics

During the study period, a total of 246 critically ill COVID-19-PCR (+) patients were included in the study (Figure 1). The median age of patients was 68 (21-93) years, and 150 (61%) of them were males. Median APACHE II and SOFA scores were 13 and 4, respectively. One or more comorbidities were frequently seen, the most common of which were hypertension (56.9%) and diabetes mellitus (DM) (37.8%). A total of 137 patients (55.7%) received at least 1 vasoactive drug, and 31 patients (12.6%) required RRT. The mortality rate was 77.2% on the 28th day. Demographic and clinical characteristics of the patients are shown in Table 1.

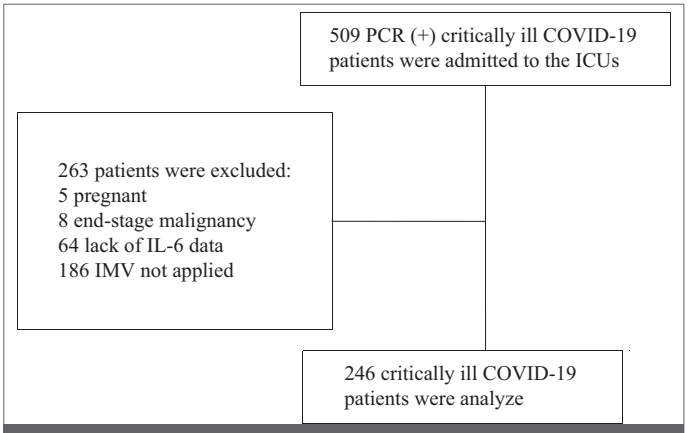

Figure 1. Flow diagram of the study. ICU, intensive care unit; IL, interleukin; IMV, invasive mechanical ventilation; PCR, polymerase chain reaction.

Table 1. Demographic and Clinical Characteristics of the Patients

	Total (n = 246)
Age (years), median (min-max)	68 (21-93)
Gender, male, % (n)	61 (150)
APACHE II score, median (min-max)	13 (3-42)
SOFA score, median (min-max)	4 (2-12)
Comorbidities, % (n)	
Hypertension	56.9 (140)
Diabetes mellitus	37.8 (93)
Coronary artery disease	23.6 (58)
Heart failure	15.9 (39)
COPD	6.5 (16)
Chronic kidney disease	6.5 (16)
Complications during ICU stay, % (n)	
Secondary infection	65.9 (162)
Shock	55.7 (137)
Acute kidney injury	35.8 (88)
Acute myocardial injury	21.1 (52)
Acute liver dysfunction	6.9 (17)
Treatments in ICU, % (n)	
Vasopressors	55.7 (137)
CRRT	12.6 (31)
Ferritin ng/mL, median (min-max)	889 (16-4552)
Interleukin-6 level, pg/mL, median (min-max)	155 (5-5000)
C-reactive protein, mg/L, median (min-max)	124 (1-415)
Duration of IMV, median (min-max)	9 (1-62)
Length of ICU stay, median (min-max)	15 (1-65)
Length of hospital stay, median (min-max)	18 (2-99)
Outcomes	
Death at ICU 28 days, % (n)	77.2 (190)

APACHE, Acute Physiological and Chronic Health Evaluation; COPD, Choronic obstructive pulmonary disease; CRRT, continuous renal replacement therapy; ICU, intensive care unit; IMV, invasive mechanical ventilation; SOFA, sequential organ failure assessment; min-max, minimum-maximum.

Nutritional Risk and Outcomes

Most of the critically ill COVID-19 patients had low nutritional risk according to NUTRIC (75.2%) and

mNUTRIC-CRP score (69.1%) at the ICU admission (Tables 2 and 3).

C-reactive protein was identified as an independent risk factor of mortality in critically ill COVID-19 patients. The AUCs of CRP was 0.663 (95% CI: 0.600-0.721) ($z=4.13$, $P<.001$), with a cutoff value of 141, CRP showed sensitivity of 53.6%, specificity of 76.7% (Figure 2).

NUTrition Risk in the Critically Ill and mNUTRIC-CRP scores were significantly higher in patients with older age, with higher APACHE II and SOFA scores (for all $P<.001$) (Tables 2 and 3).

The patients with high NUTRIC scores had more hypertension, DM, heart failure, and chronic kidney disease than those with low NUTRIC scores ($P=.001$, $P=.042$, $P<.001$,

Table 2. Comparison of Clinical Characteristics and Initial Laboratory Indices among Patients with High and Low Nutritional Risk According to NUTRIC Score

	Low Nutritional Risk Group (n=185)	High Nutritional Risk Group (n=61)	*P*
Age (years), median (min-max)	66 (21-93)	79 (52-92)	**<.001**
Gender, male, % (n)	63.2 (117)	54.1 (33)	.227
APACHE II score, median (min-max)	15 (3-31)	23 (11-42)	**<.001**
SOFA score, median (min-max)	4 (2-8)	7 (4-12)	**<.001**
Comorbidities, % (n)			
Hypertension	50.8 (94)	75.4 (46)	**.001**
Diabetes mellitus	38.9 (72)	34.4 (21)	**.042**
Coronary artery disease	22.7 (42)	26.2 (16)	.603
Heart failure	9.7 (18)	34.4 (21)	**.000**
COPD	4.9 (9)	11.5 (7)	.079
Chronic kidney disease	3.2 (6)	16.4 (10)	**.001**
Complications during ICU stay, % (n)			
Secondary infection	64.9 (120)	68.9 (42)	.642
Shock	50.3 (93)	72.1 (44)	**.003**
Acute kidney injury	35.1 (65)	37.7 (23)	.759
Acute myocardial injury	18.4 (34)	29.5 (18)	.072
Acute liver injury	7.6 (14)	4.9 (3)	.575
Treatments in ICU, % (n)			
Vasopressors	50.3 (93)	72.1 (44)	**.003**
CRRT	10.3 (19)	19.7 (12)	**.049**
Duration of IMV, days, median (minimum-maximum)	9 (1-62)	9 (1-47)	.695
Length of ICU stay, days, median (min-max)	15 (2-65)	15 (1-55)	.305
Length of hospital stay, days, median (min-max)	19 (2-99)	18 (4-66)	.573
Outcomes			
Death at ICU 28 days, % (n)	76.2 (141)	80.3 (49)	.599
Ferritin ng/mL, median (min-max)	882 (16-4552)	1017 (63-3705)	.338
C-reactive protein, mg/L, median (min-max)	123 (1-358)	133 (7-415)	.223
Interleukin-6 level, pg/mL, median (min-max)	143 (5-5000)	220 (15-5000)	**.030**

APACHE, acute physiological and chronic health evaluation; COPD, chronic obstructive pulmonary disease; CRRT, continuous renal replacement therapy; ICU, intensive care unit; IMV, invasive mechanical ventilation; SOFA, sequential organ failure assessment; min-max, minimum-maximum. <0.05 was considered statistically significant.

Table 3. Comparison of Clinical Characteristics and Initial Laboratory Indices among Patients with High and Low Nutritional Risk According to Modified NUTRIC Score (mNUTRIC-CRP)

	Low Nutritional Risk Group (n=170)	High Nutritional Risk Group (n=76)	*P*
Age (years), median (min-max)	65 (21-93)	76 (51-92)	**<.001**
Gender, % (n)	62.9 (107)	56.6 (43)	.396
APACHE II score, median (min-max)	14 (3-31)	22 (11-42)	**<.001**
SOFA score, median (min-max)	4 (2-9)	6 (3-12)	**<.001**
Comorbidities, % (n)			
Hypertension	48.8 (83)	75 (57)	**<.001**
Diabetes mellitus	37.1 (63)	39.5 (30)	.092
Coronary artery disease	24.1 (41)	22.4 (17)	.871
Heart failure	11.2 (19)	26.3 (20)	**.004**
COPD	5.3 (9)	9.2 (7)	.270
Chronic kidney disease	3.5 (6)	13.2 (10)	**.009**
Complications during ICU stay, % (n)			
Secondary infection	64.1 (109)	69.7 (53)	.467
Shock	48.8 (83)	91.1 (54)	**.001**
Acute kidney injury	35.9 (61)	35.5 (27)	1.000
Acute myocardial injury	17.6 (30)	28.9 (22)	.062
Acute liver dysfunction	8.8 (15)	2.6 (2)	.103
Treatments in ICU, % (n)			
Vasopressors	48.8 (83)	71.1 (54)	**.001**
CRRT	9.4 (16)	19.7 (15)	**.036**
Duration of IMV, median days, median (min-max)	9 (1-62)	9 (1-47)	.887
Length of ICU stay, days, median (min-max)	15 (2-65)	15 (1-55)	.239
Length of hospital stay, days, median (min-max)	19 (2-99)	18 (4-66)	.495
Outcomes			
Death at ICU 28 days, % (n)	75.3 (128)	81.6 (62)	.198
Ferritin ng/mL, median (min-max)	902 (16-4552)	775 (63-3705)	.820
C-reactive protein, mg/L, median (min-max)	116 (1-358)	146 (7-415)	**.001**
Interleukin-6 level pg/mL, median (min-max)	146.5 (5-5000)	179 (15-5000)	.900

APACHE, acute physiological and chronic health evaluation; COPD, chronic obstructive pulmonary disease; CRRT, continuous renal replacement therapy; ICU, intensive care unit; IMV, invasive mechanical ventilation; SOFA, sequential organ failure assessment; min-max, minimum-maximum.

P=.001, respectively). Patients with higher NUTRIC scores also required RRT and vasopressor treatment than the low NUTRIC score group (*P*=.003, *P*=.049, respectively) (Table 2).

In the high mNUTRIC-CRP score group, the ratio of hypertension, heart failure, and chronic kidney disease was higher than in the low mNUTRIC-CRP group (*P* < .001, *P*=.004, *P*=.009, respectively). In this group also need for

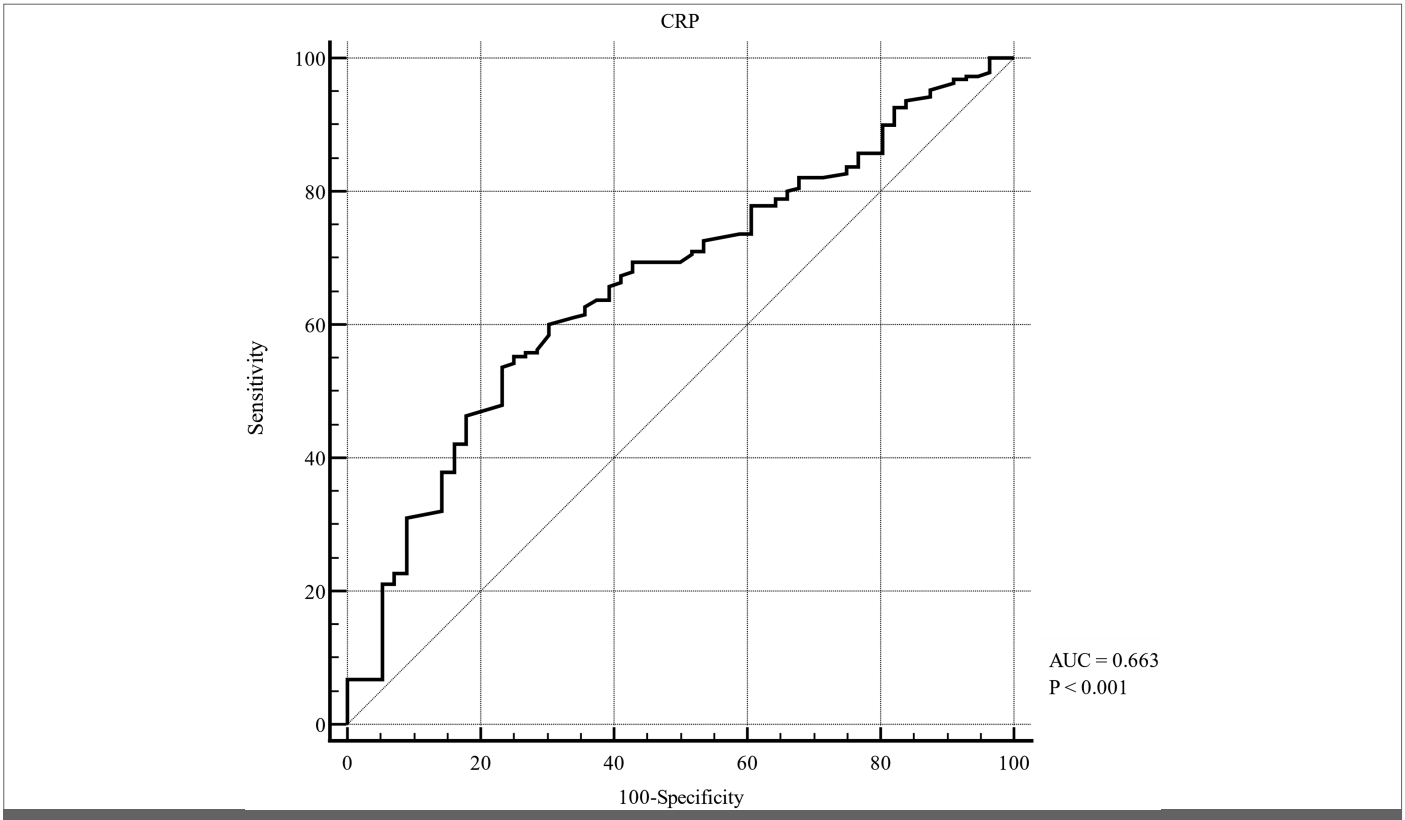

Figure 2. Prognostic accuracy of C-reactive protein to predict the outcome.

RRT and vasopressor drug use was higher than in the low-score group ($P = .001$, $P = .036$, respectively) (Table 3).

The high nutritional risk group of both NUTRIC and mNUTRIC-CRP scores had statistically significantly higher shock rates as a complication during ICU stay than the low nutritional risk group ($P = .003$, $P = .001$, retrospectively) (Tables 2 and 3).

High NUTRIC and mNUTRIC-CRP scores were not significantly associated with the duration of IMV, LOS of the ICU, and mortality at 28 days (Tables 2 and 3).

DISCUSSION

Coronavirus disease 2019 caused the death of millions of people in the world from 2019 to the present. Many studies published about risk factors, clinical outcomes, morbidity, and mortality of the disease.[9,17-19] It is suggested that the nutritional risk status affects clinical outcomes of the critically ill COVID-19 patients in ICU.[10-13,20]

In this study, we evaluated nutrition status with both NUTRIC and mNUTRIC-CRP in COVID-19 patients treated in ICU and detected that most of the patients were low nutritional risk group. Liberti et al[16] also detected that 43 COVID-19 patients in ICU had low nutritional risk with NUTRIC score. Whereas Osuna-Padilla et al[20] study included 112 patients with a diagnosis of COVID-19 who required mechanical ventilation was found that most of the patients had a high NUTRIC score (66%). The age of the patients in the studies may have contributed to these different results. Patients in Liberti's[16] and our study were at a similar age (64-68 years old, respectively), while those in Osuna's study[20] were younger (56 years old).

Comorbidities such as cardiovascular disease, hypertension, and DM were found to be significantly associated with admission to the ICU and mortality in COVID-19 patients.[9,17,19] In our study, most of the patients have at least 1 chronic disease and the most common comorbidities were hypertension, DM, and cardiovascular disease. Although the percentages varied in other studies, this triple was the most common comorbidities.[14,16,20]

Using of vasopressor for hemodynamic instability and the requirement for RRT were present in 55.7% and 12.6%, respectively, in our study. Zang et al[13] detected that the proportion of patients who were treated with vasopressor and RRT were 66% and 21%, respectively. Kucuk et al[14] detected that vasopressor drugs were required by 45% and CRRT was applied to 22% of the patients. Using of vasopressor drugs was significantly higher in patients with

high NUTRIC (72.1%) and mNUTRIC-CRP (54%) scores compared to those with low scores (50.3% and 48.8%, respectively) in our study. In the different studies, the prevalences of using vasopressors varied between 45% and 66% in the high nutrition risk groups.[12-14,20] Also, the requirement for RRT was significantly higher in patients with high NUTRIC and mNUTRIC-CRP scores compared to those with low scores in our study. Kucuk et al[14] also detected similar results in high NUTRIC scores in their study. But, Zang et al[13] did not find any differences in the requirement of RRT between high and low modified NUTRIC scores not including IL-6.

In this study, prognostic performance in COVID-19 patients treated in the ICU of both NUTRIC and mNUTRIC-CRP was evaluated, and it was detected that these scores may not be appropriate to show the requirement for IMV, LOS of hospital, and ICU and to use as a prognostic indicator in this patients. However, Li et al[10] reported a high rate of in-hospital mortality for COVID-19 patients with a high mNUTRIC score. Additionally, another study[14] also detected that the requirement for IMV, length of stay in ICU, and the mortality rates of patients were significantly higher in patients with high NUTRIC and mNUTRIC (without IL-6) scores compared to those with low scores. The authors suggested that the NUTRIC and mNUTRIC scores were effective scoring systems in COVID-19 patients in the ICU, and due to the lower cost and ease of calculation of the mNUTRIC score, it could be considered in preference to the NUTRIC score. Osuna-Padilla et al[20] detected that the patients with COVID-19 who required mechanical ventilation with a high NUTRIC score had a higher 28-day mortality, and the author suggested that high nutritional risk using NUTRIC score is associated with increased mortality risk. We think that the low number of patients included in the study was the reason why high NUTRIC scores and developing complications were not found to be associated with mortality in our study. In these studies, only high and low mNUTRIC scores or both the NUTRIC score and the mNUTRIC have been evaluated, whereas NUTRIC and mNUTRIC-CRP scores were evaluated in COVID-19 patients in our current study. In literature, values of ≥6 for both the NUTRIC[14] and mNUTRIC-CRP score[6] have been defined as high scores. We accepted the same level in both scores and detected that 61 patients had a high NUTRIC score and 76 had a high mNUTRIC-CRP in our study included a total of 246 patients. The patients with high scores were older and had higher APACHE II and SOFA scores than low scores. Zhang et al[13] compared high mNUTRIC scores with those with a low score in 136 COVID-19 patients, and they detected a statistically significant difference in respect of age, APACHE II score, SOFA score, the use of vasopressors, and mortality in high- and low-score groups. Kucuk et al[14] also detected a high NUTRIC score in older patients with COVID-19 in ICU. Additionally, in Kucuk's study, APACHE II and SOFA scores were higher in the high NUTRIC and mNUTRIC (without IL-6) score groups than in the groups with low scores. In our study, we calculated the mNUTRIC score with CRP instead of IL-6 which is an inflammation marker too.

C-reactive protein is an important marker of inflammation. Therefore, if clinicians consider or want to exclude an infectious or inflammatory etiology, CRP is mostly evaluated in ICUs.[3] Whereas, in pandemic or normal routine clinical time, IL-6 is not routinely examined in all ICUs. Therefore, in our research, we compared the NUTRIC score and the mNUTRIC-CRP score in COVID-19 critically ill patients. The only difference between the 2 scoring systems is the inclusion of CRP instead of IL-6 in the NUTRIC score calculations. According to our knowledge, there are 2 studies evaluating nutrition via NUTRIC score with CRP.[6,8] Oliveria et al[6] evaluated the concordance between the modified NUTRIC (without IL-6) and NUTRIC with CRP in identifying nutritional risk and predicting mortality in patients at ICU. The authors detected that both scores were positively associated with mortality, and the risk of death was increased in patients with a high mNUTRIC score. Moretti et al[8] also researched the same scores and found that these scores behaved similarly to the original NUTRIC score, and they suggested that the addition of the CRP improves the score performance and may be an alternative to IL-6 if it is not available. Evaluation of nutritional status using CRP values in patients with COVID-19 has never been investigated before. In our study, while the CRP level was detected to be significantly higher in patients with the high mNUTRIC-CRP group than in patients with low mNUTRIC-CRP, there was no difference between the high and low NUTRIC score groups. Additionally, the 2 scores (NUTRIC or mNUTRIC-CRP) were not superior to each other in the prediction of mortality, the difference was not statistically significant.

Strengths

To our knowledge, this study is the first to evaluate nutrition conditions via mNUTRIC-CRP score for COVID-19 patients in the ICU.

Study Limitations

This study was conducted at a single center and retrospective design. It has also a limited number of patients. Besides, it was conducted among the Turkish population. Therefore, the results of the study may not be suitable for different ethnic patients.

We found that NUTRIC and mNUTRIC-CRP scores are not correlated with the mechanical ventilation time, length of stay at the hospital and ICU, and 28-day mortality in critically ill COVID-19 patients. We think that the NUTRIC score is not an appropriate nutrition risk assessment tool as a prognostic marker in patients with SARS-CoV-2 infection, which is correlated to IL-6 levels. More studies including a larger number of patients are needed to establish the relationship between the NUTRIC score and mortality in COVID-19 patients.C-reactive protein is an independent risk factor for mortality in critically ill COVID-19 patients.

Ethics Committee Approval: Ethics committee approval was received for this study from Clinical Research Ethics Committee of Bursa City Hospital (September 9, 2021, No: 2021-15/10).

Informed Consent: Due to the retrospective design of the study, informed consent was not taken.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – G.Ç., P.K.K., M.D., N.K.G.; Supervision – G.Ç., P.K.K., N.K.G.; Resources – G.Ç., P.K.K., M.D., N.K.G.; Materials – G.Ç., P.K.K., M.D., N.K.G.; Data collection and/or Processing – G.Ç., P.K.K., M.D., N.K.G.; Analysis and/or Interpretation – G.Ç., P.K.K., M.D., N.K.G.; Literature Search – G.Ç., M.D., N.K.G.; Writing Manuscript – G.Ç., P.K.K., M.D., N.K.G.; Critical Review – G.Ç., P.K.K., M.D., N.K.G.

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