ARAŞTIRMA MAKALESİ/ORIGINAL RESEARCH

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Investigation of the Relationship between Blood Urea Nitrogen / Serum Albumin Ratio and Clinical Course in Patients with COVID-19 Pneumonia

COVID-19 Pnömonisi Olan Olgularda Kan Üre Azotu/Albümin Oranının Klinik Seyirle İlişkisinin İncelenmesi

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ABSTRACT

INTRODUCTION: This study aims to investigate whether the Blood Urea Nitrogen to Serum Albumin ratio (BAR) as well as the CURB-65, NEWS-2, and TREWS scores which are measured at admission are effective predictors of mortality and prognosis in patients with COVID-19 pneumonia.

METHODS: BAR, CURB-65, NEWS-2, and TREWS scores were calculated and a ROC curve was drawn to examine their diagnostic value in predicting 28-day mortality.

RESULTS: The BAR (p<0.001), CURB-65 (p<0.001), NEWS-2 (p<0.001), and TREWS (p<0.001) scores of the patients who died within the 28-day period were statistically significantly different. In the ROC analysis to predict 28-day mortality, the area under the curve (AUC) was found to be 0.875 for BAR [(95% CI 0.826-0.924), (p<0.001)], 0.887 for CURB-65 [(95% CI 0.834-0.940), (p<0.001)], 0.837 for NEWS-2 [(95% CI 0.768-0.907), (p<0.001)], and 0.852 for TREWS [(95% CI 0.787-0.918), (p<0.001)]. When the cut-off value of BAR in predicting 28-day mortality was taken as 4.440, the sensitivity was found to be 93.2%, specificity was 70.6%.

DISCUSSION AND CONCLUSION: The BAR, which is a simple, inexpensive and easily available parameter, is highly effective in predicting 28-day mortality in patients with COVID-19 pneumonia. It can also be used with other scoring systems.

Keywords: emergency department, COVID-19, pneumonia, BUN/albumin ratio, mortality

ÖZ

GİRİŞGİRİŞ ve AMAÇ: Bu çalışmanın amacı, acil servise başvuran COVID-19 pnömonili hastalarda başvuru esnasında ölçülen Kan Üre Azotu/Albümin oranı (BAR) ile CURB-65, NEWS-2 ve TREWS skorlarının mortalite ve prognoz tahmininde etkili bir belirteç olup olmadığını araştırmaktır.

YÖNTEM ve GEREÇLER: Hastaların BAR, CURB-65, NEWS-2 ve TREWS skorları hesaplanarak 28 günlük mortalite açısından tanısal değerlerinin araştırılması için ROC eğrisi çizildi.

BULGULAR: Yirmi sekiz günlük sürede mortalite gelişen hastaların sırası ile BAR değeri (p<0,001), CURB-65 (p<0,001), NEWS-2 (p<0,001), ve TREWS (p<0,001) skorlarının, istatistiksel olarak anlamlı derecede farklı olduğu görüldü. BAR'ın 28 günlük mortaliteyi öngörmede kullanımı için yapılan ROC analizinde; eğri altındaki alan (AUC) değeri 0,875 [(%95 GA 0,826-0,924), (p<0.001)], CURB-65 skorunun AUC değeri 0,887 [(%95 GA 0,834-0,940), (p<0.001)], NEWS-2 skorunun AUC değeri 0,837 [(%95 GA 0,768-0,907), (p<0.001)], TREWS skorunun AUC değeri 0,852 [(%95 GA 0,787-0,918), (p<0.001)] olarak bulundu. BAR'ın 28 günlük mortaliteyi öngörmede kesim değeri 4,440 olduğunda sensitivitesi % 93,2, spesifitesi % 70,6 olarak saptandı.

TARTIŞMA ve SONUÇ: Basit, ucuz ve kolay elde edilebilen bir parametre olan BAO, COVİD-19 pnömonisi olan hastalarda 28 günlük mortaliteyi öngörmede oldukça etkilidir. Aynı zamanda diğer skorlama sistemleri ile de beraber kullanılabilir.

Anahtar Kelimeler: acil servis, COVİD-19, pnömoni, kan üre azotu/albümin oranı, mortalite

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INTRODUCTION

COVID-19 pneumonia is caused by the SARS-CoV-2 virus, leading to a pandemic with high mortality worldwide. It may cause disease in all age groups. However, in the elderly and those with comorbidities, the risk of severe disease and thus mortality and morbidity is higher (1,2).

Various laboratory parameters have been studied to predict poor prognosis in COVID-19 patients. For instance, increased IL-6 level, d-dimer, cardiac troponins, WBC, lactate, procalcitonin, sedimentation, LDH, CRP, ferritin, BUN and creatinine levels, decreased lymphocyte and platelet counts, and low albumin levels were associated with poor prognosis (3-5). Serum albumin is known to be the most commonly found protein in human plasma. It is synthesized primarily in the liver with an approximate half-life of 19 days. It is a macromolecule whose responsibility is to modulate fluid distribution between body parts and determine plasma oncotic pressure. It chiefly carries fatty acids, and thus many exogenous and endogenous compounds are carried thanks to its outstanding capacity for ligand-binding. In addition, it affects the pharmacokinetics of several drugs, metabolically modifies some ligands, helps to reduce potential toxicity, and creates a basis for the antioxidant capacity of human plasma. Albumin is a valuable acute phase reactant. It is used as an important biomarker in the diagnosis of many diseases and is clinically beneficial in treating various diseases. Serum concentration is 3.4-5.4 g/dL (6,7).

Urea is produced via urea cycle enzymes which commonly exist in the liver and rarely in other tissues. The metabolic process of urea can change depending on the conditions. That is, experiencing diseases, going on diets, and hormonal changes can affect urea levels. Urine is the fluid that excretes urea. Accordingly, blood urea nitrogen (BUN) has been used to assess the function of kidneys for the past decades. However, recently, new roles of urea in the urinary, circulatory, respiratory, digestive, and nervous systems have been reported, revealing the clinical importance of urea (8). BUN is a key parameter to be used with the aim of predicting outcome in critically ill patients, reflecting the complex relationship between the patient's nutritional status and protein metabolism with kidney function (9).

Many scoring systems have been developed to detect the prognosis of critically ill patients presenting to emergency services. The most commonly used scoring systems in emergency departments are the CURB-65, used by the British Thoracic Society in 2002 for the prediction of mortality in community-acquired pneumonia, the National Early Warning Score 2 (NEWS-2), obtained by updating the NEWS score developed by the British Royal of Physicians in 2012, and the emergency department triage early warning score (TREWS), designed by Lee et al. in

2020 (10-14).

Studies have shown that the BUN to Serum Albumin Ratio (BAR) can be used as a mortality indicator (15, 16). This study aims to evaluate the relationship between the BAR as well as CURB-65, NEWS-2, and TREWS scores with clinical course in patients presenting to the emergency department, having SARS-CoV-2 virus detected by RT-PCR test, having pneumonic infiltration of lung parenchyma detected by thorax computed tomography (CT), and thus diagnosed as COVID-19 pneumonia.

MATERIAL AND METHOD

Place, Time, and Study Design

This study was carried out in the emergency department of Bursa Yuksek Ihtisas Training and Research Hospital of Health Sciences University, Turkey, with the approval of the clinical research ethics committee of the same hospital with the protocol number 2011-KAEK-25 2020/05-15.

Inclusion Criteria

All patients aged 18 years old or older who presented to the emergency department with symptoms of COVID-19 (Fever, joint pain, fatigue, cough, sore throat, dyspnea) between 01.04.2020 and 31.05.2020, who were diagnosed with COVID-19 pneumonia based on imaging findings [(Thorax Computed Tomography results of the patients were recorded as typical (peripheral, bilateral ground glass opacity (GGO) with or without consolidation or visible intralobular lines, multifocal GGO that has rounded morphology or visible intralobular lines, reverse halo sign, or other findings that shows pneumonia), intermediate, atypical, and negative according to the Radiological Society of North America (RSNA) Expert Consensus Statement on Reporting Chest CT Findings Related to COVID-19 classification)] (17). Who had a positive RT-PCR test and imaging findings, who were hospitalized (Service or Intensive Care Unit), and whose study data were fully accessible were retrospectively included in the study.

Exclusion Criteria

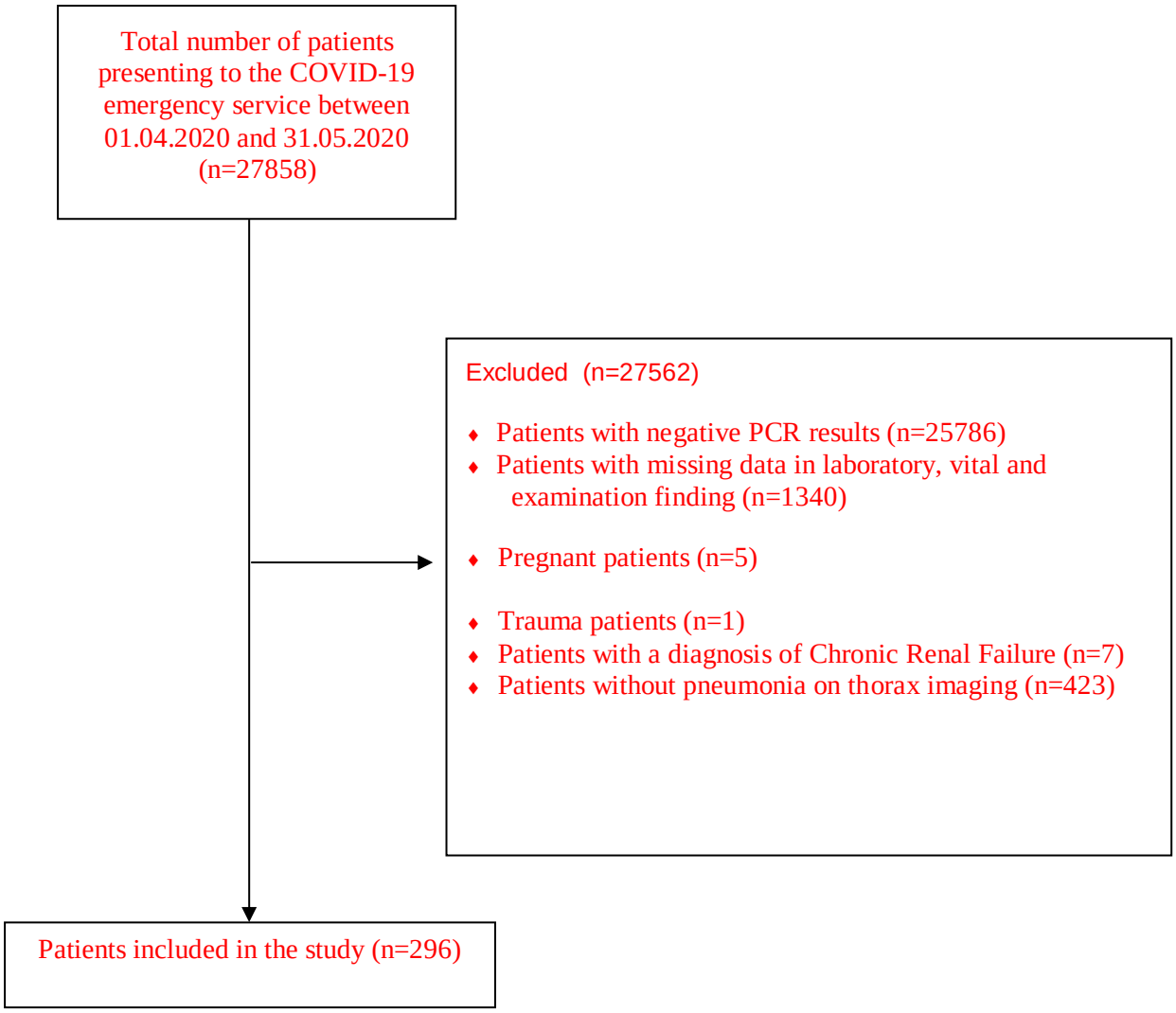
Patients who were under the age of 18, who had missing study data, who were pregnant, who had a negative RT-PCR test, who did not have COVID-19 pneumonia, who were diagnosed with chronic renal failure, who were candidates for hemodialysis or receiving hemodialysis, and who had trauma were excluded from the study.

Study Plan

The data of the study were obtained through the hospital information management system. A standard study data entry form was created. Demographic information (age, gender), date of admission to the emergency department, vital signs (fever, respiratory rate per minute, oxygen saturation on room air with pulse oximeter (SPO2), Glasgow coma score (GCS), systolic blood pressure (SBP), diastolic blood pressure (DBP), presence/absence of newly

developed confusion, admission complaints and onset time, chronic diseases, medications, thoracic CT scans and interpretation reported by the radiologists, laboratory values, RT-PCR results, and the patient's outcome in the emergency department (discharge, hospitalization, ICU admission, death, treatment rejection) were investigated. The BAR, CURB-65, NEWS-2 and TREWS scores of the patients were calculated. In addition, whether the patients died within 28 days were examined. After the study was completed, the data in the study forms were recorded in electronic format for statistical analysis.

The Flow chart of the Study



Statistical Analysis

For statistical analysis, we used IBM SPSS Statistics for Windows, Version21.0 (IBM Corp. Armonk, NY: USA. Released 2012). In descriptive statistics, for the numerical variables we used mean ± standard deviation (minimum – maximum), median, range, and/or interquartile range (IQR). On the other hand, we used number and percentages to explain the categorical variables. The normality distribution was investigated with the Kolmogorov-Smirnov test. We used the Levene's test to assess if the assumption of homogeneity was met. We used the Student's t-test to test the significance of the difference between the groups which met parametric assumptions, whereas we used the Mann Whitney U test for the nonparametric ones. In addition, we performed the Spearman correlation analysis to investigate non-parametric variables. Whether there was a relationship between categorical variables was evaluated with the Chi-square and Fisher's exact tests. We drew a ROC curve to evaluate the 28-day mortality diagnostic values of BAR, CURB-65, NEWS-2 and TREWS scores. Finally, we performed a logistic regression analysis to see the factors that have an effect on mortality. The results were given at a 95% confidence interval. $p<0.05$ was considered statistically significant.

RESULTS

A total of 296 patients were included in the study. The median age of the patients was 58 years (IQR 25-75: 46.25-71) and 162 (54.7%) of them were male. The most common symptoms in the patients were cough (n=185; 62.5%) and fever (n=131; 44.3%). One hundred-seventy six (59.5%) of the patients had a history of comorbidities. The most common comorbidities were hypertension (HT) (41.9%) and diabetes mellitus (DM) (26.7%). According to the COVID-19 Computed Tomography Involvement Score (CT-IS), 210 (70.9%) of the patients had moderate involvement. According to the RSNA, 207 (69.9%) of the patients had typical involvement. Of the patients, 279 (94.3%) were admitted to the ward, and 44(14.9%) of them died within 28 days (Table 1).

The mean BAR score of the patients was 4.95±3.60, median CURB-65 score was 0 (IQR 25-75: 0-1), median NEWS-2 score was 3 (IQR 25-75: 0-5), and median TREWS score was found to be 5 (IQR 25-75: 3-7) (Table 2).

In the Mann Whitney U test, conducted to investigate whether there was a relationship between the BAR, CURB-65, NEWS-2 and TREWS scores of the patients with the 28-day mortality, the BAR, CURB-65, NEWS-2 and TREWS scores of the patients who died within 28 days were found to be significantly different [($p<0.001$), ($p<0.001$), ($p<0.001$), ($p<0.001$)] (Table

3). In the ROC analysis performed for the diagnostic value of the BAR, CURB-65, NEWS-2 and TREWS scores in predicting the 28-day mortality, the area under the curve (AUC) of BAR for the 28-day mortality was found to be 0.875 [(95%CI 0.826-0.924), (p<0.001)], the AUC of the CURB-65 was 0.887 [(95%CI 0.834- 0.940), (p<0.001)], the AUC of the NEWS-2 was 0.837 [(95%CI 0.768-0.907), (p<0.001)] and the AUC of the TREWS was 0.852 [(95%CI 0.787-0.918), (p<0.001)] (Figure 1).

Table 1. Clinical and Demographic Data

Variables		Descriptive statistics,n(%)
Symptoms	Fever	165 (55.7)
	Cough	185 (62.5)
	Dyspnea	127 (42.9)
	Diarrhea	22 (7.4)
	Joint pain	60 (20.3)
	Loss of taste and smell	14 (4.7)
	Fatigue	108 (36.5)
	Headache	27 (9.1)
	Chills and shivering	31 (10.5)
	Nausea and vomiting	28 (9.5)
	Sore throat	21 (7.1)
	Other	28 (8.4)
Comorbidities		176 (59.5)
Comorbidities	Hypertension	124 (41.9)
	Congestive Heart Failure	28 (9.5)
	Diabetus Mellitus	79 (26.7)
	Coronary Artery Disease	60 (20.3)
	Malignancy	8 (2.7)
	Neurovascular Disease	15 (5.1)
	Chronic Lung Disease	64 (21.6)
	Other	7 (2.4)
COVID-19 CT-IS	Mild	210 (70.9)
	Moderate	68 (23.0)
	Severe	18 (6.1)
RSNA COVID-19 Pneumonia Classification	Typical	207 (69.9)
	Indeterminate	75 (25.3)
	Atypical	14 (4.7)
Emergency Service Outcome	Service	279 (94.3)
	ICU	17 (5.7)
28-Day Mortality		44 (14.9)

CT-IS: Computed Tomography Involvement Score, RSNA: Radiological Society of North America, ICU: Intensive Care Unit

Table 2. Clinical and Laboratory Data of the Patients

Variables	Value
Age median IQR (25-75)	58 (46.25-71)
GCS median IQR (25-75)	15 (15-15)
SBP mm/Hg median IQR (25-75)	125 (115-135)
DBP mm/Hg median IQR (25-75)	78 (71-84)
Fever °C mean ± SD	37.11 ± 0.69
SpO2 % median IQR (25-75)	95 (91.25-97)
Pulse /min median IQR (25-75)	85 (76-96.75)
Respiration Rate /min IQR (25-75)	18 (15-23)
BUN mg/dL mean ± SD	17.27±9.71
Albumin g/dL mean ± SD	3.76±0.63
BAR mean ± SD	4.95±3.61
Creatinine mg/dL	0.97±0.39
CURB-65 median IQR (25-75)	0 (0-1)
NEWS-2 median IQR (25-75)	3 (0-5)
TREWS median IQR (25-75)	5 (3-7)

GCS: Glasgow coma scale, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, BUN: Blood urea nitrogen BAR: Blood urea nitrogen/Albumin ratio, NEWS-2: National Early Warning Score 2, TREWS: Emergency Department Triage Early Warning Score

Table 3. 28-day Mortality Analysis of Variables

Variables	28-Day Mortality	n	Median (IQR: 25-75)	p value
BAR	No	252	3.535 (2.762-4.605)	<0.001
	Yes	44	7.365(5.172-13.672)	
	Total	296	3.77(2.952-5.467)	
CURB-65	No	252	0 (0-1)	<0.001
	Yes	44	2.5(1.25-4)	
	Total	296	0(0-1)	
NEWS-2	No	252	2(0-4)	<0.001
	Yes	44	7(4.25-12)	
	Total	296	3(0-5)	
TREWS	No	252	5 (3-6)	<0.001
	Yes	44	8(7-11.75)	
	Total	296	5(3-7)	

BAR: Blood urea nitrogen/Albumin ratio, NEWS-2: National Early Warning Score 2, TREWS: Emergency Department Triage Early Warning Score

When the cut-off value of BAR at 28-day mortality was taken as 4,440, the sensitivity was identified as 93.2% and the specificity was 70.6%. Additionally, when the cut-off value was taken as 4.910, the sensitivity was 79.5% and the specificity was 79.8%. Considering the CURB-65 score, when the cut-off value was taken as 1.5 at 28-day mortality, the sensitivity was found to be 75.0% and the specificity was 84.5%. As for the NEWS-2 score, when the cut-off value at 28-day mortality was taken as 4.5, the sensitivity was 75 % and the specificity was 75.4%. Finally, when the cut-off value of the TREWS at 28-day mortality was taken as 6.5, the sensitivity was 79.5% and the specificity was 83.7% (Table 4).

A logistic regression analysis was performed with variables of age, gender, and history of comorbidities which may have an effect on 28-day mortality. Age was found to be associated with 28-day mortality [Exp beta=6.489 (95% CI 1.607-26.208), p=0.009] (Table 5).

In the Spearman correlation analysis performed to investigate whether there was a relationship between the BAR and each of the other prognostication scores for COVID-19, a significant and positive correlation was found between BAR and CURB-65, NEWS-2 and TREWS scores, respectively [(p< 0.001, r= 0.732), (p<0.001, r= 0.512), (p<0.001, r= 0.555)]

(Table 6).

Table 4. 28-day Mortality Diagnosis of Variables by ROC Analysis

AUC(95% CI)	p	Risk Factor	Cut-off value	Sensitivity %	Specificity %
0.875 (0.826-0.924)	<0.001	BAR	4.44	93.2	70.6
			4.565	86.4	73.4
			4.635	84.1	75.4
			4.88	81.8	79.0
			4.91	79.5	79.8
0.887 (0.834-0.940)	<0.001	CURB-65	0.5	95.5	62.7
			1.5	75.0	84.5
			2.5	50.0	97.2
0.837 (0.768-0.907)	<0.001	NEWS-2	3.5	79.5	64.3
			4.5	75.0	75.4
			5.5	72.7	86.5
0.852 (0.787-0.918)	<0.001	TREWS	4.5	90.9	45.6
			5.5	86.4	64.3
			6.5	79.5	83.7

AUC: Area Under the Curve; CI: Confidence Interval, BAR: Blood urea nitrogen/Albumin ratio, NEWS-2: National Early Warning Score 2, TREWS: Emergency Department Triage Early Warning Score

Table 5. Analysis of Variables with Logistic Regression

Variables	B	S.E.	Wald	df	p	Exp(B)	95% CI	
							Upper	Lower
Gender	-0.668	0.365	3.36	1	0.067	0.513	0.251	1.047
Age	0.065	0.014	22.532	1	0.000	1.067	1.039	1.096
Comorbidities	-0.593	0.425	1.951	1	0.163	0.553	0.24	1.27
Constant	-5.421	0.963	31.684	1	0.000	0.004		

CI: Confidence Interval

Table 6. Spearman Correlation Analysis of Variables

Variables			CURB-65	NEWS-2	TREWS	BAR
Spearman's Rho	CURB-65	r	1.000	**0.527****	**0.618****	**0.732****
		p	-	**< 0.001**	**< 0.001**	**< 0.001**
	NEWS-2	r	**0.527****	1.000	**0.800****	**0.512****
		p	**< 0.001**	-	**< 0.001**	**< 0.001**
	TREWS	r	**0.618****	**0.800****	1.000	**0.555****
		p	**< 0.001**	**< 0.001**	-	**< 0.001**
	BAR	r	**0.732****	**0.512****	**0.555****	1.000
		p	**< 0.001**	**< 0.001**	**< 0.001**	-

**Correlation is significant at the 0.01 level (2-tailed).
BAR: Blood urea nitrogen/Albumin ratio, NEWS-2: National Early Warning Score 2
TREWS: Emergency Department Triage Early Warning Score

DISCUSSION

Emergency departments are critical as they are places where critical patients are frequently admitted, the first treatment is started, and the primary outcome of the diagnosed patients (discharge, service admission, intensive care admission) is determined. Early and accurate prediction of which patient will be discharged, which patient will need hospitalization, and whether this hospitalization will be in the ward or in the intensive care unit is important for more accurate and efficient patient management in extremely busy emergency services with limited beds and staff. For this purpose, many scoring systems have been developed to determine the prognosis of critically ill patients.

The CURB-65 score is used to predict the 30-day mortality of pneumonia patients and to classify patients as low, moderate, and high risk, and to decide on outpatient follow-up, ward or intensive

care admission. The higher the CURB-65 score is, the higher the mortality rate is. In a study conducted with 681 COVID-19 patients, Satıcı et al. found a CURB-65 score of 2 and above had 73% sensitivity and 85% specificity in predicting the 30-day mortality. In this study, when the cut-off value of the CURB-65 score was taken as 1.5, we found a sensitivity of 75.0% and a specificity of 84.5% in predicting 28-day mortality. Our findings are consistent with the study of Satıcı et al (18).

In a multicenter study involving 830 COVID-19 patients, the 72 hour (early death) and 30-day mortality predictions of the CURB-65, NEWS-2 and QSOFA scores were compared and the mortality prediction success of these scoring systems was found to be insufficient (19). In a study evaluating the success of NEWS-2 scoring in the diagnosis of critically ill patients, the sensitivity of predicting critical illness was found to be 80% and the specificity was 84.3% in patients with a NEWS-2 score of ≥ 6 (20). In a large meta-analysis involving 6922 participants from 18 studies, the sensitivity, specificity, and AUC of critical illness were found to be 0.82, 0.67, and 0.82, respectively, in patients with a NEWS-2 score of ≥ 6 (21). In our study, when the cut-off value of the NEWS-2 score in predicting 28-day mortality was taken as 4.5, its sensitivity was 75.0%, its specificity was 75.4%, and its AUC value was 0.837, which is consistent with the literature.

TREWS is new mortality scoring system suggested by Lee et al. in 2020. The records of 81520 emergency room patients were analyzed and TREWS was found to be more significant than NEWS, MEWS and REMS scores in predicting 24-hour, 7-day and 30-day mortality (14). There is only one COVID-19 study in the literature on TREWS. In that study, in which 339 patients were examined and the 28-day mortality prediction was investigated, the cut-off value of the TREWS score was taken as 5.5, the AUC value was found to be 0.823, the sensitivity was 77.2%, and the specificity was 67.7% (22). In our study, when the cut-off value of the TREWS score in predicting 28-day mortality was taken as 6.6, the sensitivity was calculated as 79.5%, the specificity was 83.7%, and the AUC value was 0.852. We determined that the TREWS score showed a good performance.

There are very few studies in the literature on BAR. There is a study showing that BAR is significant in terms of predicting mortality and intensive care need in community-acquired pneumonia. In the study, which included 175 community-acquired pneumonia patients, the Pneumonia Severity Index (PSI) and BAR were found to be significant in terms of mortality prediction and need for intensive care (23). In a large-scale aspiration pneumonia study including 443 patients, the BAR was found to be statistically significant in predicting mortality. In that study, the AUC value was found to be 0.70 for

BAR, 0.71 for PSI, 0.64 for CURB-65, and 0.65 for albumin (24).

In a study on 1253 patients over 65 years conducted to investigate the success of BUN, albumin and BAR in predicting the in-hospital mortality, patients were associated with high in-hospital mortality when the BAR value was >6.25 (15). Küçükceran et al. found that BUN, albumin, and BAR were reliable in predicting in-hospital mortality in COVID-19 patients in their study on patients with a diagnosis of COVID-19 presenting to the hospital within a 6-month period. In the study, when the cut-off value of BAR was taken as>3.9, the sensitivity was 87.5%, the specificity was 59.9%, and the AUC was 0.809. In particular, they found that BAR was more reliable than BUN and albumin in predicting mortality (16). In our study, when the cut-off value of BAR was taken as 4.44 in 28-day mortality, the sensitivity was found to be 93.2% and the specificity was 70.6%. Additionally, when the cut-off value was taken as 4.91%, the sensitivity was % 79.5, the specificity was 79.8%, and the AUC value was 0.875, which is consistent with the literature.

As far as we know, there is not enough study on this subject in the literature. As far as we know, this study is the first in the literature examining the BAR to make a prediction about the 28-day mortality of cases who has COVID-19 pneumonia. As a result, we found that the BAR performed as well as other scoring systems to predicting 28-day mortality among cases with COVID-19. Additionally, the BAR had a significant positive correlation with the CURB-65, NEWS-2 and TREWS scores.

There are many studies in the literature showing that disease severity and mortality increase with increasing age. In a meta-analysis examining the age and mortality of more than 500,000 patients, the mortality rate was found to be 0.3% under 29 years of age, 0.5% in the 30-39 age range, 1.1% in the 40-49 age range, 3% in the 50-59 age range, 9.5% in the 60-69 age range, 22.8% in the 70-79 age range, and 29.6% in the over 80 age group (25). In another comprehensive meta-analysis, age was found to have a significant effect on mortality when patients were evaluated as those under 50 and over 50 (p=0.0002), but the effect of age on mortality was not significant when patients were assessed as those under 65 old and over 65 (p = 0.110) (26). Similarly, age was found to be an independent risk factor for 28-day mortality in our study.

There are some limitations in our study. The limitations of the study were it was single-center retrospective study and the number of patients was small.

This study has several limitations. The main limitations of the study are that it is retrospective, the number of patients is relatively small, and the study is single-center.

In conclusion, BAR, which is a simple, inexpensive, and easily obtainable parameter, is highly effective to forecast 28-day mortality of patients who has pneumonia due to COVID-19. At the same time, its performance in predicting mortality is as significant as other scoring systems. We think that the BAR can be used together with other scoring systems and will shed light on new studies on this subject.

Conflict of Interest: There is no conflict of interest.

Financial Support: No financial support was received.

Ethics Committee Approval: Bursa Yuksek Ihtisas Training and Research Hospital of Health Sciences University, Turkey, with the approval of the clinical research ethics committee of the same hospital with the protocol number 2011-KAEK-25 2020/05-15.

Informed Consent: This a retrospective study.

Authors Contributions: Concept and Design: A. Ö., M. Y., Ü. D., M. O. A, H. K, M.B., Data Collection: A. Ö., M. Y., Ü. D. H. K, Analysis and Interpretation of Results: A. Ö., M. Y., Ü. D., M. O. A, H. K, M.B Draft Manuscript Preparation: A. Ö., M. Y., Ü. D., M. O. A, H. K, M.B., Ş. K., Ö. F. D.,

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