To cite this article: Kerimoğlu E, Eyüpoğlu S, Uyanık E. Effectiveness of albumin-bilirubin score in predicting mortality in intensive care patients. Turk J Clin Lab 2025; 2: 394-401.

Research Article

Effectiveness of albumin-bilirubin score in predicting mortality in intensive care patients

Yoğun bakım hastalarında mortaliteyi tahmin etmede albumin-bilirubin skorunun etkinliği

Elif Kerimoğlu*[1], Selin Eyüpoğlu[1], Eser Uyanık[2]

[1]Department of Intensive Care Unit, Ordu State Hospital, Ordu, Turkey,
[2]Department of Internal Medicine, Ordu State Hospital, Ordu, Turkey.

Abstract

Aim: The Albumin-Bilirubin (ALBI) score, originally developed to assess liver function in patients with hepatocellular carcinoma, has recently gained attention as a prognostic marker in critically ill patients. This study aimed to evaluate the effectiveness of the ALBI score in predicting mortality among intensive care unit (ICU) patients.

Material and Methods: This retrospective study included 157 adult patients admitted to the ICU diverse clinical conditions, including sepsis, respiratory failure, trauma, acute neurological events, and post-cardiac arrest, between November 2023 and November 2024. Clinical data, laboratory parameters, ALBI, SOFA, and APACHE II scores were assessed at ICU admission. The ALBI score is calculated as follows: (log10 bilirubin [µmol/L] × 0.66) + (albumin [g/L] × −0.085).

Results: Among the study participants (mean age: 71.7 ± 18.6 years; 55.4% male), 42.7% had diabetes mellitus, 21.7% chronic kidney disease (CKD), 38.9% chronic obstructive pulmonary disease, 73.9% cardiovascular disease, and 19.7% malignancies. The overall mortality rate was 42.7%. Multivariable Cox regression analysis revealed that CKD (HR: 1.90; 95% CI: 1.07–3.39; p = 0.029), higher ALBI scores (HR: 1.65; 95% CI: 1.03–2.65; p = 0.038) and higher APACHE II scores (HR: 1.04; 95% CI: 1.00–1.08; p = 0.031) were independent predictors of mortality.

Conclusion: The ALBI score is an independent predictor of mortality among critically ill patients with heterogeneous clinical conditions in general ICU settings. By integrating hepatic dysfunction, nutritional status, and systemic inflammation, ALBI complements traditional prognostic tools and may enhance clinical decision-making and risk stratification.

Keywords: ALBI score, intensive care, mortality, prognostic score, APACHE II, SOFA, albumin, bilirubin

Corresponding Author*: Elif Kerimoğlu, Department of Intensive Care Unit, Ordu State Hospital, Ordu, Turkey.
E-mail: ekerimoglu1@gmail.com
Orcid: 0000-0002-9846-2718
Doi: 10.18663/tjcl.1720604
Recevied: 16.06.2025 accepted: 30.06.2025
Permanent address: Department of Intensive Care Unit, Ordu University Education and Research Hospital, Ordu, Türkiye

TJCL Volume 16 Number 2 p: 394-401

Öz

Amaç: Hepatoselüler karsinomlu hastalarda karaciğer fonksiyonunu değerlendirmek için geliştirilen Albümin-Bilirubin (ALBI) skoru, yakın dönemde kritik hastalarda prognostik belirteç olarak ilgi görmüştür. Bu çalışmada, yoğun bakım ünitesi (YBÜ) hastalarında ALBI skorunun mortaliteyi öngörmedeki etkinliğinin değerlendirilmesi amaçlandı.

Gereç ve Yöntemler: Bu retrospektif gözlemsel çalışmaya, Kasım 2023 ve Kasım 2024 tarihleri arasında, sepsis, solunum yetmezliği, travma, akut nörolojik olaylar ve kardiyak arrest sonrası gibi çeşitli klinik nedenlerle YBÜ'ye kabul edilen 157 erişkin hasta dahil edildi. Klinik veriler, laboratuvar parametreleri ile ALBI, SOFA ve APACHE II skorları YBÜ'ye kabulde değerlendirildi. ALBI skoru, (log10 bilirubin [µmol/L] × 0,66) + (albumin [g/L] × -0,085) formülü ile hesaplandı.

Bulgular: Hastaların yaş ortalaması 71,7 ± 18,6 yıl olup, %55,4'ü erkekti. Hastaların %42,7'sinde diabetes mellitus, %21,7'sinde kronik böbrek hastalığı (KBH), %38,9'unda kronik obstrüktif akciğer hastalığı, %73,9'unda kardiyovasküler hastalık ve %19,7'sinde malignite mevcuttu. Genel mortalite oranı %42,7 bulundu. Çok değişkenli Cox regresyon analizinde KBH varlığı (HR: 1,90; %95 GA: 1,07–3,39; p = 0,029), yüksek ALBI skoru (HR: 1,65; %95 GA: 1,03–2,65; p = 0,038) ve yüksek APACHE II skoru (HR: 1,04; %95 GA: 1,00–1,08; p = 0,031) mortalitenin bağımsız prediktörleri olarak saptandı.

Sonuç: ALBI skoru, farklı klinik nedenlerle yoğun bakıma yatırılan hastalarda mortalitenin bağımsız bir belirleyicisidir. ALBI skoru, karaciğer fonksiyonu, beslenme durumu ve sistemik inflamasyonu birlikte yansıtarak geleneksel prognostik araçları tamamlamakta ve klinik karar verme süreçlerini destekleyici bir araç olarak kullanılabilir.

Anahtar Kelimeler: ALBI skoru, yoğun bakım, mortalite, prognostik skor, APACHE II, SOFA, albumin, bilirubin

Introduction

Critically ill patients admitted to intensive care units (ICUs) – including those with sepsis, acute respiratory failure, severe trauma, acute neurological events, or post-cardiac arrest – face high mortality rates, often exceeding 15–50% in severe cases (1-4). To stratify risk and guide clinical management in such patients, clinicians frequently rely on established severity scoring systems like the Sequential Organ Failure Assessment (SOFA) and the Acute Physiology and Chronic Health Evaluation II (APACHE II). These scoring tools are widely used to predict ICU outcomes, but they involve complex calculations and require extensive clinical data, which can hinder rapid decision-making (5). This limitation has spurred interest in additional prognostic markers that might complement existing scores in critical care.

One emerging tool is the Albumin–Bilirubin (ALBI) score, originally developed as an objective measure of liver function to predict prognosis in patients with hepatocellular carcinoma (HCC) (6). The ALBI score is calculated solely from serum albumin and bilirubin levels, offering a simplified assessment of hepatic reserve compared to traditional liver scores. Notably, the ALBI score's applicability has extended beyond its initial use in HCC; it has shown prognostic value in broader contexts, suggesting potential utility outside of hepatology (7). Recent studies have indeed explored the ALBI score in ICU cohorts. An elevated ALBI score has been independently associated with higher mortality in septic ICU patients (8), and similar findings have been reported in patients with severe trauma in the ICU (9). Likewise, in acute cardiac critical illness, such as ICU patients with heart failure, a higher ALBI score correlated with increased risk of all-cause mortality (10). Moreover, the ALBI score was demonstrated to be a superior predictor of in-hospital mortality compared to established prognostic scoring systems like SOFA and APACHE II in acute pancreatitis patients (11). These observations suggest that the ALBI score captures important prognostic information in diverse critical illnesses, possibly reflecting the impact of systemic inflammation and liver dysfunction on patient outcomes.

Despite its promising performance in various critically ill patient populations, the predictive utility of the ALBI score remains understudied in general intensive care settings. Moreover, current literature includes only limited investigations evaluating the ALBI score specifically within heterogeneous ICU cohorts comprising conditions such as sepsis, respiratory failure, trauma, acute neurological events, and post-cardiac arrest. Given this gap, we hypothesized that the ALBI score could serve as an effective prognostic tool to predict mortality among critically ill ICU patients. Thus, the primary objective of this study was to evaluate the effectiveness of the ALBI score in predicting mortality in this diverse ICU population.

Material And Methods

This retrospective study was conducted between November 2023 to November 2024 on adult patients admitted to the tertiary-level reanimation ICU of Ordu State Hospital. The study was approved by the Ordu University Non-Interventional Clinical Research

Ethics Committee (Date: 20.12.2024, Approval No: 2024/207) and was carried out in accordance with the relevant ethical guidelines and the Helsinki Declaration (2013 Brazil revision). The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

During the study period, a total of 214 patients admitted to the tertiary-level reanimation ICU of the hospital were screened for eligibility. Adult patients aged 18 years or older, regardless of sex, were eligible for inclusion. Patients were included if they were either directly admitted to the ICU or transferred from another healthcare facility or department within the same institution. In patients with multiple ICU admissions, only the first admission was considered. Exclusion criteria were age under 18 years (n = 2), ICU admission following elective surgery (n = 25), ICU stays shorter than 24 hours (n = 22), and missing data (n = 8). After exclusion criteria, 157 patients were included in the final analysis.

The hospital's electronic information system and patient files were used to gather demographic and clinical data. Laboratory parameters were recorded at two time points: (1) Admission: upon ICU entry, and (2) Last available: for survivors, the value closest to the time of ICU discharge; for non-survivors, the last measurement obtained within 24 hours prior to death. In accordance with the ICU's standard treatment protocol during the study period, patients with serum albumin levels below 2.5 g/dL had been administered 200 mL of a 20% albumin solution intravenously. Patients with anuric chronic kidney disease (CKD), oliguric acute kidney injury (AKI), or anuria were not administered albumin due to the risk of fluid overload.

Definitions

The ALBI score is an evidence-based, objective, and easily applicable scoring system developed to assess liver function. It is calculated using only two basic biochemical parameters—serum albumin and total bilirubin—and does not include any subjective components. The ALBI score is calculated as follows: (log10 bilirubin [µmol/L] × 0.66) + (albumin [g/L] × −0.085). According to this score, patients are categorized into three prognostic grades: Grade 1 for scores ≤ −2.60, Grade 2 for scores > −2.60 to ≤ −1.39, and Grade 3 for scores > −1.39. Lower ALBI scores indicate better liver function, while higher scores reflect hepatic dysfunction and increased mortality risk [4].

The SOFA score is a widely used tool for mortality prediction and assessment of multiple organ failure in ICU patients, particularly those with sepsis. It evaluates six organ systems—respiratory, cardiovascular, central nervous, renal, coagulation, and hepatic—on a scale from 0 to 4. Higher scores are associated with increased mortality risk. For example, a SOFA score ≥14 is linked to mortality rates exceeding 95%, while a mean score > 5.1 corresponds to a mortality rate of up to 84.4% [12,13].

The APACHE II score estimates mortality risk in ICU patients by integrating age, chronic health status, and 12 physiological parameters (e.g., body temperature, mean arterial pressure, arterial pH, serum sodium and potassium, creatinine, hematocrit, white blood cell count, and Glasgow Coma Scale score). Scores range from 0 to 71, with higher scores indicating a worse prognosis. For instance, mortality rates are approximately 40% for scores of 20–24 and 73% for scores of 30–34 [14].

Statistical analysis

All analyses were conducted using IBM SPSS Statistics for Windows 20.0 (IBM Corp., Armonk, NY, USA) and Medcalc 11.4.2 (MedCalc Software, Mariakerke, Belgium) software. The normal distribution of numerical variables was assessed using the Kolmogorov-Smirnov test. Data exhibiting a normal distribution were presented as mean ± standard deviation (SD), and comparisons between groups were made using the Student's T-test. Non-normally distributed data were displayed as median (interquartile range (IQR): 25-75 percentiles) and comparisons between groups were conducted using the Mann-Whitney U test. Cox proportional hazards regression was used to determine the impact of demographic, clinical and laboratory parameters on mortality during the observation period. Multivariable Cox regression analysis with the backward method was subsequently performed to identify any possible independent predictors of mortality. Receiver operating characteristic (ROC) curve analysis was performed to assess the diagnostic performance of the ALBI and APACHE II scores in predicting in-ICU mortality. Area Under the Curve (AUC) values are reported as AUC ± standard error (SE) with 95% confidence intervals (CI). Optimal cutoff values were determined by Youden's index. Changes in laboratory findings between admission and discharge were evaluated using a mixed model analysis for repeated measures. Value of $P < 0.05$ were considered statistically significant.

Results

The patients had a mean age of 71.7 ± 18.6 years, and the majority were male (55.4%). Among the patients, 42.7% had diabetes mellitus, 21.7% had CKD, 38.9% had chronic obstructive pulmonary disease (COPD), 73.9% had cardiovascular disease, and 19.7% had malignant conditions. The most common reason for admission to the intensive care unit was respiratory failure (52.2%), followed by sepsis (21.0%), acute neurological events (10.8%), cardiovascular arrest (9.6%), and trauma (6.4%). Invasive mechanical ventilation (IMV) was required in 58.6% of the patients, while 16.6% needed non-invasive mechanical ventilation (NIMV). Additionally, 45.6% required vasopressors, and 25.5% underwent hemodialysis. The median duration of ICU hospitalization was 9 days (range: 2–68), with a mortality rate of 42.7% (n = 67).

A 2.68-fold (95% CI = 1.58-4.57, p < 0.001) increase in mortality risk was observed in patients with CKD compared to those without. Admission due to acute neurological events was associated with lower mortality relative to sepsis (HR = 0.35, 95% CI = 0.13-0.98, p = 0.045). Patients who required IMV had a higher risk of mortality than those who did not (HR = 2.35, 95% CI = 1.07-5.87, p = 0.038). Likewise, patients with vasopressor requirements or those requiring hemodialysis demonstrated a significantly increased risk of mortality. Other demographic and clinical characteristics were not associated with mortality (Table 1).

At ICU admission, lower serum albumin levels were significantly associated with increased mortality risk (HR: 0.94; 95% CI: 0.91–0.98; p = 0.004). Similarly, higher ALBI score was associated with higher mortality (HR: 1.85; 95% CI: 1.19–2.87; p = 0.007). SOFA (HR: 1.12; 95% CI: 1.05–1.20; p = 0.001) and APACHE II scores (HR: 1.05; 95% CI: 1.02–1.09; p = 0.003) were associated with increased mortality risk. In contrast, admission levels of bilirubin, CRP, and procalcitonin were not significantly associated with mortality (p > 0.05) (Table 2).

All variables found to be significantly associated with mortality in univariable analysis (Table 1 and 2) were considered for inclusion in the multivariable regression analysis. However, the components of the ALBI, SOFA, and APACHE II scores were excluded due to potential multicollinearity with their respective composite scores. In the multivariable Cox regression analysis, CKD (HR: 1.90; 95% CI: 1.07–3.39; p = 0.029), higher admission ALBI score (HR: 1.65; 95% CI: 1.03–2.65; p = 0.038), and higher APACHE II score at ICU admission (HR: 1.04; 95% CI: 1.00–1.08; p = 0.031) were identified as independent predictors of mortality (Table 3).

The optimal cut-off point for the ALBI score in predicting mortality was found to be > -2.3, yielding a sensitivity of 79.1% and specificity of 61.1% (AUC ± SE: 0.774 ± 0.04; 95% CI: 0.700–0.837; p < 0.001). For the APACHE II score, the threshold was >13, with sensitivity and specificity values of 82.1% and 63.3%, respectively (AUC ± SE: 0.780 ± 0.04; 95% CI: 0.707–0.842; p < 0.001). No statistically significant difference was found between the two scores in terms of diagnostic performance (ΔAUC ± SE: 0.006 ± 0.05; 95% CI: 0.095–0.107; p = 0.900) (Figure 1).

Changes in laboratory parameters were more pronounced in non-survivors compared to survivors. In particular, the ALBI score showed a greater increase in non-survivors than in survivors (Table 4).

Table 1. Association between patients' demographic and clinical characteristics and mortality.

Variables	Intensive Care Discharge		Univariable Regression	
	Survivor n = 90	Deceased n = 67	HR (95% CI)	p
Age, years	68.2 ± 20.5	76.0 ± 15.9	1.02 (0.98-1.03)	0.093
Gender, n (%)				
Female	38 (42.2)	32 (47.8)	ref	
Male	52 (57.8)	35 (52.2)	0.75 (0.46-1.22)	0.243
Comorbidity, n (%)				
Diabetes mellitus	39 (43.3)	28 (41.8)	1.28 (0.78-2.11)	0.324
Chronic kidney disease	11 (12.2)	23 (34.3)	2.68 (1.58-4.57)	<0.001*
COPD	31 (34.4)	30 (44.8)	0.65 (0.39-1.09)	0.101
Cardiovascular disease	63 (70.0)	53 (79.1)	1.11 (0.61-2.01)	0.733
Malignancy	13 (14.4)	18 (26.9)	1.38 (0.79-2.40)	0.253
Reason for ICU admission, n (%)				
Sepsis	18 (20.0)	15 (22.4)	ref	
Respiratory failure	46 (51.1)	36 (53.7)	1.14 (0.70-1.85)	0.606
Trauma	10 (11.1)	-	0.50 (0.10-11.60)	0.995
Acute neurological event	12 (13.3)	5 (7.5)	0.35 (0.13-0.98)	0.045*
Cardiovascular arrest	4 (4.4)	11 (16.4)	1.17 (0.61-2.27)	0.635
Ventilator requirement, n (%)				
No	38 (42.2)	1 (1.5)	ref	
NIVM	21 (23.3)	5 (7.5)	1.15 (0.45-2.98)	0.770
IMV	31 (34.4)	61 (91.0)	2.35 (1.07-5.87)	0.038*
Vasopressor requirement, n (%)				
No	49 (54.4)	2 (3.0)	ref	
Low	26 (28.9)	33 (49.3)	1.37 (0.84-2.22)	0.210
High	15 (16.7)	32 (47.8)	1.58 (1.08-2.67)	0.033*
Need for hemodialysis, n (%)	10 (11.1)	30 (44.8)	2.02 (1.24-3.30)	0.005*
Length of ICU stay, days	8.0 (4.0-12.0)	10.0 (6.0-22.5)	-	-

The data are expressed as the mean ± SD or median (IQR) or number (%). * P-value <0.05 shows statistical significance. CI, confidence interval; COPD, chronic obstructive pulmonary disease; HR, hazard ratio; ICU, intensive care unit; IMV, invasive mechanical ventilation; NIVM, non-invasive mechanical ventilation.

Table 2. Association of laboratory and clinical severity parameters with mortality.

Variables	Intensive Care Discharge		Univariable Regression	
	Survivor n = 90	Deceased n = 67	HR (95% CI)	p
Albumin, g/dL	34.6 ± 6.0	31.7 ± 5.8	0.94 (0.91-0.98)	0.004*
Bilirubin, mg/dL	0.4 (0.3-0.7)	0.5 (0.3-0.8)	1.04 (0.65-1.68)	0.864
CRP, mg/ dL	81.0 (28.6-134.0)	63.7 (23.4-144.4)	0.98 (0.96-1.01)	0.216
Procalcitonin, ng/mL	0.3 (0.1-1.2)	0.7 (0.2-2.5)	0.99 (0.97-1.01)	0.113
ALBI score	-2.4 ± 0.6	-2.1 ± 0.5	1.85 (1.19-2.87)	0.006*
SOFA score	5.0 (3.0-7.8)	8.0 (6.0-10.0)	1.12 (1.05-1.20)	0.001*
APACHE II score	11.0 (8.0-16.0)	19.0 (14.0-24.0)	1.05 (1.02-1.09)	0.003*

The data are expressed as the mean ± SD or median (IQR) or number (%). * P-value <0.05 shows statistical significance. ALBI, albumin–bilirubin score; APACHE, acute physiology and chronic health evaluation; CI, confidence interval; CRP, C-reactive protein; HR, hazard ratio; ICU, intensive care unit; SOFA, sequential organ failure assessment.

Table 3. Independent risk factors associated with mortality.

Variables	HR	95% CI		p
		Lower	Upper	
Chronic kidney disease	1.90	1.07	3.39	0.029*
ALBI score	1.65	1.03	2.65	0.038*
APACHE II score	1.04	1.00	1.08	0.031*
	-2Log Likelihood = 501.7; p < 0.001			

* P-value <0.05 shows statistical significance. ALBI, albumin–bilirubin score; APACHE, acute physiology and chronic health evaluation; CI, confidence interval; HR, hazard ratio.

Table 4. Changes in laboratory parameters at admission and discharge in deceased and surviving patients.

Variables	Survivor		p	Deceased		p	Δp
	Admission	Last available		Admission	Last available		
Albumin, g/dL	34.6 ± 6.0	30.6 ± 4.7	<0.001*	31.7 ± 5.8	24.1 ± 5.0	<0.001*	<0.001*
Bilirubin, mg/dL	0.4 (0.3-0.7)	0.4 (0.3-0.6)	0.213	0.5 (0.3-0.8)	0.8 (0.4-1.3)	<0.001*	<0.001*
CRP, mg/ dL	81.0 (28.6-134.0)	52.0 (26.0-92.2)	0.005*	63.7 (23.4-144.4)	170.0 (100.3-238.0)	<0.001*	<0.001*
Procalcitonin, ng/mL	0.3 (0.1-1.2)	0.2 (0.1-0.5)	<0.001*	0.7 (0.2-2.5)	2.6 (1.0-9.1)	<0.001*	<0.001*
ALBI score	-2.4 ± 0.6	-2.0 ± 0.4	<0.001*	-2.1 ± 0.5	-1.3 ± 0.5	<0.001*	<0.001*
SOFA score	5.0 (3.0-7.8)	4.0 (2.0-6.0)	0.002*	8.0 (6.0-10.0)	13.0 (11.0-15.0)	<0.001*	<0.001*
APACHE II score	11.0 (8.0-16.0)	10.5 (8.0-14.0)	0.008*	19.0 (14.0-24.0)	32.0 (26.0-36.0)	<0.001*	<0.001*

The data are expressed as the mean ± SD or median (IQR) or number (%). * P-value <0.05 shows statistical significance. Δp reflects the between-group difference in the change of laboratory parameters from admission to discharge between patients who survived and those who did not. ALBI, albumin–bilirubin score; APACHE, acute physiology and chronic health evaluation; CRP, C-reactive protein; ICU, intensive care unit; SOFA, sequential organ failure assessment.

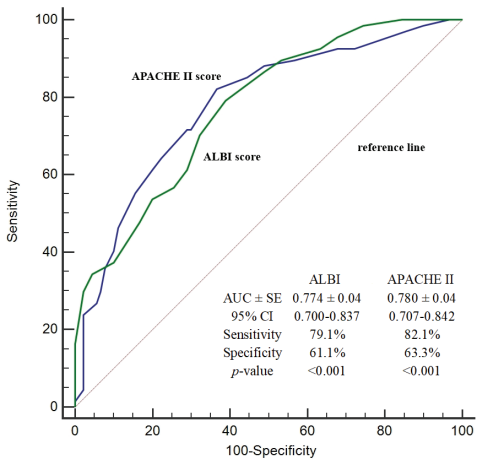

Figure 1. Diagnostic performance of ALBI and APACHE II scores in predicting mortality.

Discussion

The current study provides significant evidence supporting the prognostic value of the ALBI score in predicting mortality among patients admitted to the ICU for various clinical reasons. While the ALBI score has predominantly been evaluated within hepatology-focused populations, our findings highlight its effectiveness as a predictive tool across a diverse ICU cohort, including patients hospitalized due to respiratory failure, sepsis, trauma, acute neurological events, and post-cardiac arrest conditions. Specifically, we demonstrated that higher ALBI scores at ICU admission independently predict increased mortality risk, along with CKD and higher APACHE II scores. These findings emphasize the broader clinical relevance of the ALBI score, suggesting it can be effectively utilized in ICU settings as a simple, objective, and valuable tool for risk stratification.

Our study highlighted several clinical factors associated with increased mortality risk, including CKD, IMV, and vasopressor requirement. However, in addition to ALBI and APACHE II, only CKD remained an independent predictor after multivariable adjustment. One large sepsis study reported CKD approximately doubled 90-day mortality risk (HR ~2.3), independent of APACHE II and SOFA scores (12). The immunologic and metabolic derangements associated with CKD—such as uremic immune dysfunction and accumulation of inflammatory mediators—likely heighten vulnerability to critical illness, thereby explaining this association (12). In contrast, although IMV and vasopressor use were associated with mortality in univariate analyses, they were not independently predictive in multivariable models, likely due to their close relationship with the acute severity of illness already captured by scoring systems such as APACHE II and SOFA. Mechanical ventilation requirement is a recognized indicator of severe respiratory failure or profound neurological impairment, correlating with mortality rates ranging from approximately one-third in high-resource settings to two-thirds in resource-limited settings (13). Similarly, vasopressor use typically denotes significant hemodynamic instability, such as septic or cardiogenic shock, which inherently carries high acute mortality risks (14). Thus, our findings emphasize that both chronic conditions, such as CKD, and acute physiological disturbances captured by SOFA and APACHE II scores collectively contribute to the overall mortality risk in ICU patients.

The present study supports the finding that higher APACHE II scores are independently associated with mortality, in line with numerous studies conducted in ICU populations (15-19). As a defined component of the SOFA score, bilirubin plays a key role in assessing hepatic function. It can signify ischemic hepatopathy ("shock liver"), hemolysis, or resorptive bilirubinemia from extensive tissue injury, all of which portend a worse prognosis. Hyperbilirubinemia, which occurs in nearly 40% of critically ill ICU patients, is linked to higher organ failure rates and mortality (20, 21). Although this highlights the relevance of SOFA, previous studies have demonstrated that it shows diagnostic performance comparable to that of APACHE II (22). On the other hand, the SOFA score was significant in univariate analysis but lost its significance in the multivariate model, possibly due to acute physiology and liver dysfunction being accounted for by APACHE II and ALBI.

Hypoalbuminemia is a well-recognized marker of severe illness, poor nutritional reserve, and systemic inflammation. A substantial reduction in serum albumin levels is commonly observed in critically ill patients (23). In one ICU study, patients with profoundly low admission albumin (<~18.5 g/L) had more than double the mortality rate of those with higher albumin (52% vs 31%) (24). Yet albumin is not included in SOFA and APACHE II, meaning those scores may underweight the prognostic impact of chronic malnutrition or ongoing inflammatory burden. The ALBI score uniquely combines bilirubin with albumin, thus providing a more comprehensive assessment of liver function, metabolic stress, and inflammatory status. This integrative characteristic likely explains ALBI's superior predictive value for mortality observed in our adjusted multivariable model, consistent with prior evidence in heterogeneous ICU populations (8-11). Furthermore, in critically ill acute pancreatitis patients, ALBI demonstrated superior discrimination for in-hospital mortality (AUC: 0.86) compared to SOFA (0.72) or APACHE II (0.83) and was an independent risk factor for poor outcome (11). Likewise, recent large cohort analyses in sepsis have shown a near-linear relationship between higher ALBI values and increased death risk (adjusted HR ~1.5 per ALBI point) (8). The present study extends these observations across diverse ICU admission diagnoses – including sepsis, respiratory failure, trauma, acute neurological events, and cardiac arrest – indicating that ALBI's prognostic value is broadly applicable. Also, the diagnostic performance of the ALBI score was similar to that of the APACHE II score in the overall ICU cohort. The threshold values of the ALBI score vary across different ICU cohorts. In cardiac surgery intensive care unit patients, the ALBI cut-off for predicting mortality was reported as -2.44, while in heart failure cohorts, thresholds ranged between -2.19 and -1.92 (25-27). In sepsis cohorts, ALBI scores greater than -1.39 have been associated with an increased risk of mortality (8). The cut-off value identified in our study (> -2.3) is consistent with these findings and supports the overall applicability of the ALBI score across various intensive care settings.

The current study had several notable limitations. First, the retrospective retrieval of data from the hospital information management system carries the risk that some clinical parameters may have been missing or recorded inconsistently, which could introduce information bias into the interpretation of our findings. Second, the single-center design limits the generalizability of the results to all ICU patient populations. Third, the serum albumin and bilirubin levels used to calculate the ALBI score can be influenced by factors such as the patient's hydration status, nutritional state, and ongoing treatments. Finally, the causes of

death were not classified in detail, preventing a granular analysis of the specific factors leading to mortality. Future prospective, multicenter studies with larger and more diverse ICU cohorts are warranted to validate these findings, assess the temporal dynamics of the ALBI score, and explore causal mechanisms driving mortality in critically ill patients.

Conclusion

This study demonstrated that the ALBI score at ICU admission independently predicts mortality among critically ill adult patients admitted with diverse diagnoses, including sepsis, respiratory failure, trauma, acute neurological events, and cardiovascular arrest. Given that ALBI uniquely incorporates serum albumin, which is absent from widely used ICU prognostic scores such as SOFA and APACHE II, it provides additional prognostic value by capturing nutritional and inflammatory status alongside acute hepatic dysfunction. Therefore, ALBI may be beneficial for risk stratification and clinical decision-making in general ICU settings.

Funding

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

Conflicts of Interest

The authors declare they have no conflicts of interest.

Ethics Approval

The study was performed in accordance with the Declaration of Helsinki, and was approved by the Ordu University Non-Interventional Clinical Research Ethics Committee (Date: 20.12.2024, Approval No: 2024/207).

Informed Consent

The need for informed consent was waived under the approval of the Local Ethics Committee due to the retrospective design.

Availability of Data and Material

The data that support the findings of this study are available on request from the corresponding author.

Authors' contribution

Concept – E.K., Design- E.K., Data collection and/or processing – E.K., S.E., and E.U., Analysis and/or interpretation - E.K., S.E., and E.U., Writing – E.K., Critical review- S.E., and E.U. All authors read and approved the final version of the manuscript.

Acknowledgements

The authors thank the statistical consultancy team for support in the analysis phase.

References

1. Goncalves-Pereira J, Oliveira A, Vieira T, et al. Critically ill patient mortality by age: long-term follow-up (CIMbA-LT). Ann Intensive Care. 2023;13(1):7.
2. Otero ML, Menezes RC, Ferreira IBB, et al. Factors Associated with Mortality in Critically Ill Patients Diagnosed with Hospital Acquired Infections. Infect Drug Resist. 2020;13:2811-17.
3. Oliveira A, Vieira T, Rodrigues A, et al. Critically ill patients with high predicted mortality: Incidence and outcome. Med Intensiva (Engl Ed). 2024;48(2):85-91.
4. Mehta S and Gill SE. Improving clinical outcomes in sepsis and multiple organ dysfunction through precision medicine. J Thorac Dis. 2019;11(1):21-28.
5. Chung J, Ahn J, and Ryu JA. Beyond SOFA and APACHE II, Novel Risk Stratification Models Using Readily Available Biomarkers in Critical Care. Diagnostics (Basel). 2025;15(9)
6. Johnson PJ, Berhane S, Kagebayashi C, et al. Assessment of liver function in patients with hepatocellular carcinoma: a new evidence-based approach-the ALBI grade. J Clin Oncol. 2015;33(6):550-8.
7. Toyoda H and Johnson PJ. The ALBI score: From liver function in patients with HCC to a general measure of liver function. JHEP Rep. 2022;4(10):100557.
8. Gou E, Yang Q, Chen J, et al. Association between albumin-bilirubin score and in-hospital mortality in patients with sepsis: Evidence from two large databases. Heliyon. 2024;10(15):e34697.
9. Kuo PJ, Rau CS, Tsai CH, et al. Evaluation of the Easy Albumin-Bilirubin Score as a Prognostic Tool for Mortality in Adult Trauma Patients in the Intensive Care Unit: A Retrospective Study. Diagnostics (Basel). 2023;13(22)
10. Wang J, Wang K, Feng G, and Tian X. Association Between the Albumin-Bilirubin (ALBI) Score and All-cause Mortality Risk in Intensive Care Unit Patients with Heart Failure. Glob Heart. 2024;19(1):97.
11. Shi L, Zhang D, and Zhang J. Albumin-bilirubin score is associated with in-hospital mortality in critically ill patients with acute pancreatitis. Eur J Gastroenterol Hepatol. 2020;32(8):963-70.
12. Mansur A, Mulwande E, Steinau M, et al. Chronic kidney disease is associated with a higher 90-day mortality than other chronic medical conditions in patients with sepsis. Sci Rep. 2015;5:10539.
13. Ismaeil T, Almutairi J, Alshaikh R, Althobaiti Z, Ismaeil Y, and Othman F. Survival of mechanically ventilated patients admitted to intensive care units. Results from a tertiary care center between 2016-2018. Saudi Med J. 2019;40(8):781-88.

14. Motiejunaite J, Deniau B, Blet A, Gayat E, and Mebazaa A. Inotropes and vasopressors are associated with increased short-term mortality but not long-term survival in critically ill patients. Anaesth Crit Care Pain Med. 2022;41(1):101012.
15. Edipoglu IS, Dogruel B, Dizi S, Tosun M, and Cakar N. The association between the APACHE-II scores and age groups for predicting mortality in an intensive care unit: a retrospective study. Rom J Anaesth Intensive Care. 2019;26(1):53-58.
16. Saleh A, Ahmed M, Sultan I, and Abdel-Lateif A. Comparison of the mortality prediction of different ICU scoring systems (APACHE II and III, SAPS II, and SOFA) in a single-center ICU subpopulation with acute respiratory distress syndrome. Egyptian journal of chest diseases and tuberculosis. 2015;64(4):843-48.
17. Liang J, Li Z, Dong H, and Xu C. Prognostic factors associated with mortality in mechanically ventilated patients in the intensive care unit: A single-center, retrospective cohort study of 905 patients. Medicine (Baltimore). 2019;98(42):e17592.
18. Tian Y, Yao Y, Zhou J, et al. Dynamic APACHE II Score to Predict the Outcome of Intensive Care Unit Patients. Front Med (Lausanne). 2021;8:744907.
19. Sadaka F, EthmaneAbouElMaali C, Cytron MA, Fowler K, Javaux VM, and O'Brien J. Predicting Mortality of Patients With Sepsis: A Comparison of APACHE II and APACHE III Scoring Systems. J Clin Med Res. 2017;9(11):907-10.
20. Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016;315(8):801-10.
21. Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P, and Acute Dialysis Quality Initiative w. Acute renal failure - definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. Crit Care. 2004;8(4):R204-12.
22. Li D, Wei Y, Zhang C, et al. Value of SOFA score, APACHE II score, and WBC count for mortality risk assessment in septic patients: A retrospective study. Medicine (Baltimore). 2025;104(20):e42464.
23. Nicholson JP, Wolmarans MR, and Park GR. The role of albumin in critical illness. Br J Anaesth. 2000;85(4):599-610.
24. Atrash AK and de Vasconcellos K. Low albumin levels are associated with mortality in the critically ill: A retrospective observational study in a multidisciplinary intensive care unit. South Afr J Crit Care. 2020;36(2)
25. Duman ZM and Timur B. Albumin-Bilirubin Score: A Novel Mortality Predictor in Valvular Surgery. Braz J Cardiovasc Surg. 2023;38(2):271-77.
26. Gao X, Li C, Wang Y, et al. Association of albumin-bilirubin grade with short- and long-term mortality in patients with heart failure: a cohort study using restricted cubic splines and propensity score matching. BMC Cardiovasc Disord. 2025;25(1):307.
27. Jurkiewicz M, Szczurek-Wasilewicz W, Skrzypek M, Krych S, Gąsior M, and Szyguła-Jurkiewicz B. Albumin–Bilirubin (ALBI) Score Predicts Long-Term Survival in Elderly Patients with Decompensated Heart Failure. Journal of Clinical Medicine. 2025;14(3):808.