Review Article

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2025.63.009962

Blood Urea Nitrogen to Serum Albumin Ratio as A Potential Marker for Predicting 28-Day Mortality in Older Adults with Sepsis

Jingfang Wan[1†], Lili Fu[1†], Dandan He[1], Xinglin Chen[2] and Kehong Chen[1,3*]

[1]*Department of Nephrology, Daping Hospital, Army Medical Center of PLA, China*

[2]*Department of Epidemiology and Biostatistics, Empower U, X&Y Solutions Inc., United States*

[3]*State Key Laboratory of Trauma, Burn and Combined Injury, Army Medical University, China*

[†]*These authors contributed equally to this work.*

***Corresponding author:** Kehong Chen, Department of Nephrology, Daping Hospital, Army Medical Center of PLA, Chongqing, China, State Key Laboratory of Trauma, Burn and Combined Injury, Army Medical University, Chongqing, 400042, China

ARTICLE INFO

Received: October 12, 2025

Published: November 17, 2025

Citation: Jingfang Wan, Lili Fu, Dandan He, Xinglin Chen and Kehong Chen. Blood Urea Nitrogen to Serum Albumin Ratio as A Potential Marker for Predicting 28-Day Mortality in Older Adults with Sepsis. Biomed J Sci & Tech Res 63(5)-2025. BJSTR. MS.ID.009962.

ABSTRACT

Background: The blood urea nitrogen-to-albumin ratio (BAR) serves as the new convenient and cheap biomarker that can predict the prognosis of sepsis patients, but there is still a lack of relevant research in older adults with sepsis.

Aim: To assess BAR as a prognostic factor for sepsis in older adults.

Methods: The data comes from older adults with sepsis (aged ≥ 65) in the eICU database. All-cause mortality in 28 days after ICU admission was the outcome measure. Use Cox regression model, KM survival curves and the smooth fitting curve determined the relation of BAR with mortality, and conducted subgroup and interaction analysis.

Results: In 3,387 patients whose median age was 76 years and mean BAR was 18.59, the overall mortality rate was 19.07%. Linear relationships could be detected between 28-day mortality and the increased BAR index (HR: 1.013; 95% confidence interval: 1.006–1.019, P <0.0001). In comparison with BUN (AUC: 0.581) and ALB (AUC: 0.609) alone, the area under the working characteristic curve of hospital 28-day mortality was 0.612 for BAR (P <0.001) and had a better predictive value for hospital 28-day patient outcomes.

Conclusion: BAR can predict the 28-day mortality of older septic adults.

Relevance for Patients: Based on the findings, the relation of BAR with older adults with sepsis is different from that of general patients with sepsis. The higher the BAR, the higher the risk of death, which also emphasizes the particularity of the older adults population and the individualized needs of treatment.

Keywords: Blood Urea Nitrogen to Albumin Ratio; Older Adults; Sepsis; Mortality

Abbreviations: BAR: Blood Urea Nitrogen To Albumin Ratio; AUC: Area Under The Curve; eICU-CRD: Electronic Intensive Unit Collaborative Research Database; ICU: Intensive Care Unit; BUN: Blood Urea Nitrogen; ALB: Albumin; BMI: Body Mass Index; COPD: Chronic Obstructive Pulmonary Disease; APS: Acute Physiology Score; MAP: Mean Arterial Pressure; SCR: Serum Creatinine; GAM: Generalized Additive Modeling; HRs: Hazard Ratios; ROC: Receiver Operating Characteristic; HR: Hazard Ratio; CHF: Chronic Heart Failure

Introduction

In 2016, the American Academy of Critical Care Medicine annual meeting defined sepsis as a fatal organ dysfunction resulting from the impaired responses to an infection in the host [1]. Sepsis continues to be the public health issue globally, despite improvements in treatment, leading to increasing morbidity and mortality rates [2]. In 2017, there were 48.9 million septic cases worldwide, or 677.5 cases per 100,000 age-standardized people. Furthermore, sepsis is the cause of 11 million death cases, occupying 19.8% of all deaths worldwide [3]. Early biomarkers are required to be simple, rapid and economical, which are applied in evaluating patient prognosis and determining the severity of the disease. They can also help to effectively diagnose, treat and prioritize patients, thereby improving the provision of life-saving care. There have been some studies on early biomarkers for predicting prognosis in elderly patients with sepsis. For example, studies have found that Interleukin-16 (IL-16), pao2/fio2, 7 hub genes (PPARG, ACSL1, IRS2, PLA2G4A, ALOX5, sptlc1, JAK2), D-dimer combination presepsin, Sequential Organ Failure Assessment (SOFA) score, Tumor Necrosis Factor-alpha (TNF - α), neutrophil lymphocyte ratio, macrophage inflammatory protein-3 α, IL-7, T cells (CD3+, CD3+CD4+, CD4+CD28+and CD4+CD25+CD127) can effectively predict the prognosis of elderly sepsis. However, genes, macrophage inflammatory protein-3 α, IL-7, IL-16, TNF - α, etc. are not routine clinical detection items, in areas with limited technical conditions, they may not be the preferred biomarkers.

Secondly, the small sample size of some studies also further restricts the promotion and application of these biomarkers in clinical practice [4-8]. Malnutrition significantly reduces the survival rate of elderly patients with sepsis, and increases ICU admission rate, ventilation demand, mortality and readmission rate, albumin (ALB), as one of the most commonly used nutritional indicators for patients with sepsis, can be used as a useful prognostic indicator for short-term and long-term sepsis [9-11]. Blood nitrogen urea (BUN) can be used to evaluate protein metabolism and renal filtration function, and is tightly associated with disease severity, incidence and prognosis of various diseases, such as stroke, breast cancer, pulmonary hypertension, nutrition and heart failure [12-16]. Bun and ALB are one of the most commonly used test indicators for patients with sepsis. They have the advantages of convenience, rapidity and economy. They can be tested in most medical institutions, and have relatively low requirements for technical level. The BUN-to-albumin ratio (BAR) represents the comprehensive index of liver function, renal function, nutritional status and inflammation, BAR is closely related to a variety of serious diseases and prognosis, a recent study found that elevated BAR levels are linked to an increased mortality among patients developing community-acquired pneumonia [17]. Additionally, the higher 90-day mortality rate among type 2 diabetes mellitus patients at intensive care units (ICU) and chronic kidney disease is strongly associated with high BAR levels [18], and BAR can predict the mortality of septic cases in ICU [19,20].

Sepsis and multiple organ dysfunction frequently occur in older adults. The number and proportion of elderly patients with sepsis are on the rise, and sepsis has become a common factor inducing mortality among elderly patients [21,22]. Early detection of economic and effective biomarkers of sepsis in the elderly is expected to improve the prognosis of patients. The Medical Information Mart for Intensive Care-IV database was retrospectively analyzed, which revealed that 55% of septic cases in ICU were older than 65 years [23]. The relation of BAR with patient prognostic outcome has been relatively well established; however, pertinent research regarding the role of BAR in prognostic outcomes of older septic adults is lacking. Therefore, the BAR may be used to predict the prognosis of sepsis in older adults and independently predict patient prognosis in this age group. To test our hypothesis, we used information based on electronic ICU Collaborative Research Database (eICU-CRD) to explore the relation of BAR with prognostic outcome in septic older adults in ICU.

Material and Methods

Data Source

The eICU-CRD, which can be accessed through passing an exam and acquiring authentication following the PhysioNet Review Board's Data Use Protocol, provided the data for this study. Xinglin Chen obtained access to the database and the necessary credentials (ID: 40859994) and extracted all the data for this study. The Health Insurance Portability and Accountability Act governs its use. As the multicenter publicly available database, the eICU-CRD contains de-identified medical information on more than 200,000 ICU admissions in United States during 2014–2015 [24]. The data is de-identified, thus exempting the need for informed consent. This retrospective analysis was conducted using an anonymized database, with ethical approval being waived.

Participants

Patients below were included:

1. Those who met sepsis-3 criteria [1], referring to an elevation of SOFA score by ≥ 2 points in addition to a suspected or confirmed infection identified using an International Classification of Diseases-9 code in the eICU-CRD; and
2. Patients aged at least 65 years. The exclusion criteria were age <65 years, missing first-day ALB and BUN data, ICU stay <48 h, and missing priority events. Figure 1 presents the study flowchart.

Variables

Based on previous studies and clinical practice, we selected the following variables that were considered confounders of sepsis prognosis [19,20]. Demographics and admission conditions were age, race, gender, body mass index (BMI), renal disease, chronic obstructive pulmonary disease (COPD), diabetes mellitus, cardiac disease, and disease severity upon admission, according to the Acute Physi-

 DOI: 10.26717/BJSTR.2025.63.009962

ology Score (APS) III. Vital signs including heart rate and mean arterial pressure (MAP), were first measured upon ICU admission. The intervention included mechanical ventilation and pressors within 24 h. Laboratory results included serum creatinine (SCr), glucose, hemoglobin, platelet count, white blood cell count, and total bicarbonate contents. Based on laboratory values at ICU admission, BAR was determined by the initial BUN (mg/dL)-to-serum ALB (g/dL) ratio. The first value was selected if multiple results for any of the aforementioned parameters were obtained within a day.

Outcomes

Our outcome included in-hospital 28-day all-cause mortality post-ICU admission.

Statistical Analysis

Categorical variables were represented by numbers and percentages and compared by Chi-square test. Normally-distributed continuous variables were represented by mean ± standard deviation and compared by Student's t-test, whereas abnormally-distributed ones were represented by median and interquartile range, with Wilcoxon's rank sum test being adopted for comparison. This study utilized generalized additive modeling (GAM) to examine the dose–response association of BAR with mortality. Kaplan–Meier curves (including a log-rank test) were used for evaluating how baseline BAR affected 28-day in-hospital mortality. Moreover, we adopted Cox regression models for estimating the relation of BAR with 28-day all-cause mortality. Use three models below to write covariate adjustments for COX results:

Model 1: Age, gender, and ethnicity;

Model 2: Model 1 + platelet count, serum creatinine, bicarbonate, hemoglobin, white blood cell count, glucose, mean arterial pressure, BMI, heart rate;

Model 3: Model 2 + mechanical ventilation use, dialysis, vasopressor use, diabetes mellitus, COPD, chronic heart failure, and acute physiology score.

Data were represented by hazard ratios (HRs) and their 95% confidence intervals (95% CIs). Receiver operating characteristic (ROC) curve was plotted for assessing the prediction performances of BUN, ALB, and BAR for in-hospital 28-day mortality.

R software version 3.6.1 (http://www.r-project.org) and EmpowerStats (www.empowerstats.com; X&Y Solutions, Inc., Boston, MA, USA) were employed for statistical analysis. P <0.05 stood for significant differences.

Results

Population

Altogether 23,136 septic cases were identified, of whom 9981 were excluded because they were < 65 years, 6399 were excluded because of lack of BAR data, 2913 were excluded because they stayed in the ICU for <48 h, 456 were excluded because they had been in ICU for many times, and finally 3387 were enrolled into this work (Figure 1).

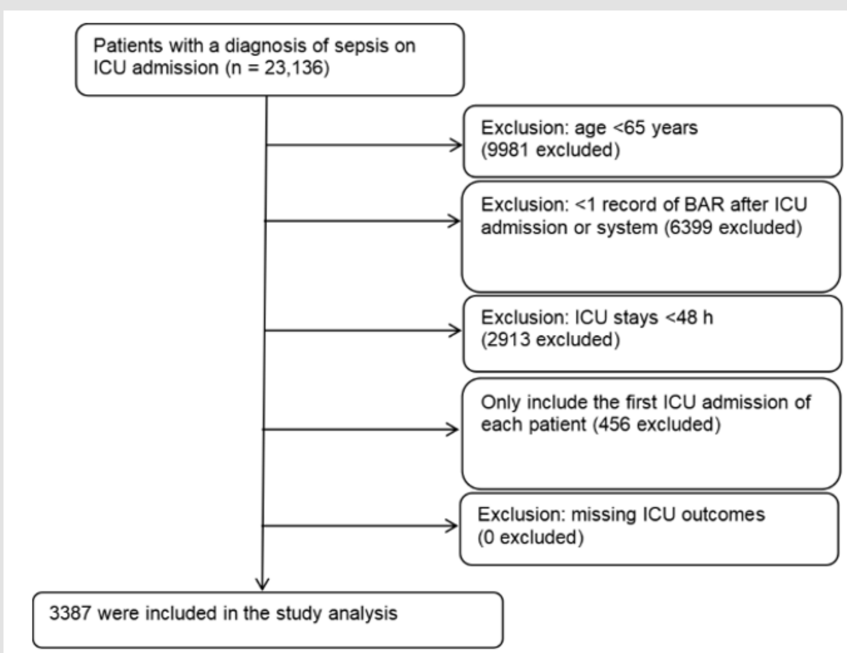

Figure 1: Flow chart of the study population.

Baseline Features

Table 1 presents baseline data of participants based on BAR tertile. We divided patients into three groups according to the BAR triad: Q1 (BAR ≤ 10), Q2 (10< BAR ≤ 19), Q3 (BAR>19). The average BAR was 18.59, male accounted for 49.50%, most of which were Caucasian (81.58%). In our study, we found that the patient mean age was 76.74 years (Q1 group: 75.99 years, Q2 group: 76.95 years, and Q3 group: 77.19; P <0.001). The higher the average age of patients, the greater the BAR value. Laboratory test results revealed significant differences in sex, hemoglobin, MAP, SCr, white blood cell count, bicarbonate ions, glucose levels, and heart rate among the groups. Variables such as BMI, platelet count, mechanical ventilation, and vasopressor use showed no significant difference among groups. However, APS III and some comorbidities (such as dialysis and diabetes mellitus) showed significant differences between the groups.

Table 1: Baseline patient characteristics.

BAR Tertile	All Patients	Q1 (BAR ≤ 10)	Q2 (10 < BAR ≤ 19)	Q3 (BAR >19)	P-Value
N	3387	1047	1157	1183	
The General Information					
Age (years)	76.74 ± 7.49	75.99 ± 7.50	76.95 ± 7.45	77.19 ± 7.48	<0.001
Male n (%)	1676 (49.50%)	566 (54.11%)	571 (49.35%)	539 (45.56%)	<0.001
Ethnicity, Caucasian n (%)	2745 (81.58%)	856 (82.47%)	949 (82.59%)	940 (79.80%)	0.107
BMI	28.16 ± 7.61	27.85 ± 7.11	28.16 ± 8.00	28.43 ± 7.65	0.207
MAP (mmHg)	54.00 (46.00-110.50)	56.00 (47.00-119.00)	54.00 (46.00-115.00)	52.00 (45.00-67.75)	0.017
Heart rate (/min)	111.35 ± 29.93	112.75 ± 29.67	112.13 ± 30.10	109.36 ± 29.90	0.016
Laboratory Test Results					
Hemoglobin (g/dL)	10.34 ± 2.09	10.69 ± 2.08	10.36 ± 2.04	10.01 ± 2.09	<0.001
Serum creatinine (mg/dL)	2.07 ± 1.66	1.12 ± 0.72	1.88 ± 1.32	3.09 ± 1.95	<0.001
White blood cell count (cells x 109/L)	14.00 (9.30-20.10)	12.80 (8.90-18.10)	13.85 (9.03-19.80)	15.22 (9.79-22.00)	<0.001
Platelets (cells x 109/L)	182.00 (125.00-254.00)	189.00 (133.75-249.25)	178.00 (123.00-250.00)	184.00 (118.00-264.00)	0.226
Bicarbonate (mmol/l)	22.26 ± 5.48	23.71 ± 5.24	22.57 ± 5.35	20.69 ± 5.42	<0.001
Glucose (mg/dL)	150.00 (95.00-216.50)	142.00 (96.00-203.00)	146.00 (95.00-215.25)	161.00 (93.00-229.00)	<0.001
BAR	15.00 (9.00-24.00)	7.00 (6.00-9.00)	14.00 (12.00-17.00)	29.00 (23.00-37.00)	<0.001
Interventions					
Mechanical ventilation use (1st 24 h)	1175 (34.69%)	335 (32.00%)	405 (35.00%)	435 (36.77%)	0.059
Vasopressor use (1st 24 h)	29 (0.86%)	6 (0.57%)	11 (0.95%)	12 (1.02%)	0.481
Comorbidity Disease					
Dialysis	168 (4.96%)	27 (2.58%)	66 (5.70%)	75 (6.34%)	<0.001
Diabetes mellitus	917 (27.07%)	220 (21.01%)	311 (26.88%)	386 (32.63%)	<0.001
COPD	319 (9.42%)	116 (11.08%)	113 (9.77%)	90 (7.61%)	0.017
Lymphoma	33 (0.97%)	11 (1.05%)	11 (0.95%)	11 (0.93%)	0.954
Metastatic cancer	113 (3.34%)	28 (2.67%)	45 (3.89%)	40 (3.38%)	0.283
Leukemia	48 (1.42%)	9 (0.86%)	18 (1.56%)	21 (1.78%)	0.167
Immunosuppression	173 (5.11%)	56 (5.35%)	71 (6.14%)	46 (3.89%)	0.043
Cirrhosis	61 (1.80%)	14 (1.34%)	17 (1.47%)	30 (2.54%)	0.061
CHF	395 (11.66%)	113 (10.79%)	140 (12.10%)	142 (12.00%)	0.572
Scoring System					
Acute Physiology Score III	64.67 ± 22.46	52.71 ± 18.83	64.72 ± 20.40	75.10 ± 22.08	<0.001
Hospital 28-Day Mortality	646 (19.07%)	128 (12.23%)	211 (18.24%)	307 (25.95%)	<0.001

Note: BMI, body mass index; MAP, mean arterial pressure; BAR, blood urea nitrogen to serum albumin ratio; COPD, chronic obstructive pulmonary disease; CHF, chronic heart failure.

 DOI: 10.26717/BJSTR.2025.63.009962

Hospital 28-day Mortality

The overall hospital 28-day all-cause mortality was 19.07%, with rates of 12.23%, 18.24%, and 25.95% in the Q1, Q2 and Q3 groups, and differences were of statistical significance (P <0.001) (Table 1). According to Cox regression results, BAR showed positive relation to 28-day all-cause mortality (Table 2). For the unadjusted model and three different adjusted models, the HRs for BAR showed statistical significance. Per 1-unit elevation of BAR, the in-hospital 28-day mortality risk elevated by 1.3% among older septic adults (HR: 1.013; 95% CI: 1.006–1.019, P <0.0001). When dividing BAR into three groups, it was found that in the third group (BAR >19), there was a stronger correlation with mortality (HR: 1.521, 95% CI: 1.152–2.009, P = 0.003). These results suggest that higher BAR levels are closely related to the increased 28-day all-cause mortality risk.

Table 2: Multivariable Cox regression analysis to assess the association between the BAR and in-hospital 28-day mortality.

	Unadjusted	Model 1	Model 2	Model 3
Variable	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
	P-value	P-value	P-value	P-value
BAR	1.016 (1.011–1.02)	1.016 (1.012–1.021)	1.019 (1.014–1.024)	1.013 (1.006–1.019)
	<0.0001	<0.0001	<0.0001	<0.0001
BAR Tertile				
Q1 (BAR ≤10)	Reference	Reference	Reference	Reference
Q2 (10 <BAR ≤ 19)	1.328 (1.066–1.655)	1.299 (1.04–1.622)	1.325 (1.038–1.692)	1.048 (0.808–1.36)
	0.011	0.021	0.024	0.721
Q3 (BAR >19)	1.862 (1.515–2.29)	1.85 (1.501–2.281)	2.081 (1.617–2.678)	1.521 (1.152–2.009)
	<0.0001	<0.0001	<0.0001	0.003

Note: Model 1: age, sex, and ethnicity; Model 2: Model 1 + platelet count, serum creatinine, bicarbonate, hemoglobin, white blood cell count, glucose, mean arterial pressure, body mass index, and heart rate; Model 3: Model 2 + mechanical ventilation use, dialysis, vasopressor use, diabetes mellitus, chronic obstructive pulmonary disease, chronic heart failure, and acute physiology score.

Relation of BAR with Hospital 28-day Mortality

Based on Kaplan–Meier curve analysis, patients in highest BAR quantile (Q3) had the lowest 28-day hospital survival rate among diverse groups (log-rank test: P = 0.003, Figure 2). The linear relation of the BAR relationship with 28-day all-cause mortality was found in GAM (Figure 3). Figure 4 shows the prediction values of BAR, BUN, and ALB for 28-day all-cause mortality in older adults with sepsis. The area under curve regarding hospital 28-day mortality was 0.612 for BAR (P <0.001), indicating that it had the best predictive value.

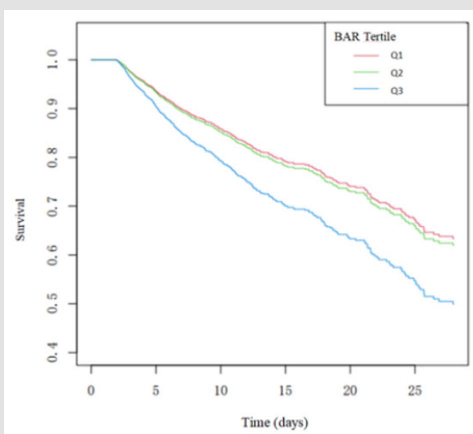

Figure 2: Kaplan–Meier curves indicate the association between the BAR and in hospital 28-day mortality of older adults with sepsis. Q1, BAR ≤10; Q2, 10 <BAR≤ 19; Q3, BAR >19. Adjusted for age, sex, race, body mass index, mean arterial pressure, heart rate, dialysis, chronic heart failure, chronic obstructive pulmonary disease, diabetes mellitus, and Acute Physiological Score III.

DOI: 10.26717/BJSTR.2025.63.009962

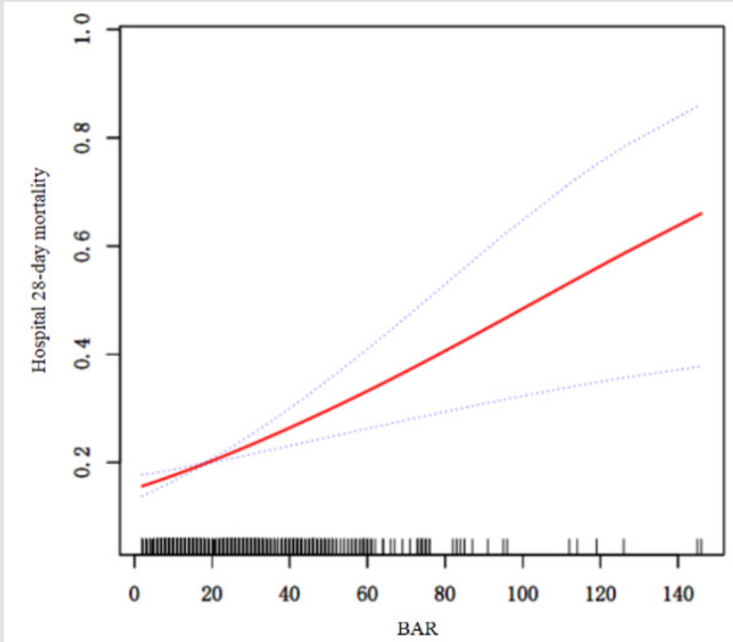

Figure 3: Associations between blood urea nitrogen to albumin ratio (BAR) and hospital 28-day mortality in older adults with sepsis. A linear association between BAR and hospital 28-day mortality was found in a generalized additive model (GAM). The solid red line represents the smooth curve fit between variables. Blue bands represent the 95% confidence interval from the fit. Adjusted for age, sex, race, body mass index, mean arterial pressure, heart rate, dialysis, chronic heart failure, chronic obstructive pulmonary disease, diabetes mellitus, and Acute Physiological Score III.

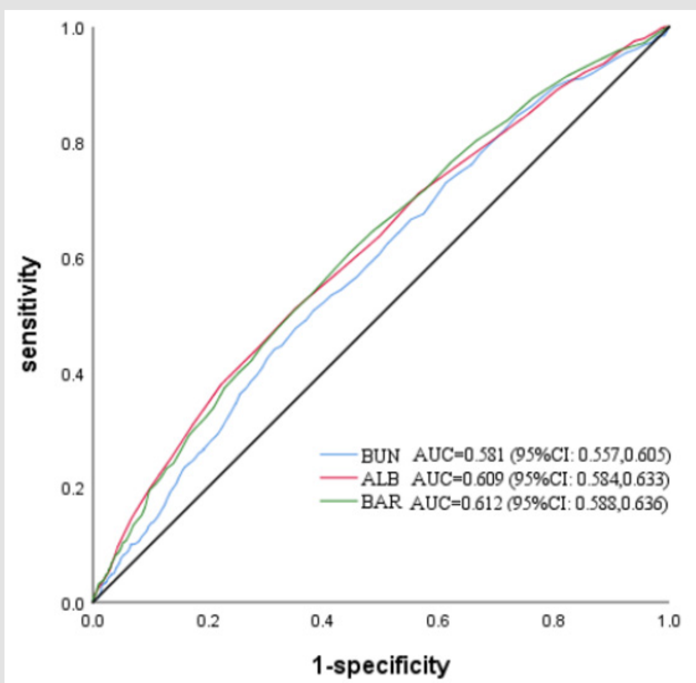

Figure 4: Receiver operating characteristic curve analysis for hospital 28-day mortality in older adults with sepsis. BUN, blood urea nitrogen; ALB, serum albumin; BAR, blood urea nitrogen/serum albumin ratio.

Subgroup Analyses

We conducted exploratory subgroup analyses of age, sex, BMI, MAP, treatment, and comorbidities to further investigate whether the BAR remains an independent predictive factor in specific subgroups of older adults with sepsis. Except for patients who received renal replacement therapy before admission and those who used vasopressors, the results showed that BAR remained an independent predictive factor in the other subgroups (Supplementary Table S1).

Supplementary Table S1: Subgroup analysis for hospital 28-day mortality.

Subgroup	n (%)	HR (95% CI), P-Value	P-Value for Interaction
Gender			0.602
Male	1676 (49.48%)	1.015 (1.007–1.022), <0.0001	
Female	1711 (50.52%)	1.017 (1.011–1.022), <0.0001	
Age (years)			0.999
≤75	1598 (47.18%)	1.016 (1.008–1.023), <0.0001	
>75	1789 (52.82%)	1.016 (1.010–1.021), <0.0001	
BMI			0.331
≤28	1898 (56.04%)	1.014 (1.009–1.020), <0.0001	
>28	1430 (42.22%)	1.019 (1.012–1.027), <0.0001	
MAP (mmHg)			0.729
≤53	1661 (49.84%)	1.017 (1.010–1.023), <0.0001	
>53	1722 (50.84%)	1.015 (1.008–1.021), <0.0001	
Mechanical ventilation use (1st 24 h)			0.382
No	2212 (65.31%)	1.017 (1.012–1.023), <0.0001	
Yes	1175 (34.69%)	1.013 (1.006–1.021), 0.0007	
Vasopressor use (1st 24 h)			0.323
No	3348 (98.85%)	1.016 (1.012–1.021), <0.0001	
Yes	29 (0.86%)	1.006 (0.969–1.044), 0.7486	
Dialysis			0.066
No	3219 (95.04%)	1.016 (1.012, 1.021) <0.0001	
Yes	168 (4.96%)	0.982 (0.948, 1.018) 0.3208	
Diabetes mellitus			0.75
No	2470 (72.93%)	1.017 (1.013, 1.022) <0.0001	
Yes	917 (27.07%)	1.011 (1.001–1.022), 0.0365	
COPD			0.853
No	3068 (90.58%)	1.015 (1.011–1.020), <0.0001	
Yes	319 (9.42%)	1.020 (1.008–1.032), 0.0012	
CHF			0.971
No	2992 (88.34%)	1.016 (1.011–1.021), <0.0001	
Yes	395 (11.66%)	1.016 (1.005–1.027), 0.0044	

Note: BMI, body mass index; MAP, mean arterial pressure; COPD, chronic obstructive pulmonary disease; CHF, chronic heart failure.

Discussion

As we know, this study has first analyzed the relation of the BAR with 28-day all-cause mortality for a cohort of older adults with sepsis in an eICU. Our findings suggest that the BAR was linearly associated with 28-day all-cause mortality among older septic adults after adjusting for confounders. Per 1-unit elevation of BAR, the 28-day mortality rate elevated by 1.3% among older septic adults (HR: 1.013; 95%: 1.006–1.019, P <0.0001). BUN, a nitrogenous byproduct during protein metabolism, is produced within the liver and eliminated by the kidneys. Septic cases may show increased BUN contents owing to metabolic reprogramming, inflammation, and microvascular dysfunction [25], which can cause renal injury. Second, patients with sepsis frequently experience hyperproteolytic catabolism [26], which

 DOI: 10.26717/BJSTR.2025.63.009962

can lead to elevated BUN levels. A non-linear connection has been observed [27] in BUN with 30-day mortality among septic cases, and the morality risk increased among individuals whose BUN contents were >41.1 mg/dL (HR: 1.045; 95% CI: 1.016–1.075; P = 0.002). Since only hepatocytes can synthesize ALB, serum ALB levels serve as a reliable indicator of hepatocyte activity26. Furthermore, ALB performs numerous vital functions in the body including preserving osmotic equilibrium, assisting in the distribution of molecules, having anti-inflammatory and antioxidant properties, and stabilizing endothelial function [28-30]. Additionally, linked to acute inflammatory activity [31], ALB is related to a poor prognostic outcome of older adults developing chronic heart failure [32].

But BUN and ALB are affected by various factors, such as BUN level is affected by kidney function, age, high catabolism, diet and other factors, ALB is changed due to different liver function, catabolism, diet and other conditions. As a composite indicator, the BAR may comprehensively evaluate the pathophysiological status and prognostic risk of patients. BAR integrates the liver function, renal function, nutritional status and other conditions of patients, and may better reflect the condition of patients with sepsis. Compared with separate indicators, BAR may have better predictive performance [33,34]. In our study, we compared the potential relationship between bun, ALB and bar parameters and elderly patients with sepsis. We were surprised to find that the BAR had better predictive efficacy than BUN or ALB alone. The are under the curve for hospital 28-day mortality was 0.612 for BAR. This result is consistent with the findings of other studies [35,36]. Several studies have found that BAR is a biomarker of poor patient prognosis. In a retrospective analysis including 13,464 septic cases 23, each 5-unit elevation of BAR was related to the increased in-hospital sepsis-related death risk by 8% (HR: 1.08, 95% CI: 1.07–1.1, P <0.001). The stratified analysis revealed an age interaction (P <0.001), and similar findings have been reported in other studies [20,36]. Elevated BAR is also a predictor of mortality among ICU patients who have coronary artery disease [35]. As a special group with an elevated death risk relative to general population, older adults are underrepresented in most studies.

Mortality is also higher in older adults with sepsis than in those without sepsis [37,38]. These results are consistent with our observations. Our research found that the BAR in older adults with sepsis is higher than that in the general population (18.59 vs. 11), which may be related to the fact that the hemodynamics and organ function of older adults are more easily affected [38]. When confounders were adjusted, BAR independently predicted the 28-day all-cause mortality risk among elderly septic patients as the categorical and continuous variable. This finding conforms to the results of other studies [20,36]. Second, a linear relation was detected in the BAR with 28-day all-cause mortality in older adults with sepsis, which contrasts with previous studies. For instance, Jie Min et al [39] observed a non-linear trend between the BAR levels upon ICU admission and all-cause mortality risk among septic cases in ICU ($\chi 2$ = 66.82, P <0.001). In the general population, when the BAR exceeded 25.31, the all-cause mortality risk among septic patients in ICU remained consistently high. In general sepsis patients with other diseases, a nonlinear relationship between BAR and sepsis patients has also been found [40]. Our study indicated that higher BAR levels were related to a higher 28-day all-cause mortality risk among older septic adults (1.013; 95% CI: 1.006–1.019, P <0.0001). This difference may be attributed to declining organ compensatory function [41] as well as reduced drug metabolism in older patients [42]. Consequently, it may be necessary to differentiate sepsis diagnosis and treatment among older adults from those in the general population.

Based on our research, the BAR may be a more practical and cost-effective predictor. The BAR values are readily accessible and calculable, making them valuable for early risk assessment in elderly patients. These findings will facilitate the development of targeted and proactive management and treatment strategies. Our subgroup study found that the relation of BAR with 28day all-cause mortality was consistent in diverse stratification of age, sex, BMI, MAP, comorbidities. In patients who had received dialysis treatment before admission to the ICU, we saw different results, which may be attributed to the active renal replacement and other comprehensive treatment programs that the patients received at the time of admission. Additionally, we observed that vasopressor use was not linked to 28-day all-cause death; however, only 0.86% of the patients in the study used vasopressors. The small percentage of vasopressor users in the study sample may not be representative, warranting further studies to explore this potential relationship.

Limitations

Certain limitations should be noted in the present work. Firstly, dynamic changes in BAR values may provide greater prognostic value in assessing septic cases; however, the present work just incorporated initial BAR values but not observed their dynamic changes. Secondly, certain patients were eliminated out of this study because of missing data that may have helped in elucidating the mechanism of sepsis-related death. Additionally, diet may affect BUN contents; nonetheless, since the eICU database does not provide information about the participants' diets, this may have had some impact on the results. The current retrospective analysis was carried out on the basis of eICU database, regardless of the efforts for adjusting for confounders, some potential confounders have not yet been identified. Therefore, further prospective multicenter large-cohort studies should be performed for exploring the mechanisms of the BAR in the prognosis of older adults with sepsis.

Conclusion

We identified a linear relation of BAR with 28-day all-cause mortality in older adults with sepsis. An increased BAR was related to the increased patient mortality. Our findings provide valuable insights for the development of more precise strategies for managing sepsis in older adults.

Acknowledgment

Our authors are very grateful to the data providers of this study.

Conflict of Interest

Our authors declare no competing interests.

Funding

The present study was funded by the National Natural Science Foundation of China (8227076, 82370745); Chongqing technology innovation project (2022YSZX-JCX0007CSTB, CSTB2023NSCQ-MSX0584, CSTB2023NSCQ-ZDJ0010) and National Science and Technology Support Plan (2022-173ZD-112, 2023-NHLHCRF-YS-01).

Author Contributions

Conceptualization: Jingfang Wan, and Kehong Chen

Formal Analysis: Jingfang Wan, Dandan He, Lili Fu and Xinglin Chen

Investigation: All authors

Methodology: Jingfang Wan, and Kehong Chen

Writing – Original Draft: Jingfang Wan

Writing – Review & Editing: Jingfang Wan, and Kehong Chen

Ethics Approval

Not applicable.

Data Availability

Data were fully available at https://eicu-crd.mit.edu/.

Disclosure

The authors declare no competing interests.

References

1. Singer M, Deutschman CS, Seymour CW, Manu Shankar-Hari, Djillali Annane, et al. (2016) The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA 315(8): 801-810.
2. Reinhart K, Daniels R, Kissoon N, Flavia R Machado, Raymond D Schachter, et al. (2017) Recognizing Sepsis as a Global Health Priority - A WHO Resolution. N Engl J Med 377(5): 414-417.
3. Rudd KE, Johnson SC, Agesa KM, Katya Anne Shackelford, Derrick Tsoi, et al. (2020) Global, regional, and national sepsis incidence and mortality, 1990-2017: analysis for the Global Burden of Disease Study. Lancet 395(10219): 200-211.
4. Zhao J, Zhang Y, Wang J, Wei B, Liu Y, et al. (2023) Potential Role and Prognostic Value of Interleukin-15 for Mortality Among Elderly Patients with Sepsis. J Inflamm Res 16: 4481-4488.
5. Bian Y, Xu J, Deng X, Zhou S, Tong J, et al. (2024) Identification of lipid metabolism-related biomarkers and prognostic analysis in geriatric patients with sepsis. J Infect Dev Ctries 18(10): 1502-1511.
6. Wang S, Ruan WQ, Yu Z, Xiang Zhao, Zhi-Xia Chen, et al. (2020) Validity of presepsin for the diagnosis and prognosis of sepsis in elderly patients admitted to the Intensive Care Unit. Minerva Anestesiol 86(11): 1170-1179.
7. Jin S, Yin JB, Li W, Zang LL (2024) Effect of neutrophil to lymphocyte ratio on prognosis of elderly patients with severe sepsis combined with diabetes mellitus. BMC Geriatr 24(1): 211.
8. Qi T, Gao Q, Song Y, Yanlan Yao, Xinyue Liu, et al. (2025) Machine Learning Reveals the Value of Unconventional T Lymphocytes in Sepsis and Prognosis of Elderly Patients With Severe Lower Respiratory Tract Infections. J Clin Lab Anal 39(14): e70065.
9. Daud M, Ullah F, Uzair M, Ambar Siddiq, Urooj Siddiq, et al. (2024) Malnutrition and Its Influence on Sepsis Outcomes in Elderly Patients. Cureus.;16(6): e63433.
10. Cao Y, Su Y, Guo C, He L, Ding N, et al. (2023) Albumin Level is Associated with Short-Term and Long-Term Outcomes in Sepsis Patients Admitted in the ICU: A Large Public Database Retrospective Research. Clin Epidemiol 15: 263-273.
11. Turcato G, Zaboli A, Sibilio S, Eleonora Rella, Antonio Bonora, et al. (2023) Albumin as a prognostic marker of 30-day mortality in septic patients admitted to the emergency department. Intern Emerg Med 18(8): 2407-2417.
12. Peng R, Liu K, Li W, Yu Yuan, Rundong Niu, et al. (2021) Blood urea nitrogen, blood urea nitrogen to creatinine ratio and incident stroke: The Dongfeng-Tongji cohort. Atherosclerosis 333: 1-8.
13. Wang C, Sun H, Liu J (2023) BUN level is associated with cancer prevalence. Eur J Med Res 28(1): 213.
14. Hu B, Xu G, Jin X, Deqing Chen, Xiaolan Qian, et al. (2021) Novel Prognostic Predictor for Primary Pulmonary Hypertension: Focus on Blood Urea Nitrogen. Front Cardiovasc Med 8: 724179.
15. Persico RS, Viana MV, Loss SH, Antonio A, Viana LV, et al. (2025) Urinary urea, nitrogen balance and mortality in critically ill patients - A prospective cohort study. Nutr Hosp 43(3): 404-410.
16. Lee SW, Yang YM, Kim HY, Hyunjeong Cho, Sang Won Nam, et al. (2022) Predialysis Urea Nitrogen Is a Nutritional Marker of Hemodialysis Patients. Chonnam Med J 58(2): 69-74.
17. Feng DY, Zhou YQ, Zou XL, Mi Zhou, Hai-Ling Yang, et al. (2019) Elevated Blood Urea Nitrogen-to-Serum Albumin Ratio as a Factor That Negatively Affects the Mortality of Patients with Hospital-Acquired Pneumonia. Can J Infect Dis Med Microbiol 2019: 1547405.
18. Liu S, Qiu C, Li W, Xingai Li, Fanna Liu, et al. (2024) Blood urea nitrogen to serum albumin ratio as a new prognostic indicator in type 2 diabetes mellitus patients with chronic kidney disease. Sci Rep14(1): 8002.
19. Pereira AG, Costa NA, Gut AL, Paula Schmidt Azevedo, Suzana Erico Tanni, et al. (2021) Urea to albumin ratio is a predictor of mortality in patients with septic shock. Clin Nutr ESPEN 42: 361-365.
20. Han T, Cheng T, Liao Y, Bofu Liu, Yarong He, et al. (2022) Analysis of the Value of the Blood Urea Nitrogen to Albumin Ratio as a Predictor of Mortality in Patients with Sepsis. J Inflamm Res 15: 1227-1235.
21. Dulger D, Ture Z, Yolcu A, Esma Eryılmaz Eren, Nevin Sanlier, et al. (2025) Sepsis in elderly patients: investigation of prognostic factors in a secondary healthcare facility. BMC Infect Dis 25(1): 907.
22. Wan MSW, Mat NM, Md RA (2022) Sepsis and Its Impact on Outcomes in Elderly Patients Admitted to a Malaysian Intensive Care Unit. Malays J Med Sci 29(3): 145-150.

23. Cai S, Wang Q, Chen C, Chunming Guo, Liangjie Zheng, et al. (2022) Association between blood urea nitrogen to serum albumin ratio and in-hospital mortality of patients with sepsis in intensive care: A retrospective analysis of the fourth-generation Medical Information Mart for Intensive Care database. Front Nutr 9: 967332.
24. Pollard TJ, Johnson A, Raffa JD, Leo A Celi, Roger G Mark, et al. (2018) The eICU Collaborative Research Database, a freely available multi-center database for critical care research. Sci Data 5: 180178.
25. Peerapornratana S, Manrique-Caballero CL, Gomez H, Kellum JA (2019) Acute kidney injury from sepsis: current concepts, epidemiology, pathophysiology, prevention and treatment. Kidney Int 96(5): 1083-1099.
26. Pose E, Gines P (2022) Improving Outcome Prediction in Alcohol-Associated Hepatitis: Blood Urea Nitrogen and Albumin Help. Mayo Clin Proc 97(3): 436-438.
27. Li X, Zheng R, Zhang T, Haifeng Li, Jiaming Liu, et al. (2021) Association between blood urea nitrogen and 30-day mortality in patients with sepsis: a retrospective analysis. Ann Palliat Med 10(11): 11653-11663.
28. Belinskaia DA, Voronina PA, Shmurak VI, Jenkins RO, Goncharov NV, et al. (2021) Serum Albumin in Health and Disease: Esterase, Antioxidant, Transporting and Signaling Properties. Int J Mol Sci 22(19).
29. De Simone G, di Masi A, Ascenzi P (2021) Serum Albumin: A Multifaced Enzyme. Int J Mol Sci 22(18).
30. Ishima Y, Maruyama T (2016) [Human Serum Albumin as Carrier in Drug Delivery Systems]. Yakugaku Zasshi 136(1): 39-47.
31. Duran-Bedolla J, Montes DOM, Saldana-Navor V, José A Villalobos-Silva, Maria Carmen Rodriguez, et al. (2014) Sepsis, mitochondrial failure and multiple organ dysfunction. Clin Invest Med 37(2): E58-E69.
32. Tan Y, Xiang W, Chen Y, Huang J, Sun D, et al. (2024) Effect of hypoproteinemia on mortality of elderly male patients with chronic heart failure. Medicine (Baltimore) 103(5): e37078.
33. Shao J, Zhang E, Chen H, Cai Z, Dong M, et al. (2025) The Ratio of Serum Urea Nitrogen to Albumin Is a Better Predictor of Overall Survival in Multiple Myeloma Patients than Urea Nitrogen Alone. Acta Haematol 148(1): 36-47.
34. Bae SJ, Lee SH, Yun SJ, Kim K (2021) Comparison of IVC diameter ratio, BUN/creatinine ratio and BUN/albumin ratio for risk prediction in emergency department patients. Am J Emerg Med 47: 198-204.
35. Zhang L, Xing M, Yu Q, Zihan Li, Yilin Tong, et al. (2024) Blood urea nitrogen to serum albumin ratio: a novel mortality indicator in intensive care unit patients with coronary heart disease. Sci Rep 14(1): 7466.
36. Wang Y, Gao S, Hong L, Tingting Hou, Huihui Liu, et al. (2023) Prognostic impact of blood urea nitrogen to albumin ratio on patients with sepsis: a retrospective cohort study. Sci Rep 13(1): 10013.
37. Rowe T, Araujo KL, Van Ness PH, Pisani MA, Juthani-Mehta M, et al. (2016) Outcomes of Older Adults With Sepsis at Admission to an Intensive Care Unit. Open Forum Infect Dis 3(1): ofw010.
38. Rowe TA, McKoy JM (2017) Sepsis in Older Adults. Infect Dis Clin North Am 31(4): 731-742.
39. Min J, Lu J, Zhong L, Yuan M, Xu Y, et al. (2022) The correlation study between blood urea nitrogen to serum albumin ratio and prognosis of patients with sepsis during hospitalization. BMC Anesthesiol 22(1): 404.
40. Cui K, Feng S, Mao Y, Haixia Luo, Jiao Yang, et al. (2024) The association between blood urea nitrogen to albumin ratio and the 28 day mortality in tuberculosis patients complicated by sepsis. Sci Rep 14(1): 16430.
41. Donato AJ, Machin DR, Lesniewski LA (2018) Mechanisms of Dysfunction in the Aging Vasculature and Role in Age-Related Disease. Circ Res 123(7): 825-848.
42. McLachlan AJ, Pont LG (2012) Drug metabolism in older people--a key consideration in achieving optimal outcomes with medicines. J Gerontol A Biol Sci Med Sci 67(2): 175-180.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2025.63.009962

Kehong Chen. Biomed J Sci & Tech Res