ORIGINAL ARTICLE

Prognostic value of lactate-enhanced quick sequential organ failure assessment (qSOFA) versus standard qSOFA in predicting mortality among sepsis patients in the emergency department: A retrospective cohort study

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ABSTRACT

BACKGROUND: The quick Sequential Organ Failure Assessment (qSOFA) score is widely used for bedside risk stratification in sepsis patients. However, its limited sensitivity may hinder early identification. The lactate-enhanced qSOFA (LqSOFA), which incorporates serum lactate levels into the qSOFA score, may improve prognostic accuracy. This study aimed to evaluate the diagnostic performance of LqSOFA in predicting early (24-hour) and late (30-day) mortality, as well as intensive care unit (ICU) admission, among patients with sepsis.

METHODS: This retrospective descriptive study included patients aged ≥18 years who were diagnosed with sepsis based on Sepsis-3 criteria and admitted to the emergency department (ED) of a tertiary-care teaching hospital between July 1, 2024 and December 31, 2024. Patients were identified through ICD-10 (International Classification of Diseases, 10th Revision) codes, and diagnoses were clinically confirmed. qSOFA and LqSOFA scores were calculated using initial vital signs and venous lactate levels. The primary outcomes were 24-hour and 30-day mortality; ICU admission was assessed as a secondary outcome. Statistical analyses were conducted using SPSS v27 and Jamovi v2.5.7. The diagnostic performance of the scores was evaluated using receiver operating characteristic (ROC) curve analysis. Area under the curve (AUC), sensitivity, specificity, and predictive values were calculated, and AUC comparisons were performed using the DeLong test ($p<0.05$ considered significant).

RESULTS: A total of 236 patients were included (median age: 75 years; 53% male). The 24-hour and 30-day mortality rates were 20.3% and 36.4%, respectively. LqSOFA demonstrated significantly higher diagnostic accuracy than qSOFA for predicting 24-hour mortality (AUC: 0.709 vs. 0.673; $p<0.05$). Although LqSOFA also showed a higher AUC for 30-day mortality, the difference was not statistically significant. Nevertheless, LqSOFA exhibited superior specificity and positive predictive value. For ICU admission, LqSOFA demonstrated greater sensitivity than qSOFA (79% vs. 57%).

CONCLUSION: LqSOFA outperforms qSOFA in predicting mortality and ICU admission among sepsis patients in the emergency department. Given its simplicity, objectivity, and ease of implementation, LqSOFA may serve as a practical tool to support clinical decision-making in emergency settings.

Keywords: Sepsis; emergency service; hospital; lactic acid; qSOFA score; intensive care units; mortality.

Cite this article as: Siber V, Erdem AB. Prognostic value of lactate-enhanced quick sequential organ failure assessment (qSOFA) versus standard qSOFA in predicting mortality among sepsis patients in the emergency department: A retrospective cohort study. Ulus Travma Acil Cerrahi Derg 2025;31:891-899.

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Ulus Travma Acil Cerrahi Derg 2025;31(9):891-899 DOI: 10.14744/tjtes.2025.55728

Submitted: 30.06.2025 Revised: 10.07.2025 Accepted: 14.08.2025 Published: 05.09.2025

INTRODUCTION

Sepsis is a systemic condition characterized by life-threatening organ dysfunction resulting from a dysregulated host response to infection. It is recognized as one of the leading causes of mortality encountered in emergency departments.[1] In cases where early diagnosis is not established, the risk of progressive multiorgan failure and death increases significantly. Therefore, the need for rapid and accurate diagnostic tools, risk stratification methods, and timely initiation of appropriate treatment in the early phase of the disease remains critical and continues to grow.[2]

The quick Sequential Organ Failure Assessment (qSOFA) score, defined by the "Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)," is a simple bedside scoring system based on three parameters: systolic blood pressure, respiratory rate, and mental status. qSOFA has been widely adopted due to its noninvasive nature and reliance on easily measurable clinical variables.[3] However, several studies have demonstrated that qSOFA may be insufficient for the early identification of sepsis due to its low sensitivity, and that its performance in predicting mortality is limited.[4,5]

In recent years, numerous studies have demonstrated that serum lactate levels are an independent predictor of poor prognosis. Lactate is considered an early indicator of cellular hypoperfusion and, in this context, provides valuable guidance for clinical decision-making. Moreover, elevated lactate levels have been found to be strongly associated with mortality, even in patients who are normotensive and not tachypneic.[6,7]

In light of this evidence, the Lactate-enhanced qSOFA (LqSOFA) score was developed by incorporating serum lactate levels into the conventional qSOFA scoring system. The literature suggests that LqSOFA outperforms qSOFA in predicting both in-hospital and 28-day mortality. In a study conducted by Liu et al.,[8] the LqSOFA score was compared with other rapid scoring systems such as qSOFA, Systemic Inflammatory Response Syndrome (SIRS), Modified Early Warning Score (MEWS), and Mortality in Emergency Department Sepsis score (MEDS); LqSOFA demonstrated the highest overall accuracy. Similarly, in a multicenter prospective cohort study conducted in Southeast Asia, Wright et al.[9] reported that the LqSOFA score significantly outperformed qSOFA in predicting 28-day mortality.

LqSOFA has garnered attention as a practical and predictive tool, particularly in emergency department settings within low- and middle-income countries, where access to laboratory and imaging resources may be limited. However, the validity, clinical performance, and predictive value of the LqSOFA score in the Turkish patient population have not yet been adequately investigated. This gap underscores the need for further studies evaluating the applicability of LqSOFA across different geographical regions and patient cohorts.

This study aims to retrospectively evaluate the performance of the LqSOFA score at the time of emergency department admission in predicting 24-hour and 30-day mortality among adult patients diagnosed with sepsis. The findings are expected to support the use of LqSOFA as a simple, rapid, and effective risk stratification tool in resource-limited clinical settings. Furthermore, by examining the association between LqSOFA scores and key clinical outcomes such as hospital admission, intensive care unit (ICU) requirement, and patient prognosis, the study is anticipated to make a meaningful contribution to the literature regarding the practical utility of the LqSOFA score.

MATERIALS AND METHODS

Study Design and Ethical Approval

This study was designed as a single-center, retrospective, descriptive, and analytical observational investigation. Ethical approval was obtained from the Clinical Research Ethics Committee of Etlik City Hospital (Approval No: AEŞH-BADEK1-2025-0177). The study was conducted in accordance with the principles of the Declaration of Helsinki. Due to its retrospective nature, the requirement for informed consent was waived.

Participants

This study included adult patients aged 18 years and older who presented to the Emergency Medicine Department of Etlik City Hospital and were diagnosed with sepsis between July 1, 2024 and December 31, 2024. Eligible cases were retrospectively identified through the hospital's electronic medical record system.

Inclusion Criteria

- Presentation to the emergency department with suspected infection and a subsequent diagnosis of sepsis
- An increase in the baseline SOFA score by ≥2 points
- Documented respiratory rate, systolic blood pressure (SBP), Glasgow Coma Scale (GCS) score, and serum lactate levels at the time of admission

Exclusion Criteria

- Presentation due to non-sepsis-related causes such as trauma or convulsions
- Patients admitted to the hospital in cardiac arrest
- Inability to reliably assess mental status due to factors such as psychotropic drug use, alcohol intoxication, altered consciousness, or pre-existing neurological disorders
- Immunosuppression (e.g., history of chemotherapy, hematologic malignancy, Human Immunodeficiency Virus [HIV] infection, or long-term immunosuppressive therapy)
- Other critical non-infectious conditions that could elicit a severe systemic response and potentially influence qSOFA scores and lactate levels such as myocardial infarction, pulmo-

nary embolism, aortic dissection, or gastrointestinal bleeding

- Missing clinical or laboratory data
- Age under 18 years
- Pregnancy.

These criteria were established to ensure methodological homogeneity and to enable an isolated evaluation of the impact of lactate levels and qSOFA scores on sepsis prognosis.

Definition of Sepsis, qSOFA, and LqSOFA Scores

According to the Sepsis-3 guidelines, sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection. Organ dysfunction is identified by an increase of ≥2 points in the SOFA score. The qSOFA score ranges from 0 to 3, assigning 1 point each for a systolic blood pressure ≤100 mmHg, respiratory rate ≥22 breaths/min, and altered mental status. A score ≥2 indicates a high risk of poor outcomes in patients with suspected sepsis.[3,10]

The qSOFA score was calculated based on triage notes recorded at emergency department admission. Patients were excluded from the study if this information was unavailable or incomplete. The LqSOFA score is a modified version of qSOFA, which incorporates serum lactate as an additional fourth parameter. One point was added if the initial serum lactate level was ≥2 mmol/L. Lactate levels were measured using venous blood gas samples.

Data Collection Process

The following variables were collected for each patient: age, sex, vital signs [respiratory rate, GCS, SBP, diastolic blood pressure (DBP), and body temperature], laboratory parameters, and clinical outcomes in the emergency department. Laboratory variables included serum levels of lactate, pH, base excess, procalcitonin, C-reactive protein (CRP), and albumin, along with complete blood count components such as white blood cell (WBC) count, hemoglobin (HGB), platelet (PLT) count, and immature granulocyte count (IGC).

All laboratory values were obtained from blood samples collected within the first hour of emergency department admission to assess the early course of pathophysiological changes. Previous studies have demonstrated a significant correlation between venous and arterial lactate levels, indicating that venous lactate is also sufficient for predicting mortality.[11,12] Accordingly, venous lactate values were used in this study.

The diagnosis of sepsis was initially identified through the hospital's information management system using the International Classification of Diseases, 10th Revision (ICD-10) codes A41.1, A41.2, A41.4, A41.5, A41.8, and A41.9. These cases were then retrospectively reviewed in detail, including their clinical and laboratory data. The diagnosis of sepsis was further confirmed based on clinical findings documented in hospital records and emergency department admission notes. This two-step verification process was employed to reduce false-positive identifications due to coding errors and to enhance the diagnostic reliability of the study population.

The calculation of qSOFA and LqSOFA scores in this study was performed by an independent researcher who was blinded to patient mortality outcomes. This approach minimized assessor bias and ensured the objectivity of the scoring process.

The qSOFA and LqSOFA scores were calculated for each patient. Patient groups were compared using descriptive, clinical, and laboratory data. The primary outcome was mortality within 24 hours and within 30 days. Secondary outcome measures included emergency department disposition (discharge, ward admission, or intensive care unit admission).

All data were recorded in accordance with the study's exclusion criteria, and no data imputation was performed. For patients with a suspected diagnosis of sepsis, consultation with the Infectious Diseases Department was obtained to confirm the diagnosis. Patients whose diagnosis could not be definitively confirmed were excluded from the study.

Statistical Analysis

All statistical analyses were performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA) and Jamovi version 2.5.7. Descriptive statistics for categorical variables were presented as frequencies and percentages, while continuous variables were summarized using median and interquartile range (IQR, 25th–75th percentile). The distribution of continuous variables was assessed using histograms and the Kolmogorov–Smirnov test.

The chi-square test was used to compare categorical variables. For continuous variables with normal distribution, comparisons were made using the Student's t-test or Welch's t-test, depending on the equality of variances. For non-normally distributed variables, the Mann–Whitney U test was applied. Homogeneity of variances was assessed using Levene's test.

To assess the diagnostic performance of qSOFA and LqSOFA scores in predicting mortality, Receiver Operating Characteristic (ROC) curve analysis was performed. The cut-off values, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (+LR), and negative likelihood ratio (–LR) were calculated. The DeLong test was used to compare the AUCs of different scoring systems. A p-value <0.05 was considered statistically significant for all analyses.

RESULTS

A total of 493 patients were initially identified based on ICD-10 codes through the hospital information management sys-

Table 1. Distribution of patients' demographic characteristics, vital signs, laboratory values, and clinical features

Sex	
Male	125 (53.0%)
Female	111 (47.0%)
Age	75 (64-84)
Vital Parameters	
Systolic Blood Pressure (mmHg)	95 (80-117)
Diastolic Blood Pressure (mmHg)	59 (50-70)
Heart Rate (beats/min)	100 (86-118)
Oxygen Saturation (%)	94 (91-96)
Respiratory Rate (breaths/min)	21 (20-23)
Body Temperature (°C)	36.8 (36.5-37.8)
Laboratory Parameters	
WBC ($\times 10^9$/L)	13.9 (8.5-19.8)
Hemoglobin (g/dL)	11.1 (9.1-12.7)
Platelet ($\times 10^9$/L)	219 (133-328)
IGC ($\times 10^3/\mu$L)	0.16 (0.08-0.48)
pH	7.38 (7.30-7.40)
Base excess	7.4 (-2.5 to 12.6)
Lactate (mmol/L)	1.77 (2.38-3.84)
Lactate ≥2 mmol/L	150 (63.6%)
Procalcitonin (ng/mL)	3.1 (0.5-21.3)
CRP (mg/L)	178 (98-271)
Albumin (g/dL)	30.4 (25.8-33.3)
Altered Mental Status	133 (56.4%)
Vasopressor Requirement	139 (58.9%)
qSOFA	
0	35 (14.8%)
1	91 (38.6%)
2	74 (31.4%)
3	36 (15.3%)
LqSOFA	
0	20 (8.5%)
1	55 (23.3%)
2	70 (29.7%)
3	62 (26.3%)
4	29 (12.3%)
Emergency Department Outcome	
Discharge	13 (5.5%)
Ward Admission	34 (14.4%)
ICU Admission	189 (80.1%)
ICU Transfer After Ward Admission	9 (3.8%)
24-hour Mortality	48 (20.3%)
30-day Mortality	86 (36.4%)

WBC: White Blood Cell Count; IGC: Immature Granulocyte Count; CRP: C-Reactive Protein; ICU: Intensive Care Unit. Values are expressed as n (%) or median (IQR), as appropriate.

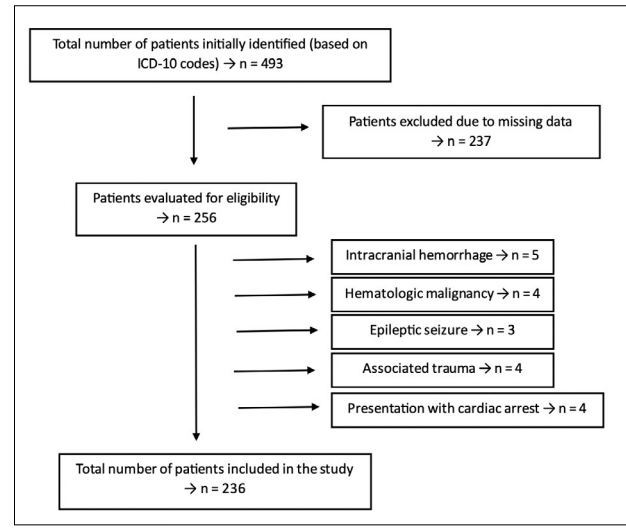

Figure 1. Patient flow diagram.

tem. Of these, 237 patients were excluded due to missing data. Among the remaining 256 patients, five were excluded due to intracranial hemorrhage, four due to hematologic malignancy, three due to epileptic seizures, four due to concomitant trauma, and four due to presentation with cardiac arrest. Consequently, a total of 236 patients were included in the final analysis (Fig. 1).

The median age of the 236 patients included in the study was 75 years, with a balanced gender distribution (53% male). Evaluation of vital signs at admission revealed a median systolic blood pressure of 95 mmHg and diastolic blood pressure of 59 mmHg, with borderline tachycardia (median heart rate: 100 bpm). The most prominent laboratory abnormality was that 63.6% of patients had a serum lactate level ≥2 mmol/L. Altered mental status was observed in 56.4% of patients at admission, and vasopressor requirement was documented in 58.9%. Approximately 50% of patients presented with a qSOFA score ≥2, while 68.3% had an LqSOFA score ≥2. Clinical outcomes showed a 24-hour mortality rate of 20.3% and a 30-day mortality rate of 36.4% (Table 1).

Table 2 demonstrates statistically significant differences in several clinical and laboratory variables associated with both 24-hour and 30-day mortality. Regarding 24-hour mortality, patients who died had significantly lower pH levels and higher lactate levels (both $p<0.001$). Hemoglobin levels were also significantly higher in the group with fatal outcomes ($p=0.025$). Additionally, altered mental status (AMS) was significantly more prevalent among patients who died within 24 hours ($p<0.001$).

Among these variables, AMS, pH, and lactate levels were also significantly associated with 30-day mortality ($p<0.001$, $p=0.012$, and $p<0.001$, respectively). Furthermore, a significantly lower serum albumin level and a higher need for vasopressor support were observed in patients who died within 30 days (both $p<0.001$).

Table 2. Association of patients' demographic characteristics, vital signs, laboratory values, and clinical features with 24-hour and 30-day mortality

	24-hour mortality			30-day mortality		
	Yes (n=48)	No (n=188)	p value	Yes (n=86)	No (n=150)	p value
Sex						
Male	22 (45.8%)	103 (54.8%)	0.2671	44 (51.2%)	81 (54.0%)	0.674[1]
Female	26 (54.2%)	85 (45.2%)		42 (48.8%)	69 (46.0%)	
Age	74 (66-82)	75 (64-84)	0.8752	74 (64-84)	75 (65-83)	0.927[2]
Vital Parameters						
SBP (mmHg)	89 (71-114)	98 (80-118)	0.132[2]	90 (75-110)	100 (83-119)	0.132[2]
DBP (mmHg)	56 (47-66)	60 (50-70)	0.262[3]	55 (47-68)	60 (50-70)	0.138[3]
HR (beats/min)	108 (89-120)	99 (85-116)	0.200[3]	107 (88-121)	98 (85-112)	0.163[3]
Oxygen (%)	93 (89-95)	94 (92-96)	0.132[2]	94 (90-96)	94 (91-96)	0.721[2]
RR (breaths/min)	20 (20-23)	21 (20-23)	0.624[2]	21 (20-24)	20 (19-23)	0.154[2]
BT (°C)	36.6 (36.5-37.3)	36.8 (36.5-37.8)	0.502[2]	36.6 (36.5-37.1)	36.8 (36.5-37.9)	0.102[2]
Laboratory Parame-ters						
WBC (×10⁹/L)	13.2 (7.3-23.0)	14.2 (8.7-19.7)	0.870[2]	11.7 (7.2-19.8)	14.9 (9.1-19.8)	0.142[2]
Hemoglobin (g/dL)	11.3 (9.8-13.0)	10.9 (9.0-12.7)	0.025[3]	10.9 (8.4-12.4)	11.2 (9.3-12.8)	0.373[3]
Platelet (×10⁹/L)	179 (114-332)	233 (138-327)	0.537[3]	184 (105-337)	237 (154-323)	0.671[4]
IGC (×10³/μL)	0.16 (0.06-0.57)	0.16 (0.09-0.47)	0.824[2]	0.14 (0.05-0.57)	0.18 (0.09-0.45)	0.321[2]
pH	7.30 (7.20-7.39)	7.40 (7.30-7.41)	<0.001[2]	7.32 (7.24-7.40)	7.40 (7.30-7.41)	0.012[2]
Base excess	2.1 (-9.8 to 14.1)	7.5 (-0.3 to 12.3)	0.059[4]	7.4 (-4.9 to 13.4)	7.4 (-0.7 to 12.2)	0.288[4]
Lactate (mmol/L)	4.56 (2.45-7.33)	2.23 (1.73-3.08)	<0.001[2]	2.95 (2.04-5.23)	2.23 (1.68-3.13)	<0.001[2]
Procalcitonin (ng/mL)	4.3 (0.9-34.2)	2.8 (0.5-19.0)	0.246[2]	2.9 (0.9-21.6)	3.5 (0.4-21.0)	0.567[2]
CRP (mg/L)	163 (83-265)	179 (101-285)	0.681[3]	181 (97-261)	177 (99-291)	0.977[3]
Albumin (g/dL)	30.1 (23.8-32.8)	30.4 (26.3-33.6)	0.164[3]	28.1 (24.3-31.9)	31.2 (27.3-34.6)	<0.001[3]
AMS	39 (81.3%)	94 (50.0%)	<0.001[1]	64 (74.4%)	69 (46.0%)	<0.001[1]
Vasopressor Re-quirement	34 (70.8%)	105 (55.9%)	0.060[1]	65 (75.6%)	74 (49.3%)	<0.001[1]
Emergency Depart-ment Outcome						
Discharge	0	13 (6.9%)		0	13 (8.7%)	
Ward Admission	1 (2.1%)	33 (17.6%)		5 (5.8%)	29 (19.3%)	
ICU Admission	47 (97.9%)	143 (76.1%)		81 (94.2%)	108 (72.0%)	
ICU Transfer After Ward Admission	1 (2.1%)	8 (4.3%)		5 (2.7%)	8 (4.3%)	

SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR: Heart Rate; RR: Respiratory Rate; BT: Body Temperature; WBC: White Blood Cell Count, IGC: Immature Granulocyte Count; CRP: C-Reactive Protein; AMS: Altered Mental Status; ICU: Intensive Care Unit. [1]Chi-square test; [2]Student's t-test; [3]Mann-Whitney U test; [4]Welch's t-test. Values are expressed as n (%) or median (IQR), as appropriate.

As shown in Figure 2, both LqSOFA and qSOFA scores demonstrated diagnostic value in predicting 24-hour and 30-day mortality. For 24-hour mortality, the LqSOFA score with a cut-off value of ≥3 yielded an area under the curve (AUC) of 0.709 (95% confidence interval [CI]: 0.629–0.789), which was higher than that of the qSOFA score (AUC: 0.673). The sensitivity and specificity of LqSOFA were 62% and 68%, respectively, with a positive predictive value of 33% and a negative predictive value of 88%. These findings indicate that while LqSOFA has higher specificity and comparable NPV compared to qSOFA in predicting early mortality, it has relatively lower sensitivity (Table 3).

For 30-day mortality prediction, the LqSOFA score with a cutoff value of ≥3 yielded an AUC of 0.676 (95% CI: 0.607–0.746), while the qSOFA score with a cutoff of ≥2 demonstrated an AUC of 0.669. Although the AUC values were relatively similar for both scores, the LqSOFA score exhibited higher specificity and positive predictive value compared to qSOFA (Table 3).

Table 3. Cut-off values of Lactate-enhanced quick Sequential Organ Failure Assessment (LqSOFA) and quick Sequential Organ Failure Assessment (qSOFA) scores for predicting 24-hour and 30-day mortality in patients with sepsis

	Cut-off	AUC (95% CI)	SEN (95% CI)	SPE (95% CI)	PPV (95% CI)	NPV (95% CI)	+LR (95% CI)	-LR (95% CI)	p value
24-hour mortality									
LqSOFA	3	0.709 (0.629-0.789)	62 (47-76)	68 (60-74)	33 (27-40)	88 (83-91)	1.93 (1.43-2.61)	0.56 (0.38-0.82)	<0.001
qSOFA	2	0.673 (0.587-0.759)	69 (54-81)	59 (52-66)	30 (25-36)	88 (83-92)	1.68 (1.30-2.17)	0.53 (0.34-0.82)	<0.001
30-day mortality									
LqSOFA	3	0.676 (0.607-0.746)	55 (44-65)	71 (63-78)	52 (44-59)	73 (68-78)	1.86 (1.36-2.55)	0.64 (0.50-0.82)	<0.001
qSOFA	2	0.669 (0.598-0.740)	65 (54-75)	64 (56-72)	51 (44-57)	76 (70-81)	1.81 (1.39-2.36)	0.55 (0.40-0.75)	<0.001

AUC: Area under the curve; SEN: Sensitivity; SPE: Specificity; PPV: Positive predictive value; NPV: Negative predictive value; +LR: Positive likelihood ratio; -LR: Negative likelihood ratio.

Table 4. Cut-off values of Lactate-enhanced quick Sequential Organ Failure Assessment (LqSOFA) and quick Sequential Organ Failure Assessment (qSOFA) scores for predicting Intensive Care Unit (ICU) admission in patients with sepsis

	Cut-off	AUC (95% CI)	SEN (95% CI)	SPE (95% CI)	PPV (95% CI)	NPV (95% CI)	+LR (95% CI)	-LR (95% CI)	p value
LqSOFA	2	0.824 (0.758-0.891	79 (72-84)	74 (60-86)	93 (88-95)	47 (39-55)	3.09 (1.89-5.06)	0.28 (0.20-0.39)	<0.001
qSOFA	2	0.820 (0.756-0.885)	57 (49-64)	94 (82-99)	97 (92-99)	35 (31-39)	8.87 (2.95-26.7)	0.46 (0.38-0.55)	<0.001

AUC: Area under the curve; SEN: Sensitivity; SPE: Specificity; PPV: Positive predictive value; NPV: Negative predictive value; +LR: Positive likelihood ratio; -LR: Negative likelihood ratio.

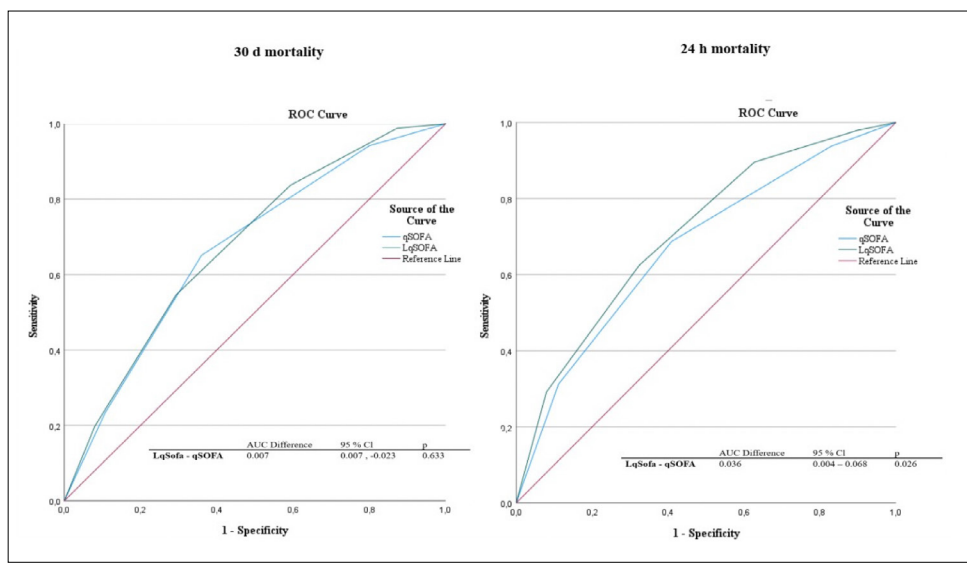

Figure 2. ROC Curves of qSOFA and LqSOFA Scores in Predicting 24-Hour and 30-Day Mortality.

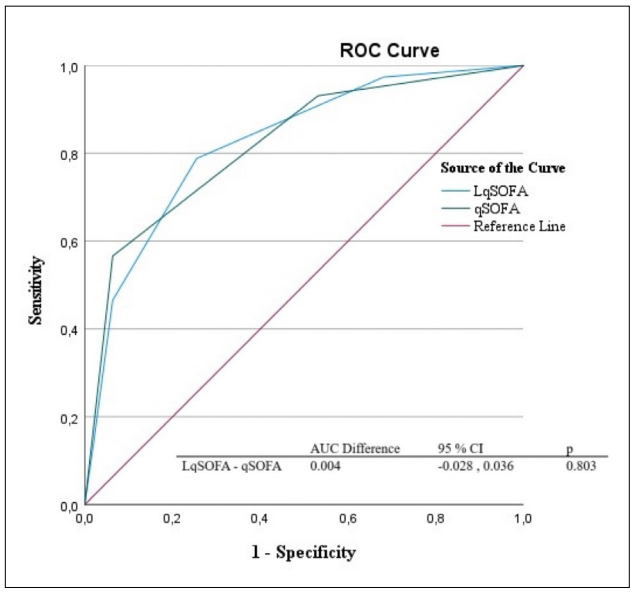

Figure 3. ROC Curves of LqSOFA and qSOFA Scores for Predicting ICU Admission.

Figure 2 demonstrates that the LqSOFA score exhibits higher diagnostic accuracy than qSOFA in predicting both 24-hour and 30-day mortality. For 24-hour mortality, the LqSOFA curve lies above that of qSOFA, with an AUC difference of 0.006 (95% CI: 0.004–0.026), which was statistically significant according to the DeLong test ($p<0.05$). This suggests that LqSOFA may offer superior performance in predicting early mortality. For 30-day mortality, although the LqSOFA score again demonstrated a higher AUC compared to qSOFA, the difference was 0.007 and did not reach statistical significance (95% CI: -0.023 to 0.633, DeLong test, $p>0.05$).

Both LqSOFA and qSOFA scores demonstrated diagnostic value in predicting ICU admission (Fig. 3). As shown in Table 4, the diagnostic performance of the two scores was comparable: the AUC for the LqSOFA score (cut-off ≥2) was 0.824 (95% CI: 0.758-0.891), which was similar to that of the qSOFA score (AUC: 0.820, 95% CI: 0.756-0.885). Both scores showed strong discriminative ability ($p<0.001$). The sensitivity and specificity of LqSOFA were 79% (95% CI: 72-84) and 74% (95% CI: 60-86), respectively. While qSOFA exhibited higher specificity (94%), it had considerably lower sensitivity (57%). These findings suggest that LqSOFA, with its higher sensitivity and balanced specificity, allows for more effective identification of high-risk patients, whereas qSOFA—despite its high specificity—may fail to detect a subset of critically ill patients due to its lower sensitivity.

In Figure 3, the diagnostic accuracy of qSOFA and LqSOFA scores for predicting ICU admission was compared using ROC curves. Although the LqSOFA curve lies slightly above that of qSOFA, the AUC difference between the two scoring systems was 0.004 (95% CI: -0.028 to 0.036), which was not statistically significant (DeLong test, $p=0.803$).

DISCUSSION

This study aimed to evaluate the predictive performance of the LqSOFA score, which incorporates serum lactate levels into the conventional qSOFA score, for both early and late mortality among adult patients diagnosed with sepsis in the emergency department. Our findings indicate that the LqSOFA score demonstrated higher diagnostic accuracy than the qSOFA score in predicting both 24-hour and 30-day mortality. Additionally, LqSOFA exhibited greater sensitivity than qSOFA in predicting ICU admission.

Sepsis represents a heterogeneous clinical spectrum characterized by systemic inflammatory response, hypoperfusion, organ dysfunction, and increased risk of death. Therefore, there is a critical need for tools that can enable both early diagnosis and risk stratification.[1,4] In this context, the qSOFA score is widely used due to its simplicity and bedside applicability. However, multiple studies have reported that it may be insufficient for early recognition of sepsis and prediction of mortality.[13-15]

Lactate is recognized as an early biochemical marker of tissue hypoperfusion in patients with sepsis or critical illness and has been identified in the literature as an independent predictor of mortality.[6,16,17] Moreover, elevated lactate levels may indicate poor prognosis even in patients who appear clinically stable, including those who are normotensive, non-tachypneic, or afebrile.[18] In this context, the LqSOFA score has emerged as a tool that may better reflect early pathophysiological deterioration in sepsis.

In our study, the AUC of the LqSOFA score for predicting 24-hour mortality was found to be 0.709, which was significantly higher than that of the qSOFA score. This finding supports the results of the study by Liu et al.,[8] in which LqSOFA was compared with other scoring systems. Liu and colleagues demonstrated that LqSOFA yielded a higher AUC than SIRS, MEWS, and MEDS in predicting in-hospital mortality and identified it as the scoring system with the highest overall accuracy. Similarly, in a prospective cohort study conducted in Southeast Asia, Wright et al.[9] found that LqSOFA significantly outperformed qSOFA in predicting 28-day mortality (AUROC: 0.78 vs. 0.68). In parallel, Bou Chebl et al.[6] showed that lactate is an independent predictor of mortality in patients diagnosed with sepsis in the emergency department.

Hemoglobin levels are a critical biomarker in sepsis, as they reflect oxygen-carrying capacity and tissue perfusion. Accordingly, low hemoglobin levels in septic patients have been associated with increased mortality.[19] However, in our study, hemoglobin levels were found to be significantly higher in the 24-hour mortality group. In a study by Sheng et al.,[20] a nonlinear association between hemoglobin levels and in-hospital mortality was observed in sepsis patients, with both low and high hemoglobin values linked to poor outcomes. Elevated hemoglobin levels may increase blood viscosity and impair microcirculation. Therefore, maintaining hemoglobin levels

within an optimal range may be important in the management of sepsis.

In our study, patients who died within both 24 hours and 30 days exhibited significantly lower pH levels, higher lactate concentrations, and a greater frequency of AMS. These findings support the strong association between hypoperfusion, metabolic dysfunction—core components of sepsis pathophysiology—and mortality.[21] Additionally, hypoalbuminemia was significantly associated with 30-day mortality, suggesting that low albumin levels may serve as an additional independent biomarker for late-phase sepsis prognosis. In line with this, a study by Seo et al.[22] identified a nomogram incorporating hypoalbuminemia, tachypnea, and low base excess as a reliable predictor of 28-day mortality among septic patients in the emergency department. Similarly, the significant association between vasopressor requirement and 30-day mortality in our cohort reinforces the prognostic value of hemodynamic instability. In septic patients, vasopressor use is commonly linked to septic shock, which is a major contributor to increased mortality.[23]

In predicting ICU admission, the LqSOFA score demonstrated higher sensitivity compared to qSOFA (79% vs. 57%), albeit with lower specificity. This suggests that LqSOFA may be a safer triage tool in emergency department settings, as it is less likely to miss high-risk patients. Conversely, the higher specificity of qSOFA (94%) may offer an advantage in reducing false-positive identifications. Therefore, it is important to consider not only the diagnostic accuracy of scoring systems but also the intended clinical purpose when applying them in decision-making processes.

The literature has emphasized the applicability of the LqSOFA score particularly in low- and middle-income countries, where emergency departments often operate with limited resources. In such settings, the use of simple, time-efficient, and objectively measurable scoring systems is of critical importance.[24,25]

In our study, only venous lactate measurements were used, which supports the feasibility and sustainability of this scoring system in emergency departments where arterial sampling may be challenging in practice. Several studies have reported a strong correlation between venous and arterial lactate levels.[12,26]

CONCLUSION

In conclusion, our study demonstrated that the LqSOFA score provides superior performance compared to qSOFA in predicting both mortality and the need for ICU admission. Given its simplicity, rapid applicability, and utility in guiding clinical decision-making, we believe that the LqSOFA score should be more widely adopted in emergency department settings. Future multicenter, prospective studies with larger sample sizes are warranted to further evaluate and validate the diagnostic accuracy of this scoring system.

Ethics Committee Approval: This study was approved by the Etlik City Hospital Clinical Research Ethics Committee (Date: 07.05.2025, Decision No: AEŞH-BADEK1-2025-0177).

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: V.S.; Design: V.S. A.B.E.; Supervision: A.B.E.; Resource: V.S.; Materials: V.S. A.B.E.; Data collection and/or processing: V.S. A.B.E.; Analysis and/or interpretation: V.S.; Literature review: V.S.; Writing: V.S.; Critical review: V.S. A.B.E.

Conflict of Interest: None declared.

Financial Disclosure: The author declared that this study has received no financial support.

REFERENCES

1. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA 2016;315:801–10.
2. Rhodes A, Evans LE, Alhazzani W, Levy MM, Antonelli M, Ferrer R, et al. Surviving Sepsis Campaign: International guidelines for management of sepsis and septic shock: 2016. Intensive Care Med 2017;43:304–77.
3. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A, et al. Assessment of clinical criteria for sepsis: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA 2016;315:762–74.
4. Raith EP, Udy AA, Bailey M, McGloughlin S, MacIsaac C, Bellomo R, et al. Prognostic accuracy of the SOFA score, SIRS criteria, and qSOFA score for in-hospital mortality among adults with suspected infection admitted to the intensive care unit. JAMA 2017;317:290–300.
5. Hwang SY, Jo IJ, Lee SU, Lee TR, Yoon H, Cha WC, et al. Low accuracy of positive qSOFA criteria for predicting 28-day mortality in critically ill septic patients during the early period after emergency department presentation. Ann Emerg Med 2018;71:1–9.e2.
6. Bou Chebl R, El Khuri C, Shami A, Rajha E, Faris N, Bachir R, et al. Serum lactate is an independent predictor of hospital mortality in critically ill patients in the emergency department: a retrospective study. Scand J Trauma Resusc Emerg Med 2017;25:69.
7. Maher SA, Temkit M, Buras MR, McLemore RY, Butler RK, Chowdhury Y, et al. Serum lactate and mortality in emergency department patients with cancer. West J Emerg Med 2018;19:827–33.
8. Liu S, He C, He W, Jiang T. Lactate-enhanced-qSOFA (LqSOFA) score is superior to the other four rapid scoring tools in predicting in-hospital mortality rate of the sepsis patients. Ann Transl Med 2020;8:1013.
9. Wright SW, Hantrakun V, Rudd KE, Lau CY, Lie KC, Chau NVV, et al. Enhanced bedside mortality prediction combining point-of-care lactate and the quick Sequential Organ Failure Assessment (qSOFA) score in patients hospitalised with suspected infection in southeast Asia: a cohort study. Lancet Glob Health 2022;10:e1281–8.
10. Oi Y, Ogawa F, Honzawa H, Abe T, Imaki S, Takeuchi I. A screening tool to predict sepsis in patients with suspected infection in the emergency department. Cureus 2025;17:e78728.
11. Oi Y, Mori K, Yamagata H, Nogaki A, Takeda T, Watanabe C, et al. Peripheral venous lactate levels substitute arterial lactate levels in the emergency department. Int J Emerg Med 2022;15:7.
12. Velissaris D, Karamouzos V, Pantzaris ND, Kyriakopoulou O, Gogos C, Karanikolas M. Relation between central venous, peripheral venous and arterial lactate levels in patients with sepsis in the emergency department. J Clin Med Res 2019;11:629–34.
13. Tusgul S, Carron PN, Yersin B, Calandra T, Dami F. Low sensitivity of qSOFA, SIRS criteria and sepsis definition to identify infected patients at risk of complication in the prehospital setting and at the emergency department triage. Scand J Trauma Resusc Emerg Med 2017;25:108.

14. Dorsett M, Kroll M, Smith CS, Asaro P, Liang SY, Moy HP. qSOFA has poor sensitivity for prehospital identification of severe sepsis and septic shock. Prehosp Emerg Care 2017;21:489–97.
15. Askim Å, Moser F, Gustad LT, Stene H, Gundersen M, Åsvold BO, et al. Poor performance of quick-SOFA (qSOFA) score in predicting severe sepsis and mortality: a prospective study of patients admitted with infection to the emergency department. Scand J Trauma Resusc Emerg Med 2017;25:56.
16. Mikkelsen ME, Miltiades AN, Gaieski DF, Goyal M, Fuchs BD, Shah CV, et al. Serum lactate is associated with mortality in severe sepsis independent of organ failure and shock. Crit Care Med 2009;37:1670–7.
17. Ryoo SM, Kim WY. Clinical applications of lactate testing in patients with sepsis and septic shock. J Emerg Crit Care Med 2018;2:14.
18. Filho RR, Rocha LL, Corrêa TD, Pessoa CMS, Colombo G, Assuncao MSC. Blood lactate levels cutoff and mortality prediction in sepsis—time for a reappraisal? A retrospective cohort study. Shock 2016;46:480–5.
19. Zhu J, Dong Y, Liao P, Yin X, He J, Guo L. Prognostic value of hemoglobin in patients with sepsis: a systematic review and meta-analysis. Heart Lung 2024;64:93–9.
20. Sheng S, Li A, Zhang C, Liu X, Zhou W, Shen T, et al. Association between hemoglobin and in-hospital mortality in critically ill patients with sepsis: evidence from two large databases. BMC Infect Dis 2024;24:1450.
21. Lee SG, Song J, Park DW, Moon S, Cho HJ, Kim JY, et al. Prognostic value of lactate levels and lactate clearance in sepsis and septic shock with initial hyperlactatemia: a retrospective cohort study according to the Sepsis-3 definitions. Medicine (Baltimore) 2021;100:e24835.
22. Seo MH, Choa M, You JS, Lee HS, Hong JH, Park YS, et al. Hypoalbuminemia, low base excess values, and tachypnea predict 28-day mortality in severe sepsis and septic shock patients in the emergency department. Yonsei Med J 2016;57:1361–9.
23. Roberts RJ, Miano TA, Hammond DA, Patel GP, Chen JT, Phillips KM, et al. Evaluation of vasopressor exposure and mortality in patients with septic shock. Crit Care Med 2020;48:1445–53.
24. Sinto R, Suwarto S, Lie KC, Harimurti K, Widodo D, Pohan HT. Prognostic accuracy of the quick Sequential Organ Failure Assessment (qSOFA)-lactate criteria for mortality in adults with suspected bacterial infection in the emergency department of a hospital with limited resources. Emerg Med J 2020;37:363–9.
25. Gill A, Ackermann K, Hughes C, Lam V, Li L. Does lactate enhance the prognostic accuracy of the quick Sequential Organ Failure Assessment for adult patients with sepsis? A systematic review. BMJ Open 2022;12:e060455.
26. Mahmoodpoor A, Shadvar K, Sanaie S, Golzari SEJ, Parthvi R, Hamishehkar H, et al. Arterial vs venous lactate: correlation and predictive value of mortality of patients with sepsis during early resuscitation phase. J Crit Care 2020;58:118–24.

ORİJİNAL ÇALIŞMA - *ÖZ*

Acil serviste sepsis hastalarında mortaliteyi tahmin etme konusunda laktatla geliştirilmiş qSOFA'nın standart qSOFA'ya karşı prognostik değeri: Retrospektif bir kohort çalışması

AMAÇ: Quick Sequential Organ Failure Assessment (qSOFA) skoru, sepsis hastalarında yatak başı risk sınıflandırması için yaygın olarak kullanılmaktadır. Ancak sınırlı duyarlılığı, erken tanı konmasını zorlaştırabilir. Serum laktat düzeylerinin qSOFA skoruna entegre edilmesiyle oluşturulan Lactate-enhanced qSOFA (LqSOFA) skoru, prognostik doğruluğu artırabilir. Bu çalışmanın amacı, LqSOFA skorunun erken (24 saat) ve geç (30 gün) mortalite ile yoğun bakım ünitesi (YBÜ) yatışını öngörmedeki tanısal performansını değerlendirmektir.

GEREÇ VE YÖNTEM: Bu retrospektif tanımlayıcı çalışma, 1 Temmuz 2024 – 31 Aralık 2024 tarihleri arasında üçüncü basamak bir eğitim ve araştırma hastanesinin acil servisine başvuran ve Sepsis-3 kriterlerine göre sepsis tanısı alan ≥18 yaş hastaları kapsamaktadır. Hastalar ICD-10 kodları ile belirlenmiş, tanılar klinik olarak doğrulanmıştır. qSOFA ve LqSOFA skorları, başvuru anındaki vital bulgular ve venöz laktat düzeylerine göre hesaplanmıştır. Birincil sonuçlar 24 saat ve 30 günlük mortalite; ikincil sonuç ise YBÜ yatışıdır. İstatistiksel analizler SPSS v27 ve Jamovi v2.5.7 ile yapılmıştır. Tanısal performans değerlendirmesi için ROC eğrisi analizi uygulanmış; AUC, duyarlılık, özgüllük ve kestirim değerleri hesaplanmıştır. AUC karşılaştırmaları DeLong testi ile yapılmış; $p<0.05$ anlamlı kabul edilmiştir.

BULGULAR: Toplam 236 hasta dahil edilmiştir (medyan yaş: 75 yıl; %53 erkek). Yirmi dört saatlik ve 30 günlük mortalite oranları sırasıyla %20.3 ve %36.4 olarak bulunmuştur. LqSOFA, 24 saatlik mortaliteyi öngörmede qSOFA'ya göre anlamlı derecede daha yüksek tanısal doğruluk göstermiştir (AUC: 0.709 ve 0.673; $p<0.05$). LqSOFA'nın 30 günlük mortalite için AUC değeri daha yüksek olmasına rağmen, fark istatistiksel olarak anlamlı değildir. Bununla birlikte, LqSOFA daha yüksek özgüllük ve pozitif kestirim değeri sergilemiştir. YBÜ yatışını öngörmede, LqSOFA skoru qSOFA'ya göre daha yüksek duyarlılığa sahiptir (%79 ve %57).

SONUÇ: LqSOFA skoru, mortalite ve YBÜ yatışını öngörmede qSOFA skoruna göre daha iyi tanısal performans sunmaktadır. Basitliği, nesnelliği ve hızlı uygulanabilirliği sayesinde, LqSOFA acil servislerde klinik karar verme sürecini destekleyen pratik bir araç olarak kullanılabilir.

Anahtar sözcükler: Hastane acil servisi; laktik asit; sepsis; mortalite; qSOFA skoru, yoğun bakım üniteleri.

Ulus Travma Acil Cerrahi Derg 2025;31(9):891-899 DOI: 10.14744/tjtes.2025.55728