Tzu Chi Medical Journal 2023; 35 (2): 182-187

Original Article

# Predictive performance of qSOFA in confirmed COVID-19 patients presenting to the emergency department

*Farhad Heydari[a], Saeed Abbasi[b], Kiana Shirani[c], Majid Zamani[a]*, Babak Masoumi[a], Saeed Majidinejad[a], Mohammad Nasr-Esfahani[a], Mahsa Sadeghi-Aliabadi[d], Mohammadreza Arbab[e]*

[a]Department of Emergency Medicine, Faculty of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran, [b]Anesthesiology and Critical Care Research Center, Nosocomial Infection Research Center, Isfahan University of Medical Sciences, Isfahan, Iran, [c]Department of Infectious Diseases, Isfahan University of Medical Sciences, Isfahan, Iran, [d]Department of Genetics, Faculty of Advanced Science and Technology, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran, [e]Department of Biology, Faculty of Science, Yazd University, Yazd, Iran



**Submission** : 07-May-2022
**Revision** : 04-Jul-2022
**Acceptance** : 13-Sep-2022
**Web Publication** : 03-Jan-2023

## Abstract

**Objectives:** It is critical to quickly and easily identify coronavirus disease 2019 (COVID-19) patients who become severely or even critically ill. Thus, this study was conducted to determine the accuracy of the quick Sequential Organ Failure Assessment (qSOFA) score in predicting the severity and mortality of COVID-19 patients. **Materials and Methods:** This was a prospective observational study of COVID-19 patients admitted to the emergency department (ED) between June 22, 2021, and November 21, 2021. The clinical characteristics of the participants were collected by the emergency physicians. The correlation of the qSOFA, Systemic Inflammatory Response Syndrome criteria (SIRS), Pneumonia Severity Index (PSI), and confusion, urea, respiratory rate, blood pressure, 65 years of age and older (CURB-65) scores for 14-day mortality were evaluated. The area under a receiver operating characteristic (AUROC) curve analysis was calculated to compare the effectiveness of qSOFA, SIRS, PSI, and CURB-65 to predict severe disease. **Results:** Eight hundred and ninety-four subjects were included. Of them, 721 patients (80.6%) survived after 14 days of admission. The mean age was 58.92 ± 17.80 years, and 551 subjects (61.6%) were male. Nonsurvived patients were significantly older (51.09 ± 23.60 vs. 38.10 ± 18.24, $P$ = 0.004) and had more comorbidities (diabetes mellitus, respiratory, cardiovascular, and cerebrovascular disease) in comparison with survived patients. For COVID-19 mortality prediction, the AUROCs of qSOFA, CURB-65, PSI, and SIRS score were 0.799 (95% confidence interval [CI 0.771–0.825]), 0.829 (95% CI [0.803–0.853]), 0.830 (95% CI [0.804–0.854]), and 0.759 (95% CI [0.730–0.787]), respectively. All scores were good predictors of COVID-19 mortality. **Conclusion:** The qSOFA was more successful than SIRS in predicting mortality for COVID-19 patients and was similar to CURB-65 and PSI. Therefore, the qSOFA score can be considered a simple and rapid screening tool for identifying high-risk patients.

**Keywords:** *COVID-19, Emergency department, Mortality, Score*

## Introduction

A novel coronavirus has been identified as the cause of the pneumonia pandemic and caused a substantial public health crisis in Wuhan, China, in December 2019 and then expeditiously spread around the world [1]. This virus has caused an outbreak of respiratory disease named coronavirus disease 2019 (COVID-19). COVID-19 has had a devastating effect on health care worldwide and has exceeded the local health care capacity in many parts of the world [1,2].

6%–20% of COVID-19 patients need to be hospitalized [3,4]. The prevalence of the critical disease among hospitalized patients is about 5%–20%, and intensive care treatment may require in >25% of them [5,6]. The mortality rate among hospitalized patients is between 11% and 28% [3,7].

Therefore, it is critical to quickly and easily identify patients who become severely or even critically ill, and this can help with the allocation of limited medical and monitoring resources. When health resources are limited, using predictive scores to estimate a patient's risk or poor outcome can

Access this article online

Quick Response Code:

Website: www.tcmjmed.com

DOI: 10.4103/tcmj.tcmj_132_22

**Address for correspondence:* Dr. Majid Zamani, Department of Emergency Medicine, Faculty of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.
E-mail: mzamani93@yahoo.com



**How to cite this article:** Heydari F, Abbasi S, Shirani K, Zamani M, Masoumi B, Majidinejad S, *et al.* Predictive performance of qSOFA in confirmed COVID-19 patients presenting to the emergency department. Tzu Chi Med J 2023;35(2):182-7.

reduce the use of limited available resources [1,3,6]. Several established clinical scoring tools have been used to classify risk stratification in patients with sepsis and community-acquired pneumonia [3,6].

Two valid scoring systems for predicting pneumonia mortality are the confusion, urea, respiratory rate, blood pressure, 65 years of age and older (CURB-65) score and Pneumonia Severity Index (PSI) [3,6,8,9], and two scoring tools for predicting sepsis mortality in the emergency department (ED) are the quick Sequential Organ Failure Assessment (qSOFA) score, and Systemic Inflammatory Response Syndrome criteria (SIRS) [6,10].

The qSOFA criteria were proposed in the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) in 2016 [3,6]. It is a valuable modality in the ED, out-of-hospital, and even at home to clinically categorize a septic patient. The patients have poor outcomes if they have at least 2 of the qSOFA criteria: systolic blood pressure (BP) ≤100 mmHg, respiratory rate (RR) ≥22 breaths/minute, and altered mental status [10,11].

The qSOFA criteria were developed initially to predict mortality in septic patients. Still, recent studies have suggested that qSOFA is an effective tool to assess the mortality risk in critically ill patients with various diseases, especially in resource-constrained scenarios [11,12]. Therefore, the qSOFA score can assist emergency physicians in predicting the mortality of COVID-19 hospitalized patients.

The present study was conducted to identify the accuracy of the qSOFA score in the ED in predicting the severity and 14-day mortality of COVID-19 patients up to two weeks after hospital admission.

## Materials and Methods

### Study setting and participants

This was a prospective observational study of patients with COVID-19 infection admitted at the ED of Al-Zahra hospital (a university-affiliated, COVID-19 referral hospital in Isfahan, Iran) between June 22, 2021, and November 21, 2021 (Delta variant of the coronavirus). This study was approved by the ethics committee of Isfahan University of Medical Sciences (code: IR.MUI.MED.REC.1399.932), and the study subjects gave informed consent.

All consecutive adult subjects who have been suspected for COVID-19 and admitted to the ED were eligible for study participation. These suspected subjects were tested for COVID-19 (by reverse-transcription polymerase chain reaction) [13]. Adult admitted patients (over 18 years of age) who were tested positive for COVID-19 were included in the study and the information were retrieved. Patients with missing data, pregnant women, patients younger than 18 years, subjects hospitalized for medical conditions unrelated to COVID-19, patients transferred from other hospitals, and patients discharged against medical advice were excluded.

Based on similar studies [3], assuming specificity of 80%, the mortality rate of 20%, the estimation accuracy of 95%, and type-1 error of 3%, the minimum sample size was 853 people.

### Data collection

The emergency medicine residents evaluated all the subjects were admitted to the ED and took over the patient's management and follow-up. They obtained detailed clinical data from each patient using a standard questionnaire. Clinical data including demographic data (gender and age), past medical history, signs and symptoms, BP, RR, heart rate (HR), the Alert Verbal Pain Unresponsiveness, Glasgow coma scale (GCS), temperature, $O_2$ saturation ($SpO_2$), laboratory findings, triage level base on Emergency Severity Index version 4, and chest computed tomographic (CT) scans were collected at ED admission. The clinical characteristics of the participants were compared by using qSOFA, SIRS, PSI, and CURB-65 scores.

### Scales definition

The qSOFA is a scale with three variables with one point value for SBP ≤100 mm Hg, RR ≥22 bpm, and altered mentation (GCS <15)(score range, 0–3 points) (10).

CURB-65 has five variables, assigning one point for confusion, urea >7 mmol/L, RR ≥30 bpm, SBP <90 mmHg or DBP ≤60 mmHg, and age ≥65 years (score range, 0–5 points) (3).

SIRS is composed of four variables: Temperature >38°C or <36°C, HR >90 bpm, RR >20 bpm, or $PaCO_2$ <4.3, white blood cell count >12 000 cells/$mm^3$ or <4000 cells/$mm^3$. (1 point for each variable; score range, 0 _4 points) (6).

The PSI is composed of 19 variables with different point values. Patients were stratified into five risk categories (risk classes I–V) (3).

### Outcome measures

Severe disease was defined as hospitalization in the intensive care unit (ICU) or death. The primary outcome was in-hospital mortality within 14 days after admission to the ED. The secondary outcome was ICU admission. Patients were transferred to ICU by decision of intensivists.

### Statistical analysis

SPSS software (ver. 25.0; IBM, Armonk, NY, USA) was performed to analyze the variables. Categorical data were defined by frequency (%), and continuous data were expressed by means and standard deviations or 95% confidence interval (CI). Chi-square test was performed for the comparisons of categorical variables, and the Student's *t*-test, or the Mann-Whitney U test, was performed for the comparisons of continuous data.

A multivariate logistic regression analysis was conducted to identify the independent risk factors of mortality. The area under a receiver operating characteristic (AUROC) curve analysis was calculated to compare the effectiveness of qSOFA, SIRS, PSI, and CURB-65 to predict severe disease. $P < 0.05$ in two-tailed tests was considered statistically significant.

## Results

Eight hundred and ninety-four subjects were included in this study. Of them, 203 (22.7%) cases were referred to the

ICU. Finally, 721 patients (80.6%) survived after 14 days of admission. The mean age was 58.92 ± 17.80 years, and 551 subjects (61.6%) were male. The mean length of hospital stay was 9.11 ± 8.44 days. The most common underlying diseases were hypertension (32.7%) and diabetes (31.7%). The baseline characteristics and the mean scores are reported in Table 1.

Nonsurvived patients were significantly older (51.09 ± 23.60 vs. 38.10 ± 18.24, $P$ = 0.004) and had more comorbidities (diabetes mellitus, respiratory, cardiovascular, and cerebrovascular disease) in comparison with survived patients. Among vital parameters at ED admission $SpO_2$, RR and HR were significantly worse in nonsurvived patients. There were significant differences between survivor and nonsurvivor patients for GCS, length of hospital stay, qSOFA, PSI, CURB-65, and SIRS [Table 1].

The results of logistic regression for mortality are reported in Table 2. The multivariate analysis (forward stepwise method) demonstrated that age, GCS, $SpO_2$, RR, and having cerebrovascular and respiratory disease were predictors of mortality.

ROC curves were performed to calculate the sensitivity, specificity, PPV, NPV, and cutoff values of scores to predict COVID-19 mortality. The optimal cutoff values of ≥2 for the qSOFA, CURB-65, SIRS, and ≥4 for the PSI were established. With a cutoff value of ≥2 for qSOFA, the sensitivity, specificity, PPV, and NPV were 86.7%, 64.8%, 37.1%, and 95.3%. The NPV of the qSOFA, CURB-65, PSI, and SIRS scores for mortality were 95.3%, 93.8%, 95.0%, and 88.6%, respectively [Table 3].

For COVID-19 mortality prediction, the AUROCs of qSOFA, CURB-65, PSI, and SIRS score were 0.799 (95% CI [0.771–0.825]), 0.829 (95% CI [0.803–0.853]), 0.830 (95% CI [0.804–0.854]), and 0.759 (95% CI [0.730–0.787]), respectively. All scores were good predictors of COVID-19 mortality [Figure 1]. The AUC analysis showed that the qSOFA was more successful than SIRS ($P$ = 0.033) in predicting mortality for COVID-19 patients and was similar to CURB-65 ($P$ = 0.136) and PSI ($P$ = 0.174) [Table 4].

For ICU admission prediction, the AUROCs of qSOFA, CURB-65, PSI, and SIRS score were 0.743 (95% CI [0.713–0.772]), 0.751 (95% CI [0.721–0.779]), 0.748 (95% CI [0.718–0.776]), and 0.605 (95% CI [0.572–0.638]), respectively. Therefore, qSOFA, CURB-65, and PSI were superior to SIRS ($P$ < 0.001), while there were no significant differences between qSOFA, CURB-65, and PSI [Figure 2].

## Discussion

Due to the limitations of medical resources during the COVID-19 outbreak [14], the initial assessment of patients with COVID-19 in terms of disease severity to ensure primary

**Table 1: Comparison of demographic and clinical characteristics of coronavirus disease 2019 patients according to 14-days mortality**

| Characteristics | Total ($n$=894), $n$ (%) | Survived ($n$=721), $n$ (%) | Nonsurvived ($n$=173), $n$ (%) | $P$ |
|---|---|---|---|---|
| Age (year) | 58.92±17.80 | 38.10±18.24 | 51.09±23.60 | 0.004 |
| Gender | | | | |
| Male | 551 (61.6) | 435 (60.3) | 116 (67.1) | 0.117 |
| Female | 343 (38.4) | 286 (39.7) | 57 (32.9) | |
| Comorbidities | | | | |
| Respiratory disease | 127 (14.2) | 80 (11.1) | 47 (27.2) | <0.001 |
| Cardiovascular disease | 160 (17.9) | 118 (16.4) | 42 (24.3) | 0.020 |
| Diabetes mellitus | 283 (31.7) | 206 (28.6) | 77 (44.5) | <0.001 |
| Hypertension | 292 (32.7) | 226 (31.3) | 66 (38.2) | 0.104 |
| Cerebrovascular disease | 79 (8.8) | 52 (7.2) | 27 (15.6) | 0.001 |
| Chronic kidney disease | 96 (10.7) | 75 (10.4) | 21 (12.1) | 0.513 |
| Chronic liver disease | 25 (2.8) | 19 (2.6) | 6 (3.5) | 0.606 |
| Malignancy | 73 (8.2) | 55 (7.6) | 18 (10.4) | 0.220 |
| GCS, mean±SD | 11.88±2.25 | 12.32±6.92 | 10.02±2.67 | <0.001 |
| Length of stay (day) | 9.11±8.44 | 8.52±5.74 | 11.53±10.72 | <0.001 |
| Vital parameters, mean±SD | | | | |
| HR (bpm) | 88.21±11.94 | 87.03±13.74 | 96.24±20.45 | <0.001 |
| SBP (mmHg) | 123.52±17.59 | 130.44±16.56 | 119.21±16.67 | 0.208 |
| DBP (mmHg) | 75.68±10.10 | 75.84±11.71 | 75.19±11.04 | 0.640 |
| RR (bpm) | 20.59±3.09 | 19.31±3.46 | 20.10±6.50 | <0.001 |
| Temperature (°C) | 37.34±0.61 | 36.97±0.31 | 36.93±0.16 | 0.078 |
| $SpO_2$ (%) | 88.99±6.06 | 94.57±2.99 | 95.03±5.03 | <0.001 |
| qSOFA, mean±SD | 1.54±0.65 | 1.36±0.52 | 2.28±0.61 | <0.001 |
| PSI, mean±SD | 3.00±1.27 | 2.72±1.19 | 4.19±0.83 | <0.001 |
| CURB-65, mean±SD | 1.15±1.00 | 0.94±0.93 | 2.01±0.78 | <0.001 |
| SIRS, mean±SD | 1.04±0.95 | 0.86±0.85 | 1.79±0.94 | <0.001 |

qSOFA: Quick sequential organ failure assessment, CURB-65: Confusion, urea, respiratory rate, blood pressure, and age ≥65 years, PSI: Pneumonia severity index, SIRS: Systemic inflammatory response syndrome, SD: Standard deviations, $SpO_2$: Oxygen saturation, BP: Blood pressure, SBP: Systolic BP, DBP: Diastolic BP, GCS: Glasgow Coma Scale, RR: Respiratory rate, HR: Heart rate

medical management and interventions are essential for these patients. Therefore, one of the essential tasks of emergency physicians is to more quickly and accurately screen cases at risk of death among severe or critically ill COVID-19 patients to receive additional monitoring, intervention, or intensive care [15]. In such situations, scoring systems can help overcome limitations. Each scoring tool has its advantages and disadvantages.

The 14-day mortality in the present study was high (19.4%). This may be because the mean age of patients was 58.9 years. Mortality in current study was similar to previous studies (ranged from 19.2% to 20.9%) [3,16,17], but higher than Wilfong *et al*. (10.9%) [18] and Jang *et al*. (5.5%) [19]. Consistent with the current study, previous studies have shown that nonsurvived COVID-19 patients were usually older and had more underlying diseases than those who survived [3,6,12,20]. In a review, Su *et al*. found that the mortality rate of COVID-19 increased with comorbidity and age [21].

The elderly, may suffer from severe comorbidities owing to virus–host interactions, including diabetes mellitus, cerebrovascular or cardiovascular disease. Furthermore, signs of aging, including aging of the immune system, contribute to the increased severity of COVID-19 infection. Natural aging, which involves the destruction of cells, tissues, and organs, increases mortality and morbidity in older age. These features can worsen the pathophysiological response of the elderly to COVID-19 [21].

**Table 2: The logistic regression models for risk factors for 14-days mortality in coronavirus disease 2019 patients**

| Variable | *B* | SE | OR (95% CI) | *P* |
|---|---|---|---|---|
| Age | 0.018 | 0.006 | 0.663 (0.417-1.056) | 0.002 |
| $SpO_2$ | 0.023 | 0.010 | 1.023 (1.003-1.043) | 0.022 |
| GCS | 0.423 | 0.032 | 1.527 (1.434-1.625) | 0.000 |
| RR | 0.104 | 0.028 | 0.532 (0305-0.928) | 0.000 |
| Cerebrovascular disease | −0.630 | 0.284 | 1.003 (0.991-1.014) | 0.026 |
| Respiratory disease | −1.125 | 0.237 | 0.325 (0.204-0.517) | 0.000 |
| Constant | 1.046 | 0.985 | 2.845 | 0.289 |

The "forward stepwise" method was used for the analyses. OR: Odds ratio, CI: Confidence interval, SE: Standard error, GCS: Glasgow Coma Scale, RR: Respiratory rate, $SpO_2$: Oxygen saturation

The current study has compared the performance of four different scoring systems to predict COVID-19 mortality. This study showed that qSOFA with a cutoff of ≥2 is the most sensitive score of mortality in patients with COVID-19 (86.71%), and it is prognostically better than SIRS. The qSOFA with an AUROC of 0.799 predicts mortality in COVID-19 patients significantly superior to SIRS, and it was similar to CURB-65 and PSI to predict COVID-19 mortality. While qSOFA did not perform significantly better than CURB-65 and PSI, it is simple, practical, and rapid. The PSI is more comprehensive, complex, and time-consuming than qSOFA. Also, qSOFA includes clinical parameters rather than laboratory test results, while CURB-65, SIRS, and PSI need laboratory tests. Although a single evaluation at hospital arrival has limited predictive ability, qSOFA could be a helpful screening score to evaluate COVID-19 patients during ED admission.

The NPV of the qSOFA, CURB-65, and PSI scores for mortality were 95.3%, 93.8%, and 95.0%. The high NPV

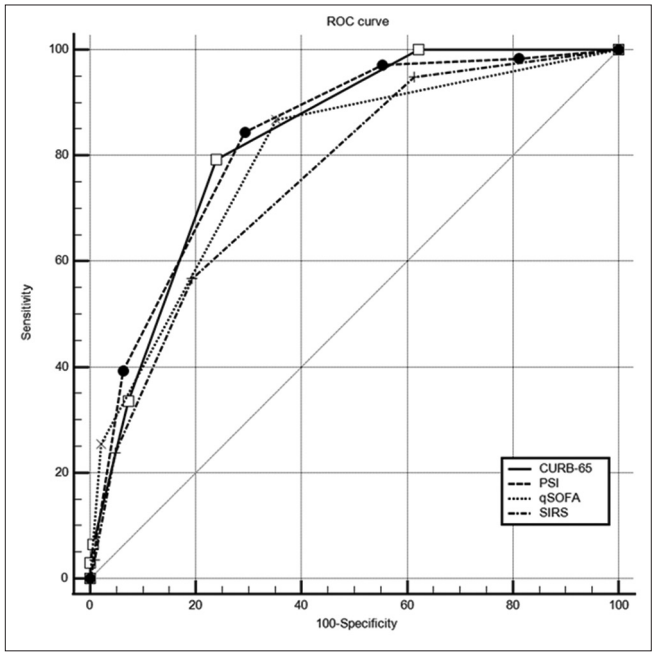


**Figure 1:** Receiver operating characteristic curves for scores in predicting in-hospital mortality in COVID-19 patients. COVID-19: Coronavirus disease 2019

**Table 3: The receiver operating characteristic analysis results of physiologic scoring systems in prediction of 14-days mortality**

| Variables | CURB-65 | qSOFA | SIRS | PSI |
|---|---|---|---|---|
| Cutoff | ≥2 | ≥2 | ≥2 | ≥4 |
| Sensitivity (95% CI) | 79.99 (72.4-85.0) | 86.71 (80.7-91.4) | 56.65 (48.9-64.1) | 84.39 (78.1-89.5) |
| Specificity (95% CI) | 86.14 (72.9-79.2) | 64.77 (61.2-68.3) | 80.72 (77.6-83.5) | 70.74 (63.7-74.0) |
| PPV (95% CI) | 44.3 (40.6-48.1) | 37.1 (34.5-39.8) | 41.4 (36.6-46.2) | 40.9 (37.8-44.1) |
| NPV (95% CI) | 93.8 (91.9-95.3) | 95.3 (93.3-96.8) | 88.6 (86.7-90.2) | 95.0 (93.0-96.4) |
| Positive likelihood ratio (95% CI) | 3.32 (2.85-3.86) | 2.46 (2.19-2.76) | 2.94 (2.4-3.6) | 2.88 (2.5-3.3) |
| Negative likelihood ratio (95% CI) | 0.27 (0.20-0.37) | 0.76 (0.70-0.83) | 0.54 (0.45-0.64) | 0.22 (0.16-0.31) |
| AUROC (95% CI) | 0.829 (0.803-0.853) | 0.799 (0.771-0.825) | 0.759 (0.730-0.787) | 0.830 (0.804-0.854) |
| *P* | <0.001 | <0.001 | <0.001 | <0.001 |

qSOFA: Quick sequential organ failure assessment, CURB-65: Confusion, urea, respiratory rate, blood pressure, and age ≥65 years, PSI: Pneumonia severity index, SIRS: Systemic inflammatory response syndrome, AUROC: Area under a receiver operating characteristic, PPV: Positive predictive value, NPV: Negative predictive value, CI: Confidence interval

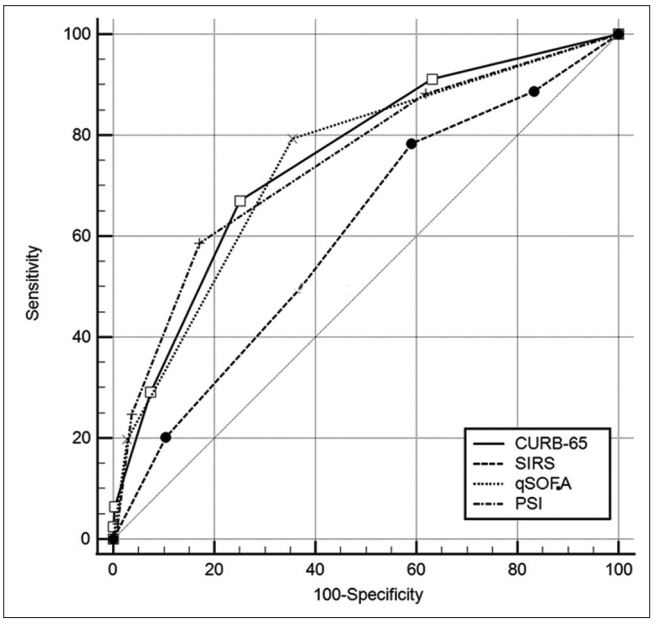


**Figure 2:** Receiver operating characteristic curves for scores in predicting ICU admission in COVID-19 patients. ICU: Intensive care unit, COVID-19: Coronavirus disease 2019

acts as a gatekeeper for the accurate identification of low-risk patients.

The diagnostic ability of qSOFA for the prediction of hospital mortality in the current study was comparable to Liu *et al*. (AUROC = 0.742), Wilfong *et al*. (AUROC = 0.801), and Jang *et al*. (AUROC = 0.779) in COVID-19 patients (AUROC 0.799) [15,18,19]. These findings showed that qSOFA is quite a good score to predict hospital mortality in patients admitted with COVID-19. On the other hand, the results of the present study are not consistent with some studies. Alencar *et al*. reported that the AUROC for qSOFA and SIRS for the prediction of mortality were 0.55 and 0.58 [22]. This study was retrospective and in-hospital mortality was high (39%). Saberian *et al*. showed that the AUROC of qSOFA for death was 0.596 [11]. In contrast to the present study, it was retrospective study and they collected data in the prehospital phase.

Artero *et al*. showed that the PSI and CURB-65 predicted hospital mortality in COVID-19 patients more accurately than qSOFA ($P < 0.001$) [3]. In the study by Holten *et al*., PSI and CURB-65 were significantly more accurate than qSOFA in predicting severe COVID-19 [6]. In the current study, PSI and CURB-65 were also superior to qSOFA, but it was not significant.

Due to silent hypoxemia in severe COVID-19, the accuracy of the qSOFA, PSI, and CURB-65 scores in predicting hospital mortality decreases. These patients appear to breathe comfortably even at low $SpO_2$. These scores only count the RR, and $SpO_2$ does not matter. Therefore, they have limitations in predicting mortality.

This study was a single-center study with limited generalizability, and the findings may not apply to other environments with different populations or healthcare systems.

**Table 4: Comparison of the different area under a receiver operating characteristic of four different tools with statistical significance (*P*)**

| | qSOFA | CURB-65 | PSI | SIRS |
|---|---|---|---|---|
| qSOFA | | 0.136 | 0.174 | 0.033 |
| CURB-65 | | | 0.944 | <0.001 |
| PSI | | | | 0.002 |
| SIRS | | | | |

The method of Delong *et al*. (1988) was used for the calculation of the difference between two AUROCs. DeLong ER, DeLong DM, Clarke-Pearson DL. Comparing the areas under two or more correlated receiver operating characteristic curves: A nonparametric approach. Biometrics 1988;44:837-45. qSOFA: Quick sequential organ failure assessment, CURB-65: Confusion, urea, respiratory rate, blood pressure, and age ≥65 years, PSI: Pneumonia severity index, SIRS: Systemic inflammatory response syndrome, AUROC: Area under a receiver operating characteristic

## Conclusions

The qSOFA predicts mortality in COVID-19 patients significantly better than SIRS, and it was equivalent to CURB-65 and PSI for predicting COVID-19 mortality. Therefore, the qSOFA score can be considered a simple and rapid screening tool to identify high-risk patients to design better strategies for the prevention and treatment of this disease. However, the value of single-patient evaluation is limited, and patients admitted to the hospital should be reassessed frequently for signs of deterioration.

### Acknowledgment

The authors appreciate the insightful cooperation of Medical Sciences and the staff of the ED of Al-Zahra hospital, Kashani hospital and Chamran hospital, Isfahan, Iran.

### Financial support and sponsorship

Isfahan University of Medical Sciences.

### Conflicts of interest

There are no conflicts of interest.

## References

1. Yang Z, Hu Q, Huang F, Xiong S, Sun Y. The prognostic value of the SOFA score in patients with COVID-19: A retrospective, observational study. Medicine (Baltimore) 2021;100:e26900.
2. Azizkhani R, Heydari F, Sadeghi A, Ahmadi O, Meibody AA. Professional quality of life and emotional well-being among healthcare workers during the COVID-19 pandemic in Iran. Front Emerg Med 2022;6:E2.
3. Artero A, Madrazo M, Fernández-Garcés M, Muiño Miguez A, González García A, Crestelo Vieitez A, et al. Severity scores in COVID-19 pneumonia: A multicenter, retrospective, cohort study. J Gen Intern Med 2021;36:1338-45.
4. Rosenberg ES, Dufort EM, Blog DS, Hall EW, Hoefer D, Backenson BP, et al. COVID-19 testing, epidemic features, hospital outcomes, and household prevalence, New York State-March 2020. Clin Infect Dis 2020;71:1953-9.
5. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020;323:1061-9.
6. Holten AR, Nore KG, Tveiten CE, Olasveengen TM, Tonby K. Predicting severe COVID-19 in the Emergency Department. Resusc Plus 2020;4:100042.

7. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. Lancet 2020;395:507-13.
8. Lim WS, van der Eerden MM, Laing R, Boersma WG, Karalus N, Town GI, et al. Defining community acquired pneumonia severity on presentation to hospital: An international derivation and validation study. Thorax 2003;58:377-82.
9. Bauer TT, Ewig S, Marre R, Suttorp N, Welte T, CAPNETZ Study Group. CRB-65 predicts death from community-acquired pneumonia. J Intern Med 2006;260:93-101.
10. April MD, Aguirre J, Tannenbaum LI, Moore T, Pingree A, Thaxton RE, et al. Sepsis clinical criteria in emergency department patients admitted to an Intensive Care Unit: An external validation study of quick sequential organ failure assessment. J Emerg Med 2017;52:622-31.
11. Saberian P, Tavakoli N, Hasani-Sharamin P, Modabber M, Jamshididana M, Baratloo A. Accuracy of the pre-hospital triage tools (qSOFA, NEWS, and PRESEP) in predicting probable COVID-19 patients' outcomes transferred by Emergency Medical Services. Caspian J Intern Med 2020;11:536-43.
12. Guo W, Ran LY, Zhu JH, Ge QG, Du Z, Wang FL, et al. Identifying critically ill patients at risk of death from coronavirus disease. World J Emerg Med 2021;12:18-23.
13. WHO. Public Health Surveillance for COVID-19: Interim Guidance. WHO; 2020. Available from: https://www.who.int/publications/i/item/who-2019-nCoVsurveillanceguidance-2020.7. [Last accessed on 2020 Dec 16].
14. Ji Y, Ma Z, Peppelenbosch MP, Pan Q. Potential association between COVID-19 mortality and health-care resource availability. Lancet Glob Health 2020;8:e480.
15. Liu S, Yao N, Qiu Y, He C. Predictive performance of SOFA and qSOFA for in-hospital mortality in severe novel coronavirus disease. Am J Emerg Med 2020;38:2074-80.
16. Bhargava A, Sharma M, Akagi E, Szpunar SM, Saravolatz L. Predictors for in-hospital mortality from coronavirus disease 2019 (COVID-19) infection among adults aged 18-65 years. Infect Control Hosp Epidemiol 2021;42:772-5.
17. Lalueza A, Lora-Tamayo J, De la Calle C, Sayas-Catalán J, Arrieta E, Maestro G, et al. The early use of sepsis scores to predict respiratory failure and mortality in non-ICU patients with COVID-19. Rev Clin Esp 2020;222:293-8.
18. Wilfong EM, Lovly CM, Gillaspie EA, Huang LC, Shyr Y, Casey JD, et al. Severity of illness scores at presentation predict ICU admission and mortality in COVID-19. J Emerg Crit Care Med 2021;5:7.
19. Jang JG, Hur J, Hong KS, Lee W, Ahn JH. Prognostic accuracy of the SIRS, qSOFA, and NEWS for early detection of clinical deterioration in SARSCoV-2 infected patients. J Korean Med Sci 2020;35:e234.
20. Yang X, Yu Y, Xu J, Shu H, Xia J, Liu H, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: A single-centered, retrospective, observational study. Lancet Respir Med 2020;8:475-81.
21. Su WL, Wu CC, Wu SV, Lee MC, Liao MT, Lu KC, et al. A review of the potential effects of melatonin in compromised mitochondrial redox activities in elderly patients with COVID-19. Front Nutr 2022;9:865321.
22. Alencar J, Marina Gómez Gómez L, Cortez AL, Possolo de Souza H, Levin AS, Salomão MC. Performance of NEWS, qSOFA, and SIRS scores for assessing mortality, early bacterial infection, and admission to ICU in COVID-19 patients in the emergency department. Front Med (Lausanne) 2022;9:779516.