

Original Article

Comparison of SAPS III and SOFA score for the prediction of mortality among ICU patients.

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Abstract

Background: The present study was designed to assess the comparative performance of the Simplified Acute Physiology Score III (SAPS III) and sequential organ failure assessment (SOFA) score in predicting mortality among critically ill ICU patients.

Methodology: A cross-sectional study was conducted from January 2019 to December 2019, including 162 patients admitted to the medical intensive care unit (ICU) of PIMS, Islamabad. The SOFA and SAPS III scores were calculated for all patients on admission. Outcome parameters included death or discharge from the hospital and disability. The receiver operating characteristic (ROC) curve was constructed for the studied models, and the scores were correlated with mortality.

Results: The overall mortality rate in the studied population was 46.9%. The mean SAPS III and SOFA scores were 55.26 ± 18.46 and 14.41 ± 5.67 , respectively. The area under the ROC curve (aROC) for the SAPS III was 0.71 at a cut-off value of 43.5, whereas the aROC for SOFA was 0.64 at a cut-off score of 12.5. The ROC curve for predicting hospital mortality exhibited that both SAPS III and SOFA scores were sensitive predictors of mortality, given SAPS III had relatively better prediction (85%) compared to SOFA (76%).

Conclusion: It is concluded that SAPS III and SOFA scores are sensitive predictors of mortality; however, SAPs score is better at predicting mortality than SOFA score.

Keywords

Simplified Acute Physiology Score III (SAPS III) and sequential organ failure assessment (SOFA) score, ICU, Mortality



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Introduction

With the significant advances in healthcare prevention during the past half-century, the life expectancy has substantially increased along with improvements in diagnosis and treatment approaches¹. ICU care in public hospitals of Pakistan is scarce and very costly. The negative effect of older age and other associated factors, including diagnosis at admission, comorbidities and functional status, has been recognized in numerous studies²⁻⁷. Hence, these factors together are better at predicting ICU outcomes than the age alone^{8,9,10}. The instruments used are sophisticated, but still, the morbidity and mortality rates are very high. In this new era, many new models have been developed to predict mortality among critically ill patients. The models like simplified acute physiology score (SAP), sequential organ failure assessment (SOFA), and acute physiology and chronic health evaluation (APACHE II) score have been useful in presenting the probable outcomes of illness among these patients. These models not only predict mortality but also assures cost-effectiveness¹.

Most of the models were developed in the late 20^s but the APACHE II score remains the most useful to date; however, the recently published SAPS III admission score was designed to predict the critical newly admitted patients' mortality within 1 hour. The model was developed based on the investigation involving a large cohort group comprising 16,784 patients enrolled/admitted in 303 different ICUs of 30 different countries around the globe¹¹. The European Society of Intensive care medicine called upon a consensus meeting in France (1994) to modify the SOFA score. The revised version included six organ dysfunctions; they graded the scores from 0-4. It improved the understanding of the natural history of organ dysfunction and used to evaluate the effect of the latest interventions on the disease progression. It is also used to calculate the effect of management by calculating the score at the time of admission¹².

With the scientific and technological advancement, the healthcare sector has identified several predicting and treatment modalities and permit more elective surgeries than previous times. There is a scarcity of local literature demonstrating the predictability of these models in the Pakistani population admitted to the ICU. Therefore, we sought to evaluate the mortality prediction of the SAPS III and SOFA scoring systems for the patients admitted to the surgical ICU.

Methodology

This cross-sectional study was conducted at the ICU of Pakistan Institute of Medical Sciences, Islamabad-Pakistan from January 2019 to December 2019. All critically ill patients older than 18 years of age were enrolled in the study. The sample size (n=162) was calculated using the World Health Organization (WHO) sample size calculator; level of significance 95%, absolute precision 5%, percent population 10%¹³.

Patient data, including demographics, reason for admission in the medical ICU, diagnosis, duration of stay in the hospital, and outcome as measured by death, discharge, or disability, were collected using a standard performa. The outcomes (mortality) among the ICU patients were determined using the severity scores, i.e. SOFA and SAPS III. Prior to the data collection ethical approval was obtained from the hospital ethical review board. The data was analyzed using SPSS version 16.0. ROC curves were plotted to determine the area under the curve (AUC). A cut-off value was calculated, sensitivity and specificity of the scoring models were determined to predict in-hospital mortality. A p-value < 0.05 was considered statistically significant.

Results

A total of 162 patients admitted to MICU were studied; of them, 50.6% were females. The mean age of the patients was 35.6±1.82 years (Range 13-90 years). Most of the patients (27.2%) were shifted from the department of general medicine, followed

by the emergency and neurology department 21% and 16%, respectively. The mean hospital stay in the medical ICU was 12.72 ± 1.83 days. Of the total, 43(26.5%) were admitted due to low Glasgow Coma Scale (GCS), 75(46.3%) due to type 1 respiratory failure, 31(19.1%) due to type 2 respiratory failure, 17(10.5%) due to status epilepticus, 24(14.8%) due to shock, 5(3.1%) due to MODS and, 2 (1.2%) due to AKI. The functionality

and mobility status was also assessed; 83.3% of patients had a normal functional status prior to admission to MICU, 8% were bedridden, and 5.6% had limited mobility. Out of 162 patients, 46.9% died while 50.6% survived and were shifted to ward. Around 37.7% of survivors had normal functional status, and 14.2% were in bed-bound status, and 1.2% had limited mobility.

Table 1: Baseline characteristics of the study population.

Variables		n=162
Age		35.6±1.82
Gender	Male	80(49.4)
	Female	82(50.6)
Length of Hospital Stay		12.72±1.83
Admission Cause	Low GCS	43 (26.5)
	Type 1 Respiratory Failure	75(46.3)
	Type 2 Respiratory Failure	31(19.1)
	Status Epilepticus	17(10.5)
	Shock	24(14.8)
	Multiple Organ Dysfunction Syndrome (MODs)	5(3.1)
	Acute Kidney Injury	2(1.2)

*Values are given as mean±SD or n(%)

The mean SAPS III and SOFA scores in non-survivors were higher than survivors, with a statistically significant p-value ($p < 0.05$).

Table 2: Comparison of non-survivors versus survivors

Scoring Models	Non-survivors (n=76)	Survivors (n=86)	p-value
SAPS III	62.93±18.21	48.48±15.94	0.000
SOFA	15.94±4.82	13.06±6.03	0.001

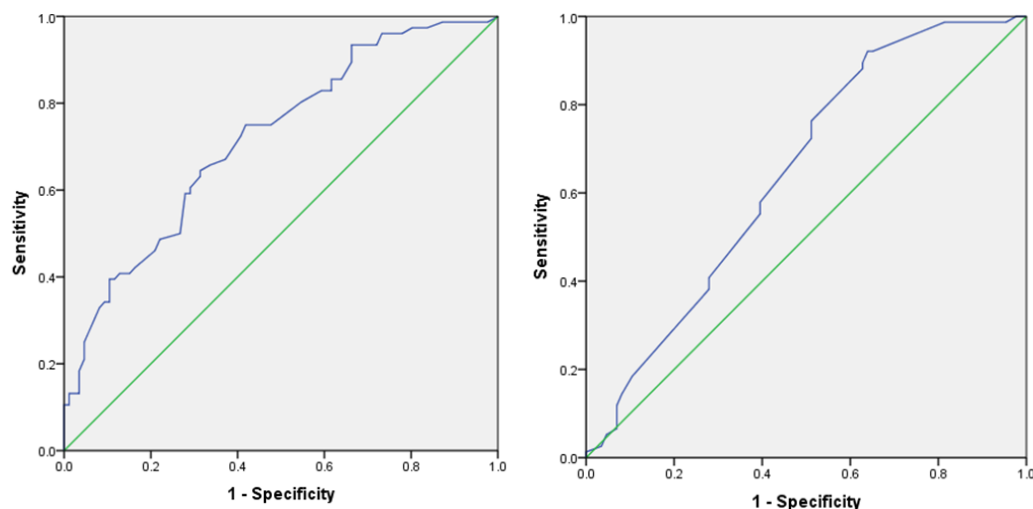


Figure 1 A & B: SAPS III and SOFA ROC curve for prediction of hospital mortality.

Using a cut-off score of 43.5, the SAPS III score predicted hospital mortality with a sensitivity of 85% and a specificity of 61%, with an aROC of 0.718 (95% CI: 0.640-0.796) ($p < 0.01$). While for SOFA, predicted hospital mortality using the cut-off score of 12.5, the sensitivity was 76%, and specificity was 51%, with an aROC of 0.645(0.561-0.729) ($p < 0.01$).

Table 3: Mean Score and Area under ROC curve.

Variable	Mean Scores	Area under ROC curve (95% CI)	PPV (%)	NPV (%)	Youden Index	p-value
SAPS III	55.26±18.46	0.718(0.640-0.796)	55	45	0.46	0.000
SOFA	14.41±5.67	0.645(0.561-0.729)	57	43	0.27	0.001

Discussion

The present study evaluated two of the common ICU mortality predictive scoring models' sensitivity and validity (SAPS III and SOFA). Both the models established favorable outcomes and were sensitive for mortality prediction. The intermodal comparison displayed that SAP III showed better performance. It is said that elderly patients around 90 years of age account for almost 50% of all ICU admissions⁵. Contrastingly, we observed higher ICU admission rates among young individuals as compared to that reported in other studies. The mean age of the enrolled patients admitted to MICU was 35.6 years^{14,15}. A study from the USA displayed that the majority population in the ICU were in between 90-95 years of age. While a local study supporting our findings showed that there were more young patients admitted to the

ICU¹. Hence, supporting the idea that longevity among the western population is more as compared to our society, and the rate of morbidity and mortality in our younger population is quite like that of the older ones¹⁶.

Of the total, 26.5% of patients in the present study were admitted due to low GCS followed by type 1, type 2 respiratory failure, status epilepticus, shock, multiple organ dysfunction syndromes (MODs) and Acute Kidney Injury (AKI). The mean length of hospital stay was 12.72 ± 1.83 days, while the mean ICU time-span was 9.06 ± 11.97 days which is consistent with published literature^{1,14,15}. The observed mortality rate was 46.9% which is comparatively higher than the earlier studies reporting a mortality rate of 35.4%, 8.2% and 5.3%^{1,15,17}. The mean SOFA score in the present study was significantly high among non-survivors

(15.94 ± 4.82) as compared to survivors (13.06 ± 6.03), and the same was for the SAPS III score (62.93 ± 18.21 vs. 48.48 ± 15.94) ($p < 0.05$). Parallel to our results, a local study using SOFA and SAPS II indicated higher scores among non-survivors¹.

Both the studied models showed good predicting command, assessed by the aROC. The SAPS III score showed better discriminative power than SOFA, as indicated by its greater aROC value (0.718). The prediction studies focusing on ICU mortality have reported better outcomes with the use of APACHE II score than SAPS or SOFA¹⁸⁻²¹. As we haven't studied the comparative predictability with the APACHE II score, it could be said that the SAPS III score worked better in predicting mortality than the SOFA score in the studied population. With the cut-off score of 43.5, the predicted hospital mortality by SAPS III score was 85%, while with SOFA score, it was 76%, keeping the cut-off score of 12.5. An Indian study reported that the SAPS III score of 57 established better sensitivity in predicting mortality (77%) with aROC of 0.5¹⁶. Moreover, a study established that a SOFA score of more than 15 suggests a 90% mortality rate²².

This study added to the validation of mortality predicting capability of SAPS III and SOFA score in ICU patients. This pilot study had certain limitations that must be considered, including the limited sample size and single data collection site.

Conclusion

Both the tested scoring models, i.e. SAPS III and SOFA, are good predictors of mortality among ICU patients. However, the SAPS III score has shown better predictability than SOFA. Large-scale prospective studies targeting the overall ICU population of Pakistan are required for further validation of these models.

Conflicts of Interest

The authors have declared that no competing interests exist.

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