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Comparison of Pediatric Sequential Organ Failure Assessment and Pediatric Risk of Mortality III Score as Prediction in Pediatric Intensive Care Unit

Kashmala Khan[1], Ibrahim Shakoor[1], Um e Aiman[1], Narmeen Kausar[1], Tooba Abdul Ghaffar[1], Yusra Azeem[2]

[1]Department of Paediatrics Unit 1, Abbasi Shaheed Hospital, Karachi, Sindh, Pakistan.
[2]GMC Registered Medical Practitioner, United Kingdom.

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Correspondence to: Kashmala Khan, Department of Paediatrics Unit 1, Abbasi Shaheed Hospital, Karachi, Sindh, Pakistan.
Email: kashmalakhan2277@gmail.com

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ABSTRACT

Objective: To compare the predictive accuracy of Pediatric Sequential Organ Failure Assessment (pSOFA) and Pediatric Risk of Mortality III (PRISM III) scores for mortality prediction in children admitted to the pediatric intensive care unit. **Study Design:** Prospective longitudinal study. **Place and Duration of Study:** Pediatric Intensive Care Unit, Abbasi Shaheed Hospital, Karachi, from June 2024 to January 2025. **Methodology:** A total of 207 critically ill children aged between 1 month and 12 years who remained in the PICU for at least 24 hours were enrolled using non-probability consecutive sampling. PRISM III and pSOFA scores were calculated within the first 24 hours of PICU admission. Patients were followed until discharge from the PICU, and 30-day mortality was recorded as the primary outcome. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated for both scoring systems. **Results:** The mean age of the patients was 4.9 ± 3.6 years and 118 (57.0%) were males. Overall mortality was observed in 43 (20.8%) patients. The mean PRISM III score was significantly higher in non-survivors compared with survivors (19.7 ± 6.3 vs. 11.2 ± 4.6). Similarly, the mean pSOFA score was higher among non-survivors compared with survivors (9.6 ± 3.1 vs. 5.1 ± 2.2). The pSOFA score demonstrated higher sensitivity (83.7%) and specificity (78.0%) compared with PRISM III (79.1% and 74.4%, respectively). The area under the receiver operating characteristic curve was 0.82 for pSOFA and 0.76 for PRISM III. **Conclusion:** Both PRISM III and pSOFA scores are useful tools for predicting mortality in critically ill children admitted to the PICU; however, pSOFA demonstrated better predictive performance. The pSOFA score may therefore serve as a practical and reliable scoring system for mortality prediction in pediatric intensive care settings.

INTRODUCTION

A paediatric intensive care unit is a specialised ward where children who are seriously or terminally ill and in need of haemodynamic monitoring and assisted ventilation receive particular care. The primary goal of this kind of environment is to reduce child mortality by offering round-the-clock care. With the development of new tools and treatments, paediatric critical care has advanced greatly, leading to the creation of more advanced paediatric intensive care units (PICUs) (1). The danger of PICU morbidity and death is significant in both wealthy and developing nations, despite the exponential rise in innovations (2, 3).

Scaling systems offer an objective way to quantify severity and prognosis, and standardising and documenting patient evaluations and prognostications is crucial. In order to estimate the severity of a patient's illness and estimate the probability of death at the time of PICU admission, a number of prognostic scores have been created. These can be highly helpful in treatment planning. Since a large portion of the variation in death rates between various ICUs is caused by characteristics unrelated to medical management, such as the primary diagnosis and severity at admission, these scales are also crucial for evaluating the quality of care (5,6). PRISM III and the paediatric SOFA score (pSOFA) are currently the most commonly utilised scores in PICUs (6,1).

To assess different scoring systems, one popular method is to utilise the PRISM III 24 score. Our ability to predict institutional performance is aided by the PRISM III 24 score (7,8). One of the greatest methods for setting up an intensive care unit is to use models such as the PRISM III 24 score. The 24-hour PRISM III 24 score is intended simply to evaluate the severity of disease and duration of stay, not to control PICU admissions (9,10).

Although the sequential organ failure assessment (SOFA) score has proven to be a reliable tool for predicting adult mortality, especially in cases of confirmed or suspected sepsis, its lack of age normalisation creates a gap in the field of paediatric care. In fact, children in critical condition frequently show notable physiological equilibrium departures from the norm. These physiological parameter deviations from the normal range are critical for determining the magnitude of these aberrations and form the basis for developing pediatric-specific grading systems. The paediatric SOFA (pSOFA) score was developed as a version of the original SOFA score to address this need. It has age-appropriate thresholds for different body systems. It is a potentially useful instrument in the paediatric critical care arsenal that could improve our capacity to predict mortality from sepsis in the PICU (11).

The fact that mortality prediction models depend on the population is one of their shortcomings. Numerous research are carried out worldwide to assess the predictive power of the pSOFA score and the PIRSM-III in predicting death. On the other hand, not much information is available regarding the use of PRISM III and pSOFA in Pakistan's tertiary hospitals. Thus, we planned the current study to collect the evidence of accuracy of these tools in our local settings and population.

OBJECTIVE

The primary objective is to determine predictive ability of pediatric sequential organ failure assessment for 30 day mortality among patients admitting to pediatric intensive care unit

The secondary study objective is to compare predictive ability of pediatric sequential organ failure assessment and pediatric risk of mortality iii score for predicting 30 day mortality among patients admitting to pediatric intensive care unit.

MATERIAL AND METHODS

Study design: Prospective longitudinal study

Study setting: Pediatric intensive care unit, Abbasi Shahhed Hospital, Karachi from June 2024 to January 2025.

Sampling technique: Non-probability consecutive

Sample size: Previous study showed that area under the curve for PRISM-III and pSOFA score was 0.75 and 0.81 respectively (12). Using 95% confidence interval and 5% margin of error, a required a sample size was 207 and 178 for PRISM-III and pSOFA respectively. Thus, a higher sample size of 207 will be enrolled into the study. Sample size was estimated using the formula provided by Hajian-Tilaki K (13).

$$n = \frac{z^2 \alpha V(AUC)}{e^2}$$

Z=1.96, for a confidence interval (α) for 95%

$V(AUC) = \left(0.0099 * e^{\frac{-a^2}{2}}\right) * (6a^2+16)$, a= ϕ^{-1}(AUC) * 1.414, ϕ^{-1} is the inverse of standard cumulative normal distribution

Calculation for AUC = 0.75

a = $\phi^{-1}(0.75)$ = 0.953

V(AUC) = (0.0099*e-(0.953^2/2)*(6*0.953^2+16)

V(AUC) = (0.006)*(21.45) = 0.1348

n = 1.96^2*0.1348 / 0.05^2 = 207.1 ≈ 207

Calculation for AUC = 0.81

a = $\phi^{-1}(0.81)$ = 1.241

V(AUC) = (0.0099*e-(1.241^2/2)*(6*1.241^2+16)

V(AUC) = (0.0045)*(25.2456) = 0.11566

n = 1.96^2*0.11566 / 0.05^2 = 177.7 ≈ 178

Inclusion Criteria

Patients of either gender aged between 1 month and 12 years admitted to the PICU were eligible for inclusion. Patients with a PICU stay of at least 24 hours and those whose guardians consented to participate in the study were included.

Exclusion Criteria

Patients with underlying congenital deformities, those who experienced cardiopulmonary resuscitation prior to PICU admission, patients with HIV infection, malignancies or hematological disorders, and patients who left the hospital against medical advice were excluded from the study.

Data Collection Procedure

The study was initiated after obtaining approval from the Institutional Review Board. The purpose and benefits of the study were explained to the parents or guardians, and informed consent was obtained before enrollment. Confidentiality of patient information was maintained by assigning serial numbers to the patients' medical record numbers to conceal their identity. Data were collected using a structured pre-designed proforma.

Upon admission to the PICU, each patient underwent a detailed clinical assessment including medical history and physical examination. Laboratory investigations included complete blood count, blood gases, C-reactive protein levels, blood glucose, electrolytes, coagulation profile, and liver and kidney function tests. Cultures of body fluids such as blood, urine, cerebrospinal fluid, or pleural fluid were performed when indicated by the treating physician. Additional diagnostic tests and imaging studies were conducted according to the patient's clinical condition. All investigations were performed as part of routine clinical management according to hospital protocol and no additional financial support was required for the study. Patients were followed until discharge from the PICU. The PRISM III score was calculated within the first 24 hours of PICU admission, and the pSOFA score was also calculated during the same period. The primary outcome measure of the study was 30-day mortality. For patients discharged from the hospital before 30 days, their mortality status at 30 days was confirmed through follow-up telephone contact with their caregivers.

Data Analysis

Data were entered and analyzed using SPSS version 27. Categorical variables were summarized as frequencies and percentages, while continuous variables were expressed as mean ± standard deviation or median with interquartile range where appropriate. Normality of numerical data was assessed using the Shapiro–Wilk test. Diagnostic performance of PRISM III and pSOFA scores was evaluated by constructing two-by-two contingency tables to

calculate sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy using 30-day mortality as the reference outcome. Discriminative ability of the scores was assessed using the area under the receiver operating characteristic curve (AUROC). An AUROC value between 0.70 and 0.79 was considered acceptable discrimination, while a value of 0.80 or greater was considered good discrimination. A p-value less than or equal to 0.05 was considered statistically significant.

RESULTS

Table 1

Demographic and Clinical Characteristics of Patients (n = 207)

Variable	Category	n (%) / Mean ± SD
Age (years)	—	4.9 ± 3.6
Age Group	1–12 months	56 (27.1)
	1–5 years	78 (37.7)
	6–12 years	73 (35.3)
Gender	Male	118 (57.0)
	Female	89 (43.0)
PICU Length of Stay (days)	—	6.8 ± 3.4
Primary Diagnosis	Sepsis	69 (33.3)
	Respiratory illness	54 (26.1)
	Neurological disorders	46 (22.2)
	Other conditions	38 (18.4)
Outcome	Survived	164 (79.2)
	Died	43 (20.8)

Table 1 shows the demographic and clinical characteristics of the 207 children admitted to the pediatric intensive care unit. The mean age of the patients was 4.9 ± 3.6 years. The largest proportion of patients were aged between 1–5 years (37.7%), followed by children aged 6–12 years (35.3%) and infants aged 1–12 months (27.1%). Male patients accounted for 118 (57.0%) of the study population while females constituted 89 (43.0%). The mean PICU length of stay was 6.8 ± 3.4 days. The most common primary diagnosis was sepsis, observed in 69 (33.3%) patients, followed by respiratory illnesses in 54 (26.1%), neurological disorders in 46 (22.2%), and other medical conditions in 38 (18.4%). Overall, 164 (79.2%) patients survived while 43 (20.8%) patients died within the study period.

Table 2

Comparison of PRISM III and pSOFA Scores According to Patient Outcome

Variable	Survivors (n = 164) Mean ± SD	Non-survivors (n = 43) Mean ± SD	p-value
PRISM III Score	11.2 ± 4.6	19.7 ± 6.3	<0.001
pSOFA Score	5.1 ± 2.2	9.6 ± 3.1	<0.001

Table 2 compares PRISM III and pSOFA scores between survivors and non-survivors. The mean PRISM III score among survivors was 11.2 ± 4.6, whereas non-survivors had a significantly higher mean score of 19.7 ± 6.3. Similarly, the mean pSOFA score among survivors was 5.1 ± 2.2 compared with 9.6 ± 3.1 in non-survivors. Both scoring systems showed significantly higher values in patients who died, indicating a strong association between higher scores and mortality risk.

Table 3

Diagnostic Performance of PRISM III and pSOFA Scores for Predicting 30-Day Mortality

Scoring System	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
PRISM III	79.1	74.4	46.5	92.3	75.4
pSOFA	83.7	78.0	51.5	94.1	80.2

Table 3 presents the diagnostic performance of PRISM III and pSOFA scores for predicting 30-day mortality in PICU patients. The pSOFA score demonstrated higher sensitivity (83.7%) and specificity (78.0%) compared with PRISM III, which showed sensitivity of 79.1% and specificity of 74.4%. The negative predictive value was also slightly higher for pSOFA (94.1%) compared with PRISM III (92.3%). Overall predictive accuracy was greater for pSOFA (80.2%) than for PRISM III (75.4%).

Table 4

Area Under the Receiver Operating Characteristic Curve for Mortality Prediction

Scoring System	AUROC (95% CI)	Interpretation
PRISM III	0.76 (0.69–0.83)	Acceptable discrimination
pSOFA	0.82 (0.75–0.88)	Good discrimination

Table 4 shows the discriminative ability of the scoring systems based on the area under the receiver operating characteristic curve. The AUROC for PRISM III was 0.76 (95% CI: 0.69–0.83), indicating acceptable discrimination for predicting mortality. In comparison, the pSOFA score showed a higher AUROC of 0.82 (95% CI: 0.75–0.88), suggesting good predictive performance. These findings indicate that the pSOFA score demonstrated slightly better predictive accuracy for mortality compared with PRISM III in the pediatric intensive care unit population.

DISCUSSION

Accurate prediction of mortality in critically ill children is essential for guiding clinical decision-making, improving patient management, and optimizing resource utilization in pediatric intensive care units. Various scoring systems have been developed to assess disease severity and predict outcomes in critically ill pediatric patients. Among these, the Pediatric Risk of Mortality III (PRISM III) score has been widely used for several decades, while the pediatric Sequential Organ Failure Assessment (pSOFA) score has emerged more recently as a promising tool for evaluating organ dysfunction and predicting mortality. The present study compared the predictive performance of PRISM III and pSOFA scores in children admitted to the PICU and evaluated their association with patient outcomes.

In this study, a total of 207 critically ill children were included, with a mean age of 4.9 ± 3.6 years. The majority of patients were between 1 and 5 years of age, and males constituted a slightly higher proportion of the study population. The most common underlying diagnosis among PICU admissions was sepsis, followed by respiratory illnesses and neurological disorders. These findings are consistent with previous studies that have reported sepsis and respiratory diseases as leading causes of PICU admissions and mortality in pediatric populations.

The results of the present study demonstrated that both PRISM III and pSOFA scores were significantly higher

among non-survivors compared with survivors. The mean PRISM III score in non-survivors was 19.7 ± 6.3 compared with 11.2 ± 4.6 in survivors, while the mean pSOFA score was 9.6 ± 3.1 among non-survivors and 5.1 ± 2.2 among survivors. These findings indicate that higher severity scores are strongly associated with increased mortality risk in critically ill children. Similar observations have been reported in previous research where both PRISM III and pSOFA scores were shown to correlate with disease severity and mortality in pediatric intensive care settings.

The diagnostic performance analysis revealed that the pSOFA score demonstrated slightly better predictive accuracy than PRISM III in this study. The pSOFA score showed a sensitivity of 83.7% and specificity of 78.0% for predicting mortality, whereas PRISM III showed sensitivity and specificity of 79.1% and 74.4%, respectively. The higher sensitivity of pSOFA suggests that it may be more effective in identifying critically ill children at higher risk of mortality. Furthermore, the negative predictive value of pSOFA (94.1%) was also slightly higher than that of PRISM III (92.3%), indicating that patients with lower pSOFA scores were more likely to survive.

The receiver operating characteristic curve analysis further supported these findings. The area under the curve for PRISM III was 0.76, indicating acceptable discrimination, whereas the pSOFA score demonstrated a higher AUROC of 0.82, which reflects good discrimination for predicting mortality. These results suggest that the pSOFA score may provide better prognostic accuracy in critically ill pediatric patients compared with PRISM III. Similar findings have been reported in previous studies where pSOFA showed strong predictive ability for mortality, particularly in patients with sepsis and multiorgan dysfunction.

One possible explanation for the improved predictive performance of the pSOFA score is that it directly evaluates the degree of organ dysfunction across multiple systems including respiratory, cardiovascular, neurological, renal, hepatic, and hematological functions. Since organ failure is a major determinant of mortality in critically ill patients, the pSOFA score may more accurately reflect the severity of illness and ongoing physiological deterioration. In contrast, PRISM III relies on physiological and laboratory parameters measured during the first 24 hours of PICU admission and may not fully capture dynamic changes in organ dysfunction over time.

Another advantage of the pSOFA scoring system is its relative simplicity and ease of calculation compared with PRISM III. The PRISM III score requires numerous laboratory measurements and physiological variables, which may limit its practical use in busy clinical settings or in hospitals with limited resources. In contrast, the pSOFA score relies on fewer variables and can be calculated more easily at the bedside, allowing clinicians to monitor disease progression and organ dysfunction more efficiently.

Despite these advantages, PRISM III remains a valuable tool for early risk stratification in critically ill children. Its long history of validation and widespread use make it a reliable scoring system for assessing disease severity at PICU admission. Therefore, both scoring systems have important roles in pediatric critical care practice. PRISM III may be particularly useful for initial severity assessment, while pSOFA may be more effective for ongoing monitoring of organ dysfunction and predicting patient outcomes during PICU stay.

Overall, the findings of this study suggest that both PRISM III and pSOFA scores are useful predictors of mortality in critically ill pediatric patients, but the pSOFA score demonstrated slightly superior predictive performance. These results support the increasing use of pSOFA as a practical and reliable tool for mortality prediction in the PICU. Further multicenter studies with larger patient populations are recommended to validate these findings and to determine whether combining these scoring systems could further improve mortality prediction in pediatric intensive care settings.

CONCLUSION

It is concluded that both Pediatric Risk of Mortality III (PRISM III) and Pediatric Sequential Organ Failure Assessment (pSOFA) scores are useful tools for predicting mortality in children admitted to the pediatric intensive care unit. However, the pSOFA score demonstrated slightly better predictive performance with higher sensitivity, specificity, and area under the receiver operating characteristic curve compared with PRISM III. These findings suggest that pSOFA may serve as a more practical and reliable scoring system for early identification of critically ill children at higher risk of mortality in the PICU. Further large-scale multicenter studies are recommended to confirm these findings and to optimize the use of mortality prediction scores in pediatric critical care.

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