Section: Pediatrics

Original Research Article

PSOFA SCORE: AS AN OUTCOME PREDICTOR OF CHILDREN ADMITTED IN PAEDIATRIC INTENSIVE CARE UNIT AT A TERTIARY CARE HOSPITAL IN KERALA

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ABSTRACT

Background: Early and objective assessment of disease severity and organ dysfunction is essential for prognostication and timely intervention in intensive care units. While several pediatric mortality prediction scores exist, many are admission-based and do not reflect the dynamic progression of organ dysfunction. The Pediatric Sequential Organ Failure Assessment (pSOFA) score is an age-adapted modification of the adult SOFA score and allows serial evaluation of organ dysfunction. This study was undertaken to assess the usefulness of the pSOFA score as an outcome predictor in children admitted to the PICU of a tertiary care hospital.
Objectives: Primary Objectives**:** To evaluate the effectiveness of pediatric SOFA score in predicting the clinical outcome of critically ill children. **Secondary objective:** 1. To compare initial SOFA score and SOFA score at 48 hours in predicting the outcome 2. To compare delta SOFA score with the outcome.
Materials and Methods: The pSOFA scoring system was applied at two time points: upon admission and after 48 hours, utilizing both clinical assessments and laboratory investigations. The change in pSOFA scores (delta pSOFA) was determined by calculating the difference between these two measurements. Patient outcomes were categorized as either survival to discharge or mortality. The discriminative capacity of the scoring system was evaluated through the construction of Receiver Operating Characteristic curves. Statistical associations were examined using Chi-square test, Fisher's exact test, and Mann–Whitney U test, with statistical significance defined as $p < 0.05$.
Results: The study enrolled 150 pediatric patients, recording an overall mortality rate of 17% in the PICU setting. Non-survivors exhibited significantly elevated mean pSOFA scores upon admission when compared to survivors, with this disparity becoming more substantial at the 48-hour assessment point. A significant positive correlation was observed between the mean change in pSOFA scores and mortality outcomes. The pSOFA score at 48 hours displayed excellent predictive discriminative capacity for mortality risk, achieving an area under the ROC curve value of 0.99 with a cut off >8. Among the SOFA score components, Serum creatinine is considered the best predictor.
Conclusion: The pediatric SOFA score is a reliable and effective tool for predicting outcomes in critically ill children admitted to the PICU. Higher pSOFA scores at admission and a high delta pSOFA are strongly associated with mortality. Serial assessment using pSOFA provides valuable prognostic information and may aid clinicians in early risk stratification, monitoring disease progression, and optimizing management strategies in pediatric intensive care settings.
Keywords: pSOFA score, Organ dysfunction, Mortality prediction.

INTRODUCTION

Mortality among critically ill children admitted to the Pediatric Intensive Care Unit (PICU) remains a major challenge despite significant advances in pediatric critical care. Early identification of children at high risk of adverse outcomes is essential for timely intervention, optimal resource allocation, and improved clinical decision-making. Various severity-of-illness scoring systems have been developed to objectively assess disease severity and predict outcomes in critically ill children.

Sepsis and organ dysfunction are among the leading causes of morbidity and mortality in PICUs worldwide. In recent years, organ dysfunction–based scoring systems like pSOFA have become increasingly relevant compared to traditional inflammation-based criteria, especially in evaluating pediatric sepsis and critical illness.[1]

In 2016, the Sepsis-3 task force introduced the Sequential Organ Failure Assessment (SOFA) score for adults as a tool to identify and quantify organ dysfunction associated with sepsis. Subsequently, the Pediatric Sequential Organ Failure Assessment (pSOFA) score was developed by adapting the SOFA score to pediatric age-specific physiological and laboratory parameters. The pSOFA score evaluates dysfunction across multiple organ systems, including respiratory, cardiovascular, neurological, hepatic, coagulation, and renal systems, thereby providing a comprehensive assessment of illness severity. Organ dysfunction was operationalized as an acute elevation in the Sequential Organ Failure Assessment (SOFA) score by ≥2 points from baseline values.[2,3]

Multiple studies from various regions have shown a robust correlation between elevated pSOFA scores, deteriorating delta pSOFA, and unfavorable outcomes, including heightened mortality, extended mechanical ventilation, and prolonged PICU duration. Compared with traditional pediatric scoring systems, pSOFA offers the advantage of dynamic assessment of organ dysfunction and can be readily applied in routine clinical practice.[4]

Table 1: Paediatric Sequential Organ Failure Assessment Score

Variable	Score 0	Score 1	Score 2	Score 3	Score 4
Respiratory PaO_2 /FiO_2	≥400	300–399	200–299	100–199 with support	<100 with support
Respiratory SpO_2 /FiO_2	≥292	264–291	221–264	148–220 with support	<148 with support
Platelet count (×10³/μL)	≥150	100–149	50–99	20–49	<20
Bilirubin (mg/dL)	<1.2	1.2–1.9	2.0–5.9	6.0–11.9	>12.0
MAP <1 month (mmHg)	≥46	<46	Dopamine ≤5	Dopamine >5 or Epi/Norepi ≤0.1	Dopamine >15 or Epi/Norepi >0.1
MAP 1–11 mo	≥55	<55	Dopamine ≤5	Dopamine >5 or Epi/Norepi ≤0.1	Dopamine >15 or Epi/Norepi >0.1
MAP 12–23 mo	≥60	<60	Dopamine ≤5	Dopamine >5 or Epi/Norepi ≤0.1	Dopamine >15 or Epi/Norepi >0.1
MAP 24–59 mo	≥62	<62	Dopamine ≤5	Dopamine >5 or Epi/Norepi ≤0.1	Dopamine >15 or Epi/Norepi >0.1
MAP 60–143 mo	≥65	<65	Dopamine ≤5	Dopamine >5 or Epi/Norepi ≤0.1	Dopamine >15 or Epi/Norepi >0.1
MAP 144–216 mo	≥67	<67	Dopamine ≤5	Dopamine >5 or Epi/Norepi ≤0.1	Dopamine >15 or Epi/Norepi >0.1
MAP >216 mo	≥70	<70	Dopamine ≤5	Dopamine >5 or Epi/Norepi ≤0.1	Dopamine >15 or Epi/Norepi >0.1
GCS	15	13–14	10–12	6–9	<6
Creatinine <1 mo	<0.8	0.8–0.9	1.0–1.1	1.2–1.5	≥1.6
Creatinine 1–11 mo	<0.3	0.3–0.4	0.5–0.7	0.8–1.1	≥1.2
Creatinine 12–23 mo	<0.4	0.4–0.5	0.6–1.0	1.1–1.4	≥1.5
Creatinine 24–59 mo	<0.6	0.6–0.8	0.9–1.5	1.6–2.2	≥2.3
Creatinine 60–143 mo	<0.7	0.7–1.0	1.1–1.7	1.8–2.5	≥2.6
Creatinine 144–216 mo	<1.0	1.0–1.6	1.7–2.8	2.9–4.1	≥4.2
Creatinine >216 mo	<1.2	1.2–1.9	2.0–3.4	3.5–4.9	≥5.0

Nevertheless, regional differences in disease profiles, nutritional status, referral patterns, and healthcare resources warrant local validation of these scoring systems. Limited data are available regarding its utility in Indian PICUs, where disease patterns, patient characteristics, and resource availability may differ from those reported in high-income countries. Therefore, this study was undertaken to evaluate the effectiveness of the Pediatric Sequential Organ Failure Assessment (pSOFA) score in predicting mortality among children admitted to the PICU and to determine its usefulness as a prognostic tool in critically ill pediatric patients.

MATERIALS AND METHODS

This prospective observational study was conducted over a 15 month period from April 2025 to September 2025, in a tertiary care center. All children admitted in PICU between 1 month to 12 years of age were included. Children who were admitted for scheduled procedures (like hemodialysis, IVIG administration) and children who were transferred to other hospital within 24 hours were excluded from the study.

Sample size was calculated by the formula, n=[z]^2xsensitivityx[1-sensitivity]/d^2 from a study conducted by Amoolya Lois, Sushma Save on serial evaluation of SOFA score as a predictor of outcome in children admitted in PICU at tertiary care hospital, sensitivity of initial SOFA score at a cut off of 7.5 was 64.7%.5

Expecting similar results with a margin of error 8% and 95% confidence interval, the minimum sample size required is

N=[1.96]^2x0.647x0.353/[0.08]^2=137

All pediatric patients aged between 1 month and 12 years who were admitted to the PICU throughout the study duration were recruited till sample size was achieved. Pediatric SOFA scoring incorporates both clinical and laboratory parameters which were gathered during admission, with a subsequent calculation conducted at 48 hours. The variation between the SOFA scores at these two time points was documented as the Delta SOFA score. The SOFA score was computed by feeding the data acquired at admission and 48 hours post-admission into online software accessible at clincalc.com/icumortality/SOFA.aspx, which did not necessitate authorization from the software creator. All study participants were monitored until discharge from the PICU or death during PICU hospitalization. Subsequently, the p-SOFA score of each child was analyzed in relation to the outcome.

The data was analysed utilizing the IBM Statistical Package for the Social Sciences (SPSS) software version 22. The Shapiro-Wilk test was applied to evaluate data normality. Continuous variables were expressed as frequency, mean, and standard deviation, whereas categorical variables were presented as numerical values and percentages. The relationship between various organ systems and patient outcomes (mortality or discharge) was examined using the Chi-square test. The sensitivity, specificity, and predictive value of the pSOFA score were determined based on actual patient outcomes. The receiver operating characteristic (ROC) curve was employed to establish the threshold value, sensitivity, and specificity of clinical measurements. The Mann- Whitney U test was utilized to examine differences in clinical measurements between deceased and discharged patient groups.

RESULTS

The study population consists of children aged between 1 month to 12 years of age. Among the total participants, 56 (37.3%) belonged to 1-5 years age group, 35 children (23.3%) were between the age 1-12 months, 59 children (39.6%) were above 5 years of age. Majority of the participants (n= 93,62%) were males. Among the 150 children, 81 (54%) had normal nutritional status, 8 (5.3%) were underweight, 10 (6.7%) had thinness and 5 children (3.3%) belonged to Failure to Thrive category. Severe Acute Malnutrition was present in 14 children (9.3%) and Moderate Acute malnutrition in 5 children. The majority of the patients (n=90, 60%) were children without any comorbidities. Most frequently observed comorbidity were prematurity (n=13, 8.7%) and Cerebral palsy/Global Developmental Delay (n=13, 8.7%).

Table 2: Baseline characteristics of study population

Parameters	Number	Percentage
Age		
Age <1 year	35	37.3%
1-5 years	56	23.3%
>5 years	59	39.6%
Sex		
Male	93	62%
Female	57	38%
Nutritional status		
Normal	81	54%
SAM	14	9.3%
MAM	5	3.3%
Co morbidities		
Prematurity	13	8.7%
Cerebral palsy	13	8.7%
Indication for admission		

Respiratory distress	37	24%
Seizures	32	21.3%
Sepsis/Shock	17	11.3%
Interventions		
Invasive ventilation	38	25.3%
Inotrope support	39	26%
Renal replacement therapy	3	2%
Outcome		
Survived	124	83%
Expired	26	17%

The most common reason for admission among the study population was respiratory distress (n=37, 24.7%) followed by seizures (n=32, 21.3%) and shock (n=17). The most common diagnosis was pneumonia and other respiratory illness followed by status epilepticus and sepsis.

Among the total participants, 59 (39.3%) were admitted in PICU for 1-2 days, 45 children (30%) for 3-5 days, 21 children (14%) for 6-10 days and 22 children (14.7%) for 11-20 days. 3 children (2%) were admitted for more than 20 days. The median duration of PICU stay was 3-5 days.

103 children (69%) needed respiratory support, out of which 38 children (25.3%) required invasive ventilation. In the study population, 39 (26%) children required inotropes. Among the total 150 children, 124 (83%) had good outcome as they had improvement in their health condition but 26 children (17%) expired.

The mean pSOFA score at admission in expired group is 8.19 and that of improved group is 4.14. Similarly, the mean pSOFA score after 48 hours in expired group is 13 and that of improved group is 3.37. The mean delta pSOFA score in expired and improved group is 4.81 and-0.77 respectively.

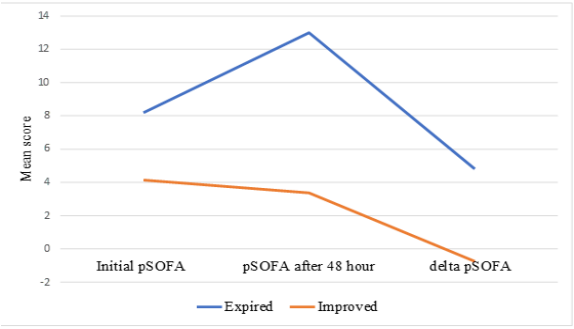


Figure 1: Comparison of the mean pSOFA score in survivors and non survivors

The effectiveness of pSOFA score in predicting the clinical outcome of critically ill children was assessed by plotting ROC curve. The pSOFA score at admission, at 48 hours and delta pSOFA was used to plot Receiver Operating Characteristic (ROC) curve with Outcome and sensitivity taken as y axis and 1-specificity as x axis. The AUC values, sensitivity and specificity percentage and cut offs of pSOFA score at admission, at 48 hours and delta score are given in the table below. [Figure 2, Table 3]

Table 3: Diagnostic accuracy of pSOFA score in predicting mortality

pSOFA score	Cut offs	AUC	Sensitivity	Specificity	p value
pSOFA score at admission	5	0.90	100%	67%	0.001
pSOFA score after 48 hours	8	0.99	100%	97%	0.001
Delta pSOFA score	2	0.96	92%	93%	0.001

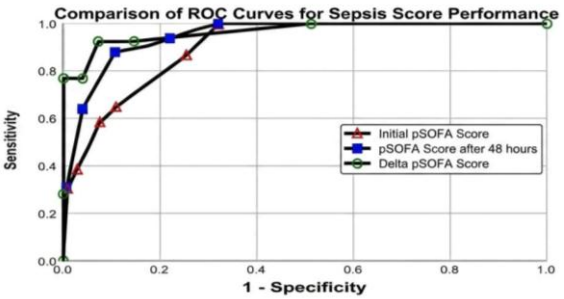


Figure 2: Comparison of the effectiveness of pSOFA score variants (Initial, 48 hours and delta) in predicting clinical outcome

The pSOFA score at admission, after 48 hour and delta pSOFA score was compared with the outcomes. Since all the scores had non normal distribution (tested using Shapiro wilk test) Mann Whitney U test was used. The results are as shown in the table below. [Table 4]

Table 4: Comparison of mean pSOFA score with outcome

pSOFA	Outcome	Mean Rank	Test statistic value	p value
pSOFA at admission	Expired	136.77	311	**0.001**
	Improved	62.65		
pSOFA after 48 hour	Expired	125.54	19	**0.001**
	Improved	65.01		
Delta pSOFA	Expired	133.31	109	**0.001**
	Improved	63.38		

Higher rank indicates higher pSOFA scores. Expired patients had much higher pSOFA score at admission, after 48 hours and also delta pSOFA score. A statistically significant difference in all the three pSOFA scoring between expired and improved patients. Among these parameters, pSOFA score at 48 hours appeared as the strongest outcome predictor, followed by delta pSOFA score.

A Multivariate Logistic regression was applied to find the best predictor of mortality among the SOFA score components. The outcome was taken as dependent variable and each SOFA component at admission taken as Independent variable. After running the test except for Bilirubin all was found to be significant with a p value of <0.05. Based on Exp (B) value, (values<1) the component with lowest value is the strongest independent predictor of outcome. Hence Serum creatinine is considered the best predictor. [Table 5]

Table 5: Predictive value of different components of pSOFA

SOFA component	B	Sig.	Exp(B)	95% CI. for EXP(B)	
				Lower	Upper
GCS at admission	-.859	.002	.424	.244	.736
MAP	-.567	.012	.567	.364	.884
pa02/fio2	-.761	.028	.467	.237	.921
Platelet count	-.894	.002	.409	.234	.714
Total bilirubin	.059	.934	1.061	.258	4.358
Serum creatinine	-1.164	.000	.312	.175	.558

DISCUSSION

The study was conducted to assess the utility of the Pediatric Sequential Organ Failure Assessment (pSOFA) score as a prognostic tool in children admitted in a Pediatric Intensive Care Unit (PICU).

In this study, most children were from the age group 1-5 years (37.3%), followed by those in the 6–10 year category (28%), infants (23.3%), and children older than 10 years (11.3%). Comparable age distributions have been documented in Indian PICU studies conducted by Sankar et al. and Khilnani et al., demonstrating the susceptibility of younger children to critical illness requiring PICU admission.[6,7]

Pneumonia emerged as the predominant provisional diagnosis (24.7%) and respiratory distress the leading reason for PICU admission (38.7%) in this study. This observation aligns with findings reported by Amoolya Lois et al,[5] where respiratory disorders and respiratory failure represented the primary causes of PICU admission and mortality.

Pediatric patients presenting with cardiovascular involvement exhibited a considerably elevated mortality rate (50%) in comparison to those without cardiovascular dysfunction. This observation is consistent with earlier investigations establishing that cardiovascular failure represents a critical determinant of mortality in pediatric sepsis and critical illness.[8,9]

The mean pSOFA score upon admission was notably elevated among children who expired (8.19) in comparison to those who survived (4.14). This observation aligns with the study conducted by Amoolya Lois and Save, which revealed substantially higher admission SOFA scores in non-survivors.[5] Comparable findings have been documented by El-Mashad et al. and other previous studies validating the utility of admission pSOFA for early risk categorization.[8,9,10]

The ROC analysis conducted in this study indicated that the admission pSOFA score possessed excellent predictive capacity for mortality, achieving an AUC of 0.90. A threshold value of ≥5 exhibited 100% sensitivity and 67% specificity. These results are in agreement with earlier studies where admission pSOFA threshold values between 5 and 8 were linked with elevated mortality.[5,11,12]

pSOFA score at 48 hours showed better prognostic accuracy than admission pSOFA, with an AUC of 0.99, sensitivity of 100%, & specificity of 97%. Children with pSOFA scores ≥8 at 48 hours had significantly higher mortality. This finding supports the idea that persistent or worsening organ dysfunction over time is a stronger outcome predictor than initial severity alone.

Similar results have been reported by Lalitha et al. and others who demonstrated that pSOFA scores at 48–72 hours had greater discriminative power for mortality compared to admission scores.[8,11,13]

Delta pSOFA score also showed excellent predictive ability with an AUC of 0.96. A delta pSOFA cut-off value of ≥2 was strongly linked with mortality, showing high sensitivity & specificity. Expired children had a mean delta pSOFA score of 4.81, while survivors showed a negative delta pSOFA, indicating improvement in organ dysfunction.

This observation aligns with previous studies that have emphasized the importance of delta SOFA in predicting outcomes, highlighting that worsening organ dysfunction over the first 48 hours is a critical mortality determinant.[5,7,11,14,15]

When comparing admission pSOFA, pSOFA at 48 hours, & delta pSOFA, the pSOFA score at 48 hours emerged as the best mortality predictor, followed by delta pSOFA & admission pSOFA. This emphasizes the importance of serial assessment rather than dependence on a single time-point score. Similar conclusions have been drawn in multiple studies evaluating pSOFA in pediatric critical illness.[5,8,9]

Limitation: This study was a single-center study carried out in a tertiary care PICU, a larger multicentric study could yield more reliable estimates & enable subgroup analyses based on specific diagnoses & age categories. This study did not incorporate direct comparison with other severity scoring systems like PRISM III, PIM, or PELOD-2. While earlier studies have shown that pSOFA performs equally well or superior to these scores, a head-to-head comparison within the same population would have reinforced the conclusions.[8,9]

CONCLUSION

This study demonstrates that pSOFA score is a robust & reliable tool for predicting outcomes in critically ill children. Serial assessment, particularly pSOFA at 48 hours & delta pSOFA, provides superior prognostic information compared to admission pSOFA alone. Given its simplicity, reliance on routinely available clinical parameters, & strong association with mortality, pSOFA can be effectively used as a dynamic outcome prediction tool in tertiary care PICUs in similar setting.

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