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Paediatric Risk of Mortality III Score (Modified PRISM) – To Predict Mortality and Hospital Stay in Paediatric Intensive Care Unit

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ABSTRACT

Objective: To determine mortality and length of stay (LOS) using PRISM III score in critically ill children.

Methodology: This study included a total of 129 patients who met the inclusion criteria. The study was carried out in the Pediatric Intensive Care Unit (PICU) of the UCHS & Children Hospital Lahore, spanning from December 2023 to May 2024.

Results: The mean age of patients was 7.55 ± 4.20 years, with a mean hospital stay of 5.18 ± 1.30 days. Male patients had a mean age of 8.18 ± 4.38 years, while females had 6.79 ± 3.88 years. PRISM score analysis showed a significant trend in discharge and mortality rates. In the 0-4 PRISM range, 84.7% were discharged, while 15.3% died. For scores of 5-9, 83.0% were discharged, and 17.0% died. In the 10-14 range, 57.1% survived, while 42.9% died. Among scores of 15-19, 40.0% were discharged, and 60.0% died. In the ≥20 range, 16.7% survived, while 83.3% died. Linear regression showed a significant association between PRISM score and length of stay (LOS), with a baseline LOS of 4.716 days. Each 1-unit PRISM increase extended LOS by approximately 5 hours (B = 0.069 days).

Conclusion: It was concluded that the PRISM III score has discriminatory power in distinguishing between survival and mortality outcomes. Additionally, it proves to be predictor of the length of stay among survivors.

Key words: Length of stay, Mortality, PRISM III score.

Authors' Contribution:
[1,2]Conception; Literature research; manuscript design and drafting; [2,3]Critical analysis and manuscript review; [5,6]Data analysis; Manuscript Editing.

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Introduction

The Pediatric Risk of Mortality III (PRISM III) score, developed by Pollack et al. in 1996, has proven to be an important tool for assessing mortality risk in paediatric intensive care units (PICUs).[1] Modifications to the PRISM III score have been proposed, aiming to enhance its predictive accuracy and clinical utility.[2] The concept of critical illness in the paediatric age group has long been recognized by clinicians and researchers alike.[3] However, the quantification and objective assessment of critical illness were significantly enhanced with the development of scoring systems specifically for paediatric populations. The development of scoring systems for paediatric critical illness marked a significant advancement in paediatric intensive care.[4] These scoring systems generally incorporate a

range of physiological parameters, laboratory results, and clinical observations to produce a numerical value that indicates the severity of illness and helps predict the likelihood of negative outcomes, such as mortality or extended hospital stays. The Pediatric Risk of Mortality (PRISM) series, including PRISM III and its modified versions, are among the most commonly used severity-of-illness scores in paediatric care.[5]

The modified PRISM III scoring system used in this study excluded certain parameters, such as respiratory rate, calcium levels, serum bilirubin, PaCO2/FiO2 ratio and diastolic blood pressure (BP). Instead, it included temperature, systolic BP, serum creatinine, acid-base gas parameter percentages, blood urea nitrogen (BUN), platelet count and white blood cell (WBC) count, resulting in a total of 17 parameters. It is important to note that the PRISM III score is independent of the institution and can be calculated at both 12 hours (PRISM-12) and 24 hours (PRISM-24).[6,7]

The PRISM III score has been extensively studied for its effectiveness as a mortality predictor in different clinical scenarios, there has been comparatively limited exploration of its utility in predicting the length of stay (LOS) among survivors.[8] Modified PRISM III is enhanced from standard PRISM III score with various innovations, making it a more accurate tool for estimating paediatric mortality risk in order to ensure higher accuracy across age groups, it integrates enhanced age-based stratification, classifying variables by neonates, infants, children, and adolescents.[9] These parameters added to the scoring system increase its accuracy and reliability. Well established predictors of mortality in paediatric patients include systolic blood pressure and temperature and acid base gas parameters which are critical for metabolic and respiratory status. Serum creatinine, blood urea nitrogen (BUN) and white blood cell (WBC) count are all important indicators of renal function, nitrogen balance and infection, respectively. The incorporation of these variables into the modified PRISM III score results in a better and more effective tool for predicting mortality in paediatric patients.[8]

Numerous studies have evaluated the accuracy of the PRISM III score in stratifying mortality risk within paediatric intensive care units (PICUs).[10] However, the potential of this scoring system to provide insights into the duration of hospitalization for patients who survive critical illness has not been thoroughly investigated.

The emphasis on mortality prediction in previous research reflects the paramount importance of identifying high-risk patients who may require more intensive monitoring and intervention.

Investigating the predictive value of the PRISM III score for length of stay (LOS) among survivors could provide valuable insights into the post-acute care requirements of paediatric patients recovering from critical illness. The severity of the disease, organ dysfunction, and comorbidities, as assessed by the PRISM III score, may influence the recovery process and subsequently affect the duration of hospital stay. By incorporating LOS prediction into the evaluation of PRISM III score performance, clinicians and healthcare administrators can gain a more comprehensive understanding of patient outcomes and resource utilization in PICU settings.

Methodology

A cross sectional study was conducted from December 2023 to May 2024 at the Pediatric Critical Care Unit of the Children's Hospital Lahore over a period of six months. A total of 129 patients were enrolled, with the sample size determined using the OpenID calculator, considering a 95% confidence interval, 8% absolute precision, and a previously reported mortality frequency of 31%.[8]

Patients included in the study were between the ages of 1 month and 14 years and had been admitted to the Pediatric Intensive Care Unit (PICU) for at least 24 hours. Readmissions were counted as separate admissions, and both male and female patients were included.

However, patients who left against medical advice, those with a stay of less than 24 hours, and those requiring continuous cardiopulmonary resuscitation (CPR) without achieving stable vital signs within two hours of admission were excluded from the study. Data collection was carried out using a pre-designed questionnaire. Information regarding demographics, including age, gender, diagnosis, duration of stay, and outcomes (survival or non-survival), was recorded. Each patient underwent a thorough physical examination, and relevant laboratory investigations were performed and documented after the interval of every 6 hour within the first 24 hours of admission and the time period which shows worst values were taken as a Modified PRISM III score.

Table I. Standard PRISM III parameters and Modified PRISM III parameter used

PRISM III	Modified PRISM III
Temperature	Temperature
Systolic BP	Systolic BP
Serum creatinine	Serum creatinine
Acid-base gas parameter percentages	Acid-base gas parameter percentages
Blood urea nitrogen (BUN)	Blood urea nitrogen (BUN)
Platelet count	Platelet count
White blood cell (WBC) count	White blood cell (WBC) count
Respiratory rate	
Calcium levels	
Serum bilirubin	
PaCO2/FiO2 ratio	
Diastolic blood pressure (BP)	

Statistical analysis of the collected data was conducted using SPSS Version 25. Continuous variables were summarized as means and standard deviations, while categorical variables were presented as frequencies and percentages. Chi-Square test was used to check the association between PRISM score and mortality rate. A p-value of <0.05 was considered statistically significant. Linear regression analysis was applied to examine the relationship between length of stay (LOS) in survivors and the PRISM score, revealing significant results.

Ethical approval was taken from the Institutional Review Board (IRB) of The Children's Hospital, University of Child Health Sciences, Lahore dated 26th December 2023 with reference number (No. 751/CH-UCHS)

Results

The mean age of all the enrolled patients were 7.55±4.20 years with mean length of hospital stay of 5.18±1.30 days. There is a higher ratio of male patients 71% as compared to female patients that is 58% as shown in figure 1. The mean age of female patients and male patients were 6.79±3.88 years and 8.18±4.38 years respectively. The distribution of primary diagnoses among the patients is shown in table 2. Frequency of discharged and mortality patients on the basis of PRISM score shown in table 3. The distribution of patient outcomes based on PRISM scores in our study reveals significant trends in mortality and discharge rates. For patients with a PRISM score of 0-4, 50 individuals (84.7%) were discharged, while 9 (15.3%) experienced mortality. Among those with a PRISM score 5-9, 39 patients (83.0%) were discharged, compared to 8 (17.0%) who did not survive. In the 10-14 PRISM score range, only 4 patients (57.1%) were discharged, whereas 3 patients (42.9%) faced mortality. For those with PRISM score 15-19, 4 patients (40.0%) were discharged, and 6 (60.0%) faced mortality. In the ≥20 PRISM score range, only 1 patient (16.7%) was discharged, whereas 5 patients (83.3%) faced mortality. Linear regression analysis was applied to examine the relationship between length of stay (LOS) in survivors and the PRISM score, revealing significant results.

Table II. Characteristics of all enrolled patients *(n=129)*	
Variables	Mean ± SD
Age (years)	7.55±4.20
Male age (years)	8.18±4.38
Female age (years)	6.79±3.88
Length Hospital stay (days)	5.18±1.30

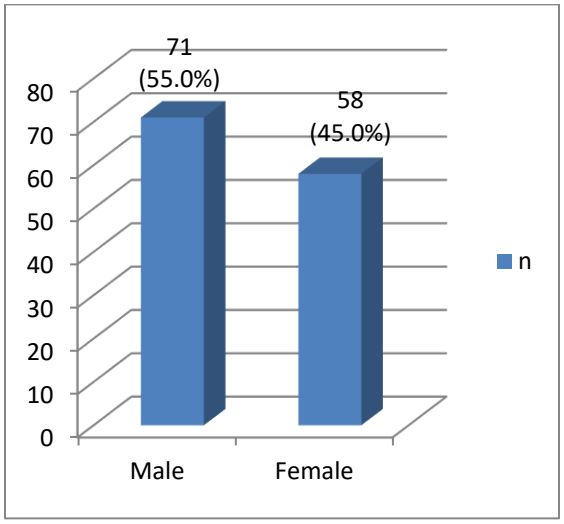

Figure 1: Frequency of patients on the basis of gender.

The analysis showed that the baseline LOS, independent of the PRISM score, was 4.716 days (intercept). Moreover, for every 1-unit increase in the PRISM score, the LOS increased by approximately 5 hours (coefficient B = 0.069 days).

Table III. Distribution of primary diagnoses among the patients (n=129)	
Diagnosis	n (%)
Sepsis	18 (14.0%)
Bronchopneumonia	32 (24.8%)
Bronchiolitis	26 (20.2%)
Tuberculosis	6 (4.7%)
Meningitis	36 (27.6%)
Meningoencephalitis	11 (8.5%)

Table IV: Frequency of discharged and mortality patients on the basis of PRISM score *(n=129)*		
PRISM score	**Discharged**	**Mortality**
0-4	50(84.7%)	9(15.3%)
5-9	39(83.0%)	8(17.0%)
10-14	4(57.1%)	3(42.9%)
15-19	4(40.0%)	6(60.0%)
≥20	1(16.7%)	5(83.3%)
P-value<0.001		

Table V: Linear regression model showing relationship of paediatric risk of mortality score of survivors and length of stay

	Unstandardized coefficients		Standardized coefficients	t	Significant	95% CI for B	
	B	SE	B			Lower bound	Upper bound
Constant	4.716			24.108	0.000	4.350	5.082
PRISM score	0.069	0.022	.271	3.177	0.002	0.026	0.111

Discussion

The Pediatric Risk of Mortality (PRISM) III score is a commonly used tool for assessing the severity of illness, specifically developed to predict mortality risk in patients within paediatric intensive care units (PICUs). The modified PRISM III incorporates several clinical parameters to assess the risk and outcomes of critically ill children.[11] The Pediatric Risk of Mortality (PRISM) III score has been shown to be a reliable predictor of mortality and illness severity in patients admitted to our tertiary Pediatric Intensive Care Unit (PICU) [7]. Higher PRISM III scores have been associated with increased mortality rates.[12] Several factors influence PRISM III score and length of stay

in Pediatric Intensive Care Units (PICUs). Age, weight and height of patients are also important. The PRISM III score and length of stay are also influenced by disease severity and comorbidities such as respiratory, central nervous system and infectious diseases.[13]Patients that were enrolled had an average age of 7.55 years, with males having a significantly higher mean age (8.18 years) than females (6.79 years).

The study's findings show how useful the modified PRISM III score is for predicting length of stay (LOS) and death in paediatric intensive care units (PICUs). Based on PRISM scores, the mortality and discharge rate distribution show a distinct trend: the chance of fatality increases and the discharge rate decreases as the PRISM score rises.

These findings align with a Portuguese study in which survivors' mean PRISM scores were 5.6 while non-survivors' were 19.7.[14] Similarly, a Brazilian study showed a strong correlation between worse outcomes and higher PRISM scores, with median scores of 7 for survivors and 15 for non-survivors.[15] Another study conducted in India reported mean PRISM scores of 7.5878 ± 5.032 for survivors and 20.63 ± 3.41 for non-survivors.[16] A separate study from Egypt found higher mean PRISM scores for both survivors (17.39 ± 6.60) and non-survivors (35.81 ± 6.69).[13]

Higher PRISM scores are found to be significantly linked to higher mortality and lower discharge chances. The severity of the illness probably gets worse as PRISM scores go up, which is indicative of worse patient outcomes. These results are consistent with research that has shown PRISM scores to be a valid indicator of paediatric mortality, underscoring its usefulness in risk stratification and therapeutic decision-making. There have been comparable trends identified when compared to previous studies. Slater *et al*., 2003 for instance, found that an increased chance of death is linked to rising PRISM scores, especially for scores above 10.[17] Higher PRISM scores were also strongly associated with negative outcomes in critically sick paediatric patients, according to another study by Pollack *et al*., 2013. These findings support PRISM's reliability as a prognostic instrument in paediatric critical care environments.[18]

The analysis showed that the baseline LOS, independent of the PRISM score, was 4.716 days (intercept). Moreover, for every 1-unit increase in the PRISM score, the LOS increased by approximately 5 hours (coefficient B = 0.069 days).Pupil and Kumar, 2018 discovered a biphasic correlation between length of stay (LOS) and PRISM III ratings. Due to a higher percentage of premature deaths, LOS dropped with higher PRISM III scores, but it climbed with scores up to 14. Mortality was almost 100% after a score of 19, with only one child (score of 26) surviving. Of the 145 patients, 49 (33.8%) passed away and 96 (66.2%) survived. [19]

The potential usefulness of PRISM scoring in resource allocation is highlighted by the shown association between PRISM scores and LOS. These scores can help clinicians predict length of stay (LOS) and rank high-risk patients for early intervention or rigorous surveillance. Additionally, by offering more accurate prognostic data, the results may help guide family therapy by assisting families in comprehending the anticipated trajectory of sickness.[20]

The constant coefficient (B = 4.716) suggests that when the PRISM score is zero, the average length of stay is approximately 4.716 days, indicating a baseline duration. Additionally, the coefficient for the PRISM score (B = 0.069) signifies a positive association between higher PRISM scores and longer lengths of stay, albeit with a relatively small effect size. The 95% confidence interval for the PRISM score coefficient ranges from 0.026 to 0.111, further supporting its statistical significance. These results show that longer hospital stays for survivors are predicted by higher PRISM scores, underscoring the usefulness of the PRISM score as a significant indicator of resource use. The results are reliable due to the statistically significant association and narrow confidence intervals, which highlight the

importance of PRISM scores in paediatric hospital resource allocation and clinical decision-making.

Modified PRISM III scoring system is a useful tool for predicting patient outcomes, resource allocation, and identifying high risk patients, optimizing care delivery, and quality improvement initiatives. Nevertheless, confounding factors include demographics, comorbidities, hospital management, and admission practices. The system should be validated in diverse setting other than where it was developed, to guarantee reliability and generalizability. This will make it useful in improving patient care and guiding clinical decision making in different healthcare settings.

Limitations: Only a few participants were included in the current investigation. A multicentre experiment will be required to verify the validity of a score such as the PRISM III, allowing for a greater number of cases from different regions.

Conclusion

The findings show a substantial correlation between hospital length of stay (LOS) and PRISM III ratings and patient outcomes. PRISM ratings are useful as a predictor of patient prognosis because they are linked to higher mortality rates and lower discharge rates. This demonstrates how the modified PRISM III score can be used as a trustworthy predictor to gauge the severity of a disease, direct clinical judgments, and maximize the use of resources in paediatric care

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