https://doi.org/10.29309/TPMJ/2026.33.04.10226 www.theprofesional.com

ORIGINAL ARTICLE

Correlation of peripheral perfusion index and mortality of patients with shock in Pediatric Intensive Care Unit of NICH, Karachi, Pakistan.

Muhammad Sami[1], Murtaza Ali Gowa[2], Hira Nawaz[3], Zaiba Anwar[4], Uzma Siddique[5], Ghazala Jamal[6]

ABSTRACT… Objective: To investigate the correlation between peripheral perfusion index (PPI) and mortality among pediatric shock patients admitted to the pediatric intensive care unit (PICU). **Study Design:** Prospective, Observational study. **Setting:** The PICU of National Institute of Child Health, Karachi, Pakistan. **Period:** March 2024 to February 2025. **Methods:** A total of 64 children aged between 1 month to 18 years and admitted to the PICU with a diagnosis of shock were analyzed. The PPI was categorized as mild (≥1.4), moderate (>0.6 to <1.4), and critical (≤0.6). At the time of admission, demographic, clinical parameters and vitals were documented. Saturation and perfusion index were noted on admission and during the course of illness in PICU. PPI was measured using pulse oximeter. **Results:** In a total of 64 children, 38 (59.4%) were female, with an overall mean age of 7.39±4.57 years. The mean baseline PPI was 0.97±0.66. Critical perfusion was found to have significant association with higher heart rate (p=0.036), lower systolic (p=0.007) and diastolic blood pressures (p=0.043), higher PRISM III scores (p<0.001), increased need for mechanical ventilation (p=0.014), longer PICU stays (p=0.006), and higher mortality rates (p=0.036). Lower PPI values were significantly correlated with higher heart rate (r=–0.407; p=0.001), lower systolic blood pressure (r=0.352; p=0.004), lower diastolic blood pressure (r=0.289; p=0.021), higher PRISM III scores (r=–0.676; p<0.001), and longer PICU stays (r=–0.296; p=0.018). **Conclusion:** Lower baseline PPI values (<0.6) were significantly associated with adverse hemodynamic parameters, increased severity of illness scores, greater need for mechanical ventilation, and higher mortality rates.

Key words: Children, Mortality, Peripheral Perfusion Index, PICU, Shock.

Article Citation: Sami M, Gowa MA, Nawaz H, Anwar Z, Siddique U, Jamal G. Correlation of peripheral perfusion index and mortality of patients with shock in Pediatric Intensive Care Unit of NICH, Karachi, Pakistan. Professional Med J 2026; 33(04):701-706. https://doi.org/10.29309/TPMJ/2026.33.04.10226

INTRODUCTION

Shock remains a major clinical challenge faced commonly in pediatric intensive care units (PICUs), especially among lower-middle-income countries.[1,2] Shock is generally described as a state of inadequate tissue perfusion, and requires early recognition and timely intervention to minimize related adverse outcomes.[3] Traditional indicators of shock alone may not always correctly reflect peripheral perfusion status or predict impending clinical deterioration.[4]

In the recent decades, peripheral perfusion index (PPI) emerged as a reliable adjunct for evaluating the severity as well as the progression of shock.[5-7] Variations in PPI is described to effectively reflect alterations in vasomotor tone and intravascular volume status, thus, providing an early sign of circulatory compromise.[8] Sivaprasath et al.[9], demonstrated that a baseline reduction in PPI by approximately 57% strongly predicted impending shock, showing significant correlation with essential hemodynamic parameters.[9] Recently data from Bangladesh also described PPI as an effective non-invasive tool in PICU.[10]

In Pakistan, the limited availability of resources required for invasive monitoring underscores the necessity for simpler, cost-effective, yet reliable tools. Implementation of PPI measurement in PICU settings may facilitate early identification and management of shock, potentially reducing morbidity and mortality. This study aimed to investigate the correlation between PPI and mortality among pediatric shock patients admitted to the PICU.

METHODS

This prospective observational study was performed at the PICU at the National Institute of Child

1. MBBS, Postgraduate Trainee Pediatric Medicine, National Institute of Child Health, Karachi, Pakistan.
2. MBBS, FCPS (Padiatric Medicine), MRCPCH (UK), PCCM, Associate Professor, Section Head Pediatric Intensive Care Unit, National Institute of Child Health, Karachi, Pakistan.
3. MBBS, FCPS (Pediatric Medicine), Consultant Pediatrician and Post-Fellow Critical Care Medicine, Pediatric Intensive Care Unit, National Institute of Child Health, Karachi, Pakistan.
4. MBBS, Postgraduate Trainee Pediatric Medicine, National Institute of Child Health, Karachi, Pakistan.
5. MBBS, FCPS (Pediatrics), Fellow Pediatric Intensive Care Unit, National Institute of Child Health, Karachi, Pakistan.
6. MBBS, MCPS (Pediatrics), Registrar Pediatric Intensive Care Unit, National Institute of Child Health, Karachi, Pakistan.

Correspondence Address:
Dr. Muhammad Sami
Department of Pediatric Medicine, National Institute of Child Health, Karachi, Pakistan.
drsami.1609@hotmail.com

Article received on:
14/10/2025
Accepted for publication:
20/12/2025

Health (NICH), Karachi, Pakistan, between March 2024 to February 2025. Approval was acquired from Institutional Ethical Review Board prior to the commencement of this study (IERB-46/2023, dated: 16-10-2023). Informed and written consents were obtained from parents/guardians. A sample size of 64 was calculated using WHO sample size calculator with 95% confidence level, 5% margin of error and prevalence of shock in PICU as 4.3%.[11] Adopting non-probability consecutive sampling technique, children aged between 1 month up to 18 years, and admitted to PICU with a diagnosis of shock were analzyed.[12] Exclusion criteria were children having technical difficulty in obtaining PPI.

At the time of admission, demographic, clinical parameters and vitals were documented. Saturation and perfusion index were noted on admission and during the course of illness in PICU. PPI was measured using pulse oximeter and as the ratio of pulsatile to non-pulsatile blood flow in the patient's peripheral tissues.[13] PPI were categorized as mild, moderate, or critical as scores ≥ 1.4),> 0.6 but < 1.4, or critical ≤ 0.6, respectively.[13]

Data were analyzed using IBM-SPSS Statistics, version 26.0 Mean and standard deviation (SD) were computed for quantitative variables, and compared using t-test or analysis of variance (as appropriate). Frequency and percentages were shown for qualitative variables, and compared applying chi-square test. The diagnostic performance of the PPI in predicting mortality was evaluated using ROC analysis. Correlational analysis was performed applying Pearson's correlation. P<0.05 was considered statistically significant.

RESULTS

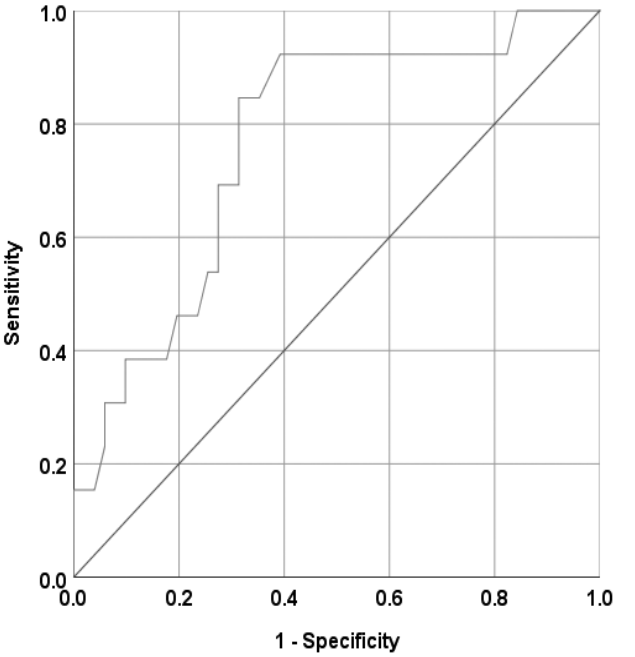
In a total of 64 children, 38 (59.4%) were females. The mean age, and baseline PPI were 7.39±4.57 years, 0.97±0.66, respectively. PPI did not differ significantly between gender (p=0.262), or age groups (p=0.333). Primary cite of infection or diagnosis did not significantly influence PPI (p=0.440). Baseline clinical characteristics and PPI values stratified by gender, age group, primary site of infection, and need for mechanical ventilation (MV) within 24 hours are presented in Table-I.

Children with critical perfusion had significantly higher heart rate (HR) (140.05±29.13 beats/min) compared to those with mild or moderate perfusion (p=0.036). Systolic (p=0.007) and diastolic BP (p=0.043) were significantly lower in the critical group. PRISM III scores increased markedly with worsening PPI, with a mean score of 17.82±4.11 in the critical group compared to 6.76±3.95 in the mild group (p<0.001). The requirement for MV within 24 hours was significantly higher among children with critical perfusion (54.5%; p=0.014). The mean PICU stay was longest in the critical group (20.95±6.84 days; p=0.006). Mortality rates were significantly higher among patients with critical perfusion (36.4%) compared to those with moderate (19.0%) and mild perfusion (4.8%) (p=0.036) (Table-II).

The ROC curve demonstrated strong discriminatory power, with an AUC 0.768 (95% CI: 0.630-0.906) (Figure-1) in predicting mortality with respect to PPI. An optimal cutoff value of PPI ≤ 0.59 was associated with a sensitivity of 84.6% and a specificity of 68.6%.

FIGURE-1

ROC curve analysis showing the utility of baseline PPI in predicting mortality (N=64)



Correlation analysis (Table-III) showed that lower PPI values were significantly associated with higher HR

TABLE-I

Baseline demographical and clinical characteristics with respect to PPI (n=64)

Characteristics		Frequency (%)	Baseline PPI	P-Value
Gender	Male	26 (40.6%)	0.85±0.51	0.262*
	Female	38 (59.4%)	1.04±0.74	
Age	1 month to 5 years	23 (35.9%)	0.85±0.71	0.333*
	Above 5 years up to 18 years	41 (64.1%)	1.02±0.63	
Primary site of infection / diagnosis	Respiratory	31 (48.4%)	0.80±0.64	0.440^
	Central nervous system	10 (15.6%)	1.03±0.71	
	Gastrointestinal tract	7 (10.9%)	1.34±0.94	
	Urinary tract	6 (9.4%)	1.00±0.44	
	Hematological	4 (6.3%)	1.21±0.28	
	Others	6 (9.4%)	1.06±0.59	
Need of mechanical ventilation withing 24 hours 44 (68.7%)		20 (31.3%)	0.75±0.74	0.079*
		1.06±0.60		

*Independent sample t-test applied; ^Analysis of variance applied

TABLE-II

Association of baseline PPI severity with demographical, clinical and laboratory parameters among children (N=64)

Characteristics		PPI Severity			P-Value
	Mild	Moderate	Critical		
Gender	Male	6 (28.6%)	12 (57.1%)	8 (36.4%)	0.149#
	Female	15 (71.4%)	9 (42.9%)	14 (63.6%)	
Age	1 month to 5 years	7 (33.3%)	5 (23.8%)	11 (50.0%)	0.193#
	Above 5 years up to 18 years	14 (66.7%)	16 (76.2%)	11 (50.0%)	
Heart beat (beats/min)		117.29±27.69	130.43±27.93	140.05±29.13	0.036^
Respiratory rate (respirations/min)		47.62±16.12	52.95±19.23	52.05±19.30	0.601^
Temperature (^{0}C)		38.11±1.23	38.16±1.25	38.19±1.18	0.979^
Systolic BP (mmHg)		94.86±11.13	92.86±12.19	84.14±10.88	0.007^
Diastolic BP (mmHg)		60.14±10.60	60.95±8.83	54.45±7.52	0.043^
Saturation (%)		90.33±6.70	89.14±5.95	89.27±6.04	0.794^
PRISM III score		6.76±3.95	9.05±3.96	17.82±4.11	<0.001^
Need of mechanical ventilation withing 24 hours		4 (19.0%)	4 (19.0%)	12 (54.5%)	0.014#
Duration of stay (days)		14.67±5.94	15.71±7.19	20.95±6.84	0.006^
Mortality		1 (4.8%)	4 (19.0%)	8 (36.4%)	0.036#

#Chi-square test applied; ^Analysis of variance applied

(r=–0.407; p=0.001), lower systolic BP (r=0.352; p=0.004), lower diastolic BP (r=0.289; p=0.021), higher PRISM III scores (r=–0.676; p<0.001), and longer PICU stays (r=–0.296; p=0.018).

DICUSSION

PPI monitoring has increasingly gained recognition as a vital parameter in the early detection of circulatory compromise. In the present study, children categorized under critical perfusion had significantly higher HR, lower systolic, and diastolic BP, and markedly elevated PRISM III scores. Mortality in this group was 36.4%, substantially higher than in those with moderate (19.0%) and mild perfusion (4.8%) (p=0.036).

TABLE-III

Correlation of peripheral perfusion index with clinical and laboratory parameters (N=64)

Parameter	r	P-Value
Age (years)	0.245	0.051
Heart beat (beats/minute)	-0.407	0.001
Respiratory rate (respirations/ minute)	-0.136	0.283
Temperature (^{0}C)	-0.021	0.869
Systolic BP (mmHg)	0.352	0.004
Diastolic BP (mmHg)	0.289	0.021
Saturation (%)	0.089	0.487
PRISM III score	-0.676	<0.001
PICU stay (days)	-0.296	0.018

These findings mimic closely to another prospective observational study by Av et al., in a pediatric tertiary hospital in India that evaluated children with septic shock and found that a PPI ≤0.6 at 6 hours predicted mortality with an AUC of 0.74, sensitivity of 70%, and specificity of 81%, and these findings align closely with the present study's optimal cutoff of PPI ≤0.59 (sensitivity 84.6%, specificity 68.6%), supporting the notion that a low PPI threshold around 0.6 is a critical determinant of poor outcomes in children with shock. Alakaya et al.[15], documented that median PPI values at 0 and 6 hours were significantly lower in non-survivors than survivors in PICU (p<0.001), with ≤ 0.63 yielding specificity, and sensitivity for mortality as 90.1%, 75.9%, respectively. Chi et al.[16], studying septic shock found that patients who did not survive beyond 28-day period were having significantly lower baseline PPI levels.

This study found that higher PPI values correlated with better hemodynamic parameters and clinical outcomes. Guo et al.[17], observed that lower PPI values were significantly linked with significant mortality, coagulation dysfunction, elevated lactate, prolonged MV, and prolonged ICU stay. The consistent direction of correlation between contemporary literature and exhibition of significance between PPI and adverse outcomes underscore the physiological significance of PPI as a major indicator of systemic health in PICUs. On the contrary, Mehmet et al.[18], found that while PPI predicted 7-day mortality in ventilated patients, it did not yield any significant associations with 60-day mortality, depicting potential temporal limitation of static PPI values which need further exploration in the large scale future studies. Agerskov et al.[19], in a retrospective observational study at a surgical ICU revealed that intraoperative PPI was having significant association with short-term post-srugery complications, but mean arterial pressure was not having signficiant linkage with PPI. These findings shed further light on the utility of PPI and emphasize the importance of contextual interpretation and timing of PPI measurements.

The findings of this study exhibit that PPI provides a non-invasive, continuous, and real-time estimates of peripheral perfusion, which could be difficult to assess accurately with traditional signs such as capillary refill or extremity temperature.[20,21] The strong correlation of lower PPI values with HR, systolic BP, PRISM III score, and PICU stay makes PPI a valuable adjunct in prognostication and clinical decision-making in PICUs.[22] Since the technology for measuring PPI is already embedded in many pulse oximeters, it offers an affordable and easily deployable tool, particularly relevant in resource-limited settings like Pakistan.

Regarding the limitations of this study, single center study designs with a modest sample size limits the generalizability of present findings. PPI was only measured at baseline, whereas serial or trend-based monitoring has been shown in prior studies to offer superior prognostic insight. Factors such as peripheral vasoconstriction due to cold ambient temperatures, sedatives, or vasoactive drugs may confound PPI readings, although efforts were made to control for these variables.

CONCLUSION

The PPI is an effective, non-invasive predictor of mortality among pediatric patients presenting with shock. Lower baseline PPI values (<0.6) were significantly associated with adverse hemodynamic parameters, increased severity of illness scores, greater need for MV, and higher mortality rates.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Assies R, Snik I, Kumwenda M, Chimalizeni Y, Langton J, van Woensel JBM, et al. **Etiology, pathophysiology and mortality of shock in children in low (Middle) income countries: A systematic review.** J Trop Pediatr. 2022; 68(4):fmac053.
2. Rech L, Sousa ITE, Tonial CT, Piva JP. **Epidemiology and outcomes of septic shock in children with complex chronic conditions in a developing country PICU.** J Pediatr (Rio J). 2022; 98(6):614-20.
3. Gupta S, Sankar J. **Advances in shock management and fluid resuscitation in children.** Indian J Pediatr. 2023; 90(3):280-88.
4. Singh Y, Villaescusa JU, da Cruz EM, Tibby SM, Bottari G, Saxena R, et al. **Recommendations for hemodynamic monitoring for critically ill children-expert consensus statement issued by the cardiovascular dynamics section of the European Society of Paediatric and Neonatal Intensive Care (ESPNIC).** Crit Care. 2020; 24(1):620.
5. Singh RB, Shekhar S, Sinha S, Singh S, Singh R, Kumar Nayan S. **An observational study to correlate peripheral perfusion index as a predictor of hypotension and mortality in sepsis patients.** Cureus. 2025; 17(3):e80431.
6. Elshal MM, Hasanin AM, Mostafa M, Gamal RM. **Plethysmographic peripheral perfusion index: Could it be a new vital sign? Front Med (Lausanne).** 2021; 8:651909.
7. Narayanan BJ, Rao SV, Kandasamy S. **Peripheral perfusion index for prediction of fluid responsiveness in spontaneously breathing critically Ill patients: A prospective observational study.** Indian J Crit Care Med. 2025; 29(2):151-154.
8. Guo Q, Liu D, Wang X. **Chinese Critical Ultrasound Study Group (CCUSG). Early peripheral perfusion monitoring in septic shock.** Eur J Med Res. 2024; 29(1):477.
9. Sivaprasath P, Mookka Gounder R, Mythili B. **Prediction of shock by peripheral perfusion index.** Indian J Pediatr. 2019; 86(10):903-08.
10. Ullah M, Biswas S, Islam MS, Hossain M, Amin Chowdhury MJB, Chowdhury R, et al. **Peripheral Perfusion Index in Assessment of Shock in Paediatric Intensive Care Unit of A Tertiary Care Hospital.** IAHS Med J. 2022; 4(2):46-50.
11. Singh D, Chopra A, Pooni PA, Bhatia RC. **A clinical profile of shock in children in Punjab, India.** Indian Pediatr. 2006 Jul; 43(7):619-23.
12. Randolph AG, McCulloh RJ. **Pediatric sepsis: important considerations for diagnosing and managing severe infections in infants, children, and adolescents.** Virulence. 2014 Jan 1; 5(1):179-89.
13. Sasikumar N, Madhavankutty NS, Gutjahr G, Bendapudi P, Moosa A, Prasenan K, et al. **Distribution and reference values of peripheral perfusion index in neonates from population-wide screening.** BMJ Paediatr Open. 2024; 8(1):e002607.
14. Av L, Kuzhikkombil Mani S, Ghosh S. **Perfusion index variations in children with septic shock: Single-center observational cohort study in India.** Pediatr Crit Care Med. 2024; 25(1):47-53.
15. Alakaya M, Arslankoylu AE, Erdogan S. **The usefulness of perfusion index for predicting mortality in pediatric intensive care unit.** J Pediatr Emerg Intensive Care Med. 2022; 9(2):123-29.
16. Chi C, Gong H, Yang K, Peng P, Zhang X. **Early peripheral perfusion index predicts 28-day outcome in patients with septic shock.** World J Emerg Med. 2024; 15(5):372-78.
17. Guo Q, Lian H, Wang G, Zhang H, Wang X. **Prospective evaluation of the peripheral perfusion index in assessing the organ dysfunction and prognosis of adult patients with sepsis in the ICU.** J Intensive Care Med. 2024; 39(11):1109-19.
18. Mehman MCE, Kaya C, Ustun YB, Sahinoglu AH. **Predictive value of perfusion index for mortality in mechanically ventilated patients.** Aging Male. 2020; 23(5):1251-58.
19. Agerskov M, Thusholdt ANW, Holm-Sørensen H, Wiberg S, Meyhoff CS, Højlund J, et al. **Association of the intraoperative peripheral perfusion index with postoperative morbidity and mortality in acute surgical patients: a retrospective observational multicentre cohort study.** Br J Anaesth. 2021; 127(3):396-404.
20. Singla PR, Mahajan SK. **An observational study to correlate arterial lactate level and peripheral perfusion index in context of tissue perfusion in sepsis.** Int J Res Med Sci. 2023; 11(5):1665-70.
21. Daş M, Bardakci O, Siddikoglu D, Akdur G, Yilmaz MC, Akdur O, et al. **Prognostic performance of peripheral perfusion index and shock index combined with ESI to predict hospital outcome.** Am J Emerg Med. 2020; 38(10):2055-59.
22. Gutiérrez-Zárate D, Rosas-Sánchez K, Zaragoza JJ. **Clinical evaluation of peripheral tissue perfusion as a predictor of mortality in sepsis and septic shock in the intensive care unit: Systematic review and meta-analysis.** Med Intensiva (Engl Ed). 2023; 47(12):697-707.

AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Muhammad Sami:** Data collection.
2	**Murtaza Ali Gowa:** Concept of study.
3	**Hira Nawaz:** Critical revision.
4	**Zaiba Anwar:** Proof reading.
5	**Uzma Siddique:** Data analysis.
6	**Ghazala Jamal:** Data entry.