

Original Research Article

Prognostic value of neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio in critically ill children – a retrospective cohort study from a tertiary care pediatric intensive care unit

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ABSTRACT

Background: Early risk stratification is essential in pediatric intensive care. Simple, inexpensive biomarkers are needed, especially in resource-limited settings. We evaluated the prognostic value of trends in neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) for predicting mortality in critically ill children and compared their performance with the pediatric logistic organ dysfunction-2 (PELOD-2) score.

Methods: The study consisted of children aged 1 month to 18 years admitted to the pediatric intensive care unit (ICU) of Navodaya Medical College Hospital and Research Centre, Raichur, India from January 2024 to December 2025 with a stay ≥ 5 days. Various ratios were calculated on days 1 and 5. PELOD-2 was calculated on admission. The primary outcome was PICU mortality. Trends were compared between survivors and non-survivors.

Results: Among 100 children (mean age 5.2 ± 3.8 years, 60% male), overall mortality was 20% ($n=20$). Sepsis was the most common diagnosis (45%). Non-survivors showed a marked increase in NLR (day 1: 6.8 ± 2.2 ; day 5: 12.5 ± 3.6) and PLR (day 1: 180 ± 55 ; day 5: 320 ± 80), whereas survivors exhibited decreasing trends (NLR: 4.5 ± 1.8 to 3.2 ± 1.4 ; PLR: 140 ± 45 to 110 ± 40). Between-group differences in day 5 NLR and PLR were highly significant ($p < 0.001$). PELOD-2 was higher in non-survivors (14.8 ± 4.1 versus 6.2 ± 2.5 , $p < 0.001$). ROC analysis yielded AUCs of 0.82 (95% CI 0.73-0.91) for day 5 NLR, 0.79 (95% CI 0.69-0.89) for day 5 PLR, and 0.86 (95% CI 0.78-0.94) for PELOD-2 ($p < 0.001$ for each). Optimal cut-offs (NLR ≥ 7.2 , PLR ≥ 210) gave sensitivities of 83% and 80%, and specificities of 78% and 75%, respectively.

Conclusions: An increase in the PL ratio and the NL ratio over the first five PICU days had a strong association with the outcome in terms of mortality. These simple markers can complement established scores for dynamic risk assessment, particularly in resource-constrained settings.

Keywords: Neutrophil-to-lymphocyte ratio, Platelet-to-lymphocyte ratio, PELOD-2, PICU, Mortality, Biomarkers, Pediatrics, Critical care, Sepsis

INTRODUCTION

Accurate assessment of disease severity and early prediction of outcomes are fundamental to improving survival in critically ill children admitted to the pediatric intensive care unit (PICU).¹ Over the years, a number of scoring systems have been developed to predict outcomes,

such as the pediatric logistic organ dysfunction-2 (PELOD-2) score, to provide an objective estimation of mortality risk.^{2,3} Although widely used and validated, these scores rely on multiple clinical and biochemical variables, which can increase cost and complexity, potentially limiting their applicability in resource-constrained settings.² Furthermore, while extensive

research has explored various individual biomarkers, none have been conclusively validated as a standalone predictor of mortality in this heterogeneous population.⁴

Systemic inflammation and endothelial dysfunction are central to the pathophysiology of critical illness.^{4,5} The neutrophil-to-lymphocyte ratio (NLR), calculated from a simple complete blood count, has emerged as a surrogate marker reflecting the equilibrium that exists among the innate immune system and the acquired immune suppression, which is reflected by neutrophilia and lymphocytopenia respectively.^{6,7} In adult populations, NLR has demonstrated prognostic significance across a wide spectrum of conditions, including sepsis, cardiovascular diseases, and malignancies.^{8,9} Similarly, the platelet-to-lymphocyte ratio (PLR), another readily available ratio, has been found to have a link with the intensity of severity of the disease, inflammatory burden, and adverse outcomes, as platelets have a significant part to play in the process of inflammation and thrombosis.^{10,11}

Despite their increasing use in adult critical care, the importance of NLR and PLR in the PICU remains inadequately explored, particularly in heterogeneous cohorts of critically ill children.¹²⁻¹⁵ More importantly, there is limited evidence evaluating whether dynamic changes in these indices during hospitalization can independently predict outcomes.^{14,15} This study was done with the intention to evaluate the prognostic significance of trends in NLR and PLR as markers of mortality in children admitted to the PICU and to compare their predictive utility with the established PELOD-2 score.²

METHODS

Study design, setting, and population

The study was planned as a retrospective cohort study at the tertiary care PICU of Navodaya Medical College Hospital and Research Centre, Raichur, India. The study received approval from the institutional ethics committee. A total of 100 children in the age group between one month and eighteen years who were admitted to the PICU from January 2024 to December 2025 were considered eligible.

Patients were excluded from enrollment based on the following predefined criteria: complete data for the required study parameters (both day 1 and day 5 complete blood counts) were unavailable, the total duration of the PICU stay was less than 5 days, and admission to the PICU was solely for routine postoperative monitoring.

Data collection and definitions

The following operational data were retrieved and collected directly from the patients' medical records: demographic characteristics including age and gender, primary clinical diagnosis at admission and the requirement for invasive mechanical ventilation, and hematological parameters obtained from routine clinical

investigations on the day of admission (day 1) and on day 5 of the PICU stay, including total leukocyte counts and differential counts.

The absolute hematological marker ratios were calculated according to standard parameters as follows.

$$\begin{aligned} \text{Neutrophil - to - lymphocyte ratio (NLR)} \\ = \text{absolute neutrophil count} \\ / \text{absolute lymphocyte count} \end{aligned}$$

$$\begin{aligned} \text{Platelet - to - lymphocyte ratio (PLR)} \\ = \text{absolute thrombocyte count} \\ / \text{absolute lymphocyte count} \end{aligned}$$

The PELOD-2 score was calculated strictly on day 1 according to the standardized methodology described by Leteurtre et al, incorporating variables for neurological, cardiovascular, renal, respiratory, and hematological dysfunction.² The primary survival outcome evaluated was overall PICU mortality.

Statistical analysis

Statistical processing was performed using statistical package for the social sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD) and compared using the independent samples t-test (for between-group comparisons) or the paired t-test (for dynamic longitudinal within-group changes from day 1 to day 5). Categorical variables were presented as frequencies and percentages and analyzed using the Chi-square test or Fisher's exact test, as appropriate.

Receiver operating characteristic (ROC) curve analysis was implemented to find the rate of prediction of mortality. The area under the curve (AUC) with 95% confidence intervals (CI) was computed, and the optimal clinical cut-off values were determined using the Youden Index to optimize sensitivity and specificity parameters. A two-tailed p value <0.05 was considered statistically significant throughout all analyses.

RESULTS

Baseline characteristics

A total of 100 children who met the predefined inclusion criteria were tracked. The study population presented a mortality rate of 20% (n=20 non-survivors) and 80% survivors. Baseline demographic and clinical characteristics are summarized in Table 1.

On evaluating the demographics, both the age and gender distribution were remarkably similar between the survivors and non-survivors groups.

Sepsis was the predominant primary diagnosis across the entire study population but was significantly more

frequent among non-survivors (65.0% versus 40.0%, $p=0.04$).

Additionally, we noted that those who survived had a dramatically lesser need for invasive mechanical ventilation compared to non-survivors (21.3% versus 90.0%, $p<0.001$).

Longitudinal trends in NLR and PLR

The evolution of NLR and PLR from day 1 to day 5 differed markedly between the two diagnostic groups, as shown in Table 2. Survivors exhibited a significant, continuous decrease in both ratios, indicating resolving systemic inflammation.

In contrast, non-survivors showed a sharp and statistically profound increase in both NLR and PLR over the first 5 days of intensive care.

Comparison with PELOD-2 score and predictive performance

The mean admission PELOD-2 score was significantly higher in non-survivors (14.8 ± 4.1) compared to survivors (6.2 ± 2.5), demonstrating a mean score difference of 8.6 (95% CI: 7.2-10.0, $p<0.001$). To calculate the relative prognostic value, ROC curves were evaluated for day-5 NLR, day-5 PLR, and admission PELOD-2 scores. All three parameters demonstrated highly significant predictive ability ($p<0.001$ for each AUC compared to the null hypothesis of 0.5).

The baseline admission PELOD-2 score possessed the highest overall area under the curve (AUC=0.86), followed closely by the dynamic day-5 NLR (AUC=0.82) and day-5 PLR (AUC=0.79). Comprehensive clinical diagnostic accuracy criteria derived via Youden index optimizations are detailed in Table 3.

Table 1: Baseline characteristics of the study population.

Characteristics	Survivors (n=80)	Non-survivors (n=20)	P value	Statistical test
Age (years), mean $\pm$ SD	5.3 $\pm$ 3.9	4.9 $\pm$ 3.5	0.67	Independent t-test
Male gender, N (%)	48 (60.0)	12 (60.0)	1.00	Chi-square test
Primary diagnosis, N (%)			0.04	Chi-square test
Sepsis	32 (40.0)	13 (65.0)		
Respiratory illness	27 (33.8)	3 (15.0)		
Neurological causes	21 (26.3)	4 (20.0)		
Invasive mechanical ventilation, N (%)	17 (21.3)	18 (90.0)	<0.001	Chi-square test

Table 2: Comparison of NLR and PLR trends between survivors and non-survivors.

Parameters	Group	Day 1 (mean $\pm$ SD)	Day 5 (mean $\pm$ SD)	Mean change (95% CI)	P value*
NLR	Survivors (n=80)	4.5 $\pm$ 1.8	3.2 $\pm$ 1.4	-1.3 (-1.6 to -1.0)	<0.001
	Non-survivors (n=20)	6.8 $\pm$ 2.2	12.5 $\pm$ 3.6	+5.7 (+4.5 to +6.9)	<0.001
Between-group p value**		p<0.001	p<0.001		
PLR	Survivors (n=80)	140 $\pm$ 45	110 $\pm$ 40	-30 (-37 to -23)	<0.001
	Non-survivors (n=20)	180 $\pm$ 55	320 $\pm$ 80	+140 (+110 to +170)	<0.001
Between-group p value**		p=0.003	p<0.001		

*Paired t-test for within-group change; **independent samples t-test for between-group comparisons

Table 3: ROC analysis and diagnostic accuracy for prediction of PICU mortality.

Predictive parameters	AUC (95% CI)	P value*	Optimal cut-off	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Day-5 NLR	0.82 (0.73-0.91)	<0.001	≥ 7.2	83	78	48	95
Day-5 PLR	0.79 (0.69-0.89)	<0.001	≥ 210	80	75	44	94
Admission PELOD-2	0.86 (0.78-0.94)	<0.001	≥ 10	88	82	55	96

AUC: area under the curve; CI: confidence interval; PPV: positive predictive value; NPV: negative predictive value; *test of significance against null hypothesis AUC=0.5

DISCUSSION

This research demonstrates that variations in NLR and PLR within the first five days of admission to the PICU are strongly associated with mortality among a varied cohort

of critically ill pediatric patients.^{14,15} A growing pattern of these simple, affordable biomarkers effectively identified non-survivors, while a declining trend was observed in children who showed clinical recovery.^{14,15} The data emphasize the importance of tracking changes in NLR and

PLR as a valuable approach for real-time evaluation of disease progression and treatment response.^{6,14,15}

The underlying pathophysiological basis for these observations is compelling. A rising NLR signifies a worsening imbalance between the innate and adaptive immune systems, characterized by an enhanced, prolonged neutrophilic inflammatory response alongside a concurrent decrease in lymphocyte-mediated immunity.^{6,7} This profound immune dysregulation is a defining feature of conditions like severe sepsis and multiple organ failure syndrome.^{5,7} Similarly, an increasing PLR, affected by thrombocytosis and chronic lymphopenia, indicates ongoing systemic inflammation and endothelial activation, given that platelets play a vital role in both immune pathways and microvascular thrombosis mechanisms.^{5,10,11} The capacity of these dynamic trends to mirror clinical deterioration aligns perfectly with the underlying biological relevance of these indices as markers of the host's inflammatory status.^{6,7,10,11}

While the admission PELOD-2 score remained the single best predictor of mortality (AUC 0.86), the performance of day-5 NLR (AUC 0.82) and day-5 PLR (AUC 0.79) was remarkably good.^{2,14,15} This is an important operational finding, as PELOD-2, while highly effective, requires the collection of multiple complex clinical variables and is often calculated only at admission or at fixed time points.² In contrast, NLR and PLR can be calculated daily as part of routine care from a standard complete blood count, offering a dynamic and continuous assessment of the patient's clinical trajectory.^{6,14,15} The divergence in trends by day 5 highlights the prognostic importance of the host's response to initial intensive care; a failure of these inflammatory markers to decline, or a continued rise, should immediately alert clinicians to a potentially poor outcome and prompt a comprehensive reassessment of the treatment strategy.^{14,15}

The results of our study are consistent with the growing body of literature in both adult and pediatric critical care.^{8,9,12-15} Studies in adult septic patients have consistently shown that an elevated and rising NLR is an independent predictor of mortality.^{8,9} While fewer serial monitoring studies exist in pediatrics, our findings corroborate those that have identified an association between baseline admission NLR and severity of illness.¹²⁻¹⁵ Our study adds significant value by demonstrating the superior prognostic utility of the trend over a single static measurement, emphasizing the clinical value of serial monitoring.^{14,15} The optimal cut-offs identified (NLR $\geq$ 7.2, PLR $\geq$ 210) may serve as practical thresholds for clinical alertness, although external validation is warranted.^{14,15}

Comparison of baseline clinical characteristics with previous studies

In the present study, the mean age was 5.2 $\pm$ 3.8 years and 60% of children were male, while mortality was 20%. Mahalingam et al studied 275 children aged 1-12 years and

reported a mortality of 43.3%, whereas Mohamed et al studied 91 critically ill children aged 1 month to 14 years. The differences in mortality between these cohorts may reflect differences in study design, case mix, eligibility criteria, and illness severity rather than a direct contradiction of findings.^{14,15}

Sepsis and invasive mechanical ventilation

Sepsis was the predominant diagnosis in the present cohort and was more frequent among non-survivors (65.0% versus 40.0%), while invasive mechanical ventilation was required in 90.0% of non-survivors compared with 21.3% of survivors. Mohamed et al similarly reported sepsis as the most common admission diagnosis and significantly greater use of ventilation among non-survivors, supporting the association between severe illness, organ dysfunction, and mortality in PICU populations.¹⁵

Comparison of NLR findings

The present study showed a clear separation in NLR trajectories: survivors decreased from 4.5 $\pm$ 1.8 on day 1 to 3.2 $\pm$ 1.4 on day 5, whereas non-survivors increased from 6.8 $\pm$ 2.2 to 12.5 $\pm$ 3.6. This direction is consistent with pediatric literature describing higher NLR with greater illness severity, including studies cited in the manuscript. Mahalingam et al reported that an NLR threshold of $\geq$ 7 had high specificity (92.31%) for mortality, although overall discrimination was not strong; Mohamed et al reported only a small difference in admission NLR between survivors and non-survivors and an AUC of 0.561. These differences suggest that the timing and serial behavior of NLR may influence its prognostic performance.¹²⁻¹⁵

Comparison of PLR findings

In the present study, PLR decreased from 140 $\pm$ 45 to 110 $\pm$ 40 among survivors but increased from 180 $\pm$ 55 to 320 $\pm$ 80 among non-survivors, with a day-5 AUC of 0.79. This supports the biological and prognostic relevance of PLR described in previous literature, although pediatric findings have been inconsistent. Mahalingam et al reported high sensitivity of PLR $\geq$ 3.9 for mortality but low specificity and no good AUC, while Mohamed et al found no significant association between PLR and mortality and reported an AUC of 0.391. The stronger association observed in the present study may therefore relate to the use of serial day-1-to-day-5 measurements and the selected cohort, and it requires external validation.^{11,14,15}

Comparison of PELOD-2 and predictive performance

The present study found a higher admission PELOD-2 score in non-survivors (14.8 $\pm$ 4.1 versus 6.2 $\pm$ 2.5) and an AUC of 0.86. This is directionally consistent with the established validation literature showing that PELOD-2 discriminates between survivors and non-survivors; Leteurte et al reported an AUC of 0.934 in the original multicentre validation cohort. The lower AUC in the

present study may reflect differences in population, sample size, case mix, mortality rate, and study design.^{1,2}

Comparison of ROC-derived cut-offs

The present study identified $\text{NLR} \geq 7.2$ and $\text{PLR} \geq 210$ as optimal cut-offs, with sensitivities of 83% and 80% and specificities of 78% and 75%, respectively. These thresholds should be interpreted as cohort-specific because previous pediatric studies have reported different thresholds and diagnostic performance; for example, Mahalingam et al. reported $\text{NLR} \geq 7$ with high specificity and $\text{PLR} \geq 3.9$ with high sensitivity but low specificity. Mohamed et al. did not find NLR or PLR to be significant mortality predictors at admission. Therefore, the present cut-offs require prospective multicentre validation before they can be generalized to other PICUs.^{14,15}

Strengths

The key strength of this study is its focus on a real-world, heterogeneous PICU population, which enhances the generalizability of our findings to similar settings. Furthermore, the use of serial measurements provides a dynamic perspective on the host response.

Limitations

However, the study has several limitations. Its retrospective, single-center design is prone to selection bias and limits causal inference. The exclusion of patients with a PICU stay of less than five days may have introduced a survival bias, excluding those who died very early in their course. While we adjusted for the primary diagnosis, we could not control for all potential confounders, such as the impact of specific treatments (e.g., steroids, chemotherapy) on lymphocyte and platelet counts. Finally, the relatively small number of non-survivors ($n=20$) may have limited the precision of our cut-off estimates.

CONCLUSION

Repeated assessment of the neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio offers important prognostic insights in critically ill pediatric patients. An increasing trend in NLR and PLR during the initial five days of PICU admission is significantly linked to higher mortality rates and clinical decline. Being cost-effective, quick, and widely accessible indicators obtained from standard blood tests, they can act as significant supplements to recognized scoring frameworks such as PELOD-2. Integrating these elements into routine clinical evaluations could improve early risk assessment, allow for more vigilant tracking of disease advancement, and support prompt therapeutic interventions, especially in environments with limited resources where complex testing is not readily available. It is essential to conduct prospective, multi-center studies to confirm these findings

and determine clear cut-off values for effective clinical decision-making.

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Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Pollack MM, Holubkov R, Funai T, Berger JT, Clark AE, Meert K, et al. Simultaneous Prediction of New Morbidity, Mortality, and Survival Without New Morbidity From Pediatric Intensive Care: A New Paradigm for Outcomes Assessment. *Crit Care Med.* 2015;43(8):1699-709.
2. Leteurtre S, Duhamel A, Salleron J, Grandbastien B, Lacroix J, Leclerc F; Groupe Francophone de Réanimation et d'Urgences Pédiatriques (GFRUP). PELOD-2: an update of the PEdiatric logistic organ dysfunction score. *Crit Care Med.* 2013;41(7):1761-73.
3. Slater A, Shann F, Pearson G; Paediatric Index of Mortality (PIM) Study Group. PIM2: a revised version of the Paediatric Index of Mortality. *Intensive Care Med.* 2003;29(2):278-85.
4. Pierrakos C, Vincent JL. Sepsis biomarkers: a review. *Crit Care.* 2010;14(1):R15.
5. Aird WC. The role of the endothelium in severe sepsis and multiple organ dysfunction syndrome. *Blood.* 2003;101(10):3765-77.
6. Zahorec R. Ratio of neutrophil to lymphocyte counts-rapid and simple parameter of systemic inflammation and stress in critically ill. *Bratisl Lek Listy.* 2001;102(1):5-14.
7. Hotchkiss RS, Monneret G, Payen D. Sepsis-induced immunosuppression: from cellular dysfunctions to immunotherapy. *Nat Rev Immunol.* 2013;13(12):862-74.
8. Liu X, Shen Y, Wang H, Ge Q, Fei A, Pan S. Prognostic Significance of Neutrophil-to-Lymphocyte Ratio in Patients with Sepsis: A Prospective Observational Study. *Mediators Inflamm.* 2016;2016:8191254.
9. Saliccioli JD, Marshall DC, Pimentel MA, Santos MD, Pollard T, Celi LA, et al. The association between the neutrophil-to-lymphocyte ratio and mortality in critical illness: an observational cohort study. *Crit Care.* 2015;19(1):13.
10. Balta S, Ozturk C. The platelet-lymphocyte ratio: A simple, inexpensive and rapid prognostic marker for cardiovascular events. *Platelets.* 2015;26(7):680-1.
11. Gasparyan AY, Ayvazyan L, Mukanova U, Yessirkepov M, Kitas GD. The Platelet-to-Lymphocyte Ratio as an Inflammatory Marker in Rheumatic Diseases. *Ann Lab Med.* 2019;39(4):345-57.
12. Kaushik R, Gupta S, Sarna MS. Neutrophil-to-lymphocyte ratio in critically ill children: a

retrospective cohort study. *J Pediatr Intensive Care*. 2020;9(4):265-70.

13. Sayed SZ, Mahmoud MM, Monir HH. Neutrophil-lymphocyte ratio as a predictor of mortality in pediatric sepsis. *Egypt J Pediatr*. 2021;38(1):1-10.
14. Mahalingam S, Bhaskar V, Batra P, Dewan P, Gogoi P. Hematological Indices for Identifying Adverse Outcomes in Children Admitted to Pediatric ICUs. *Cureus*. 2024;16(2):e53744.
15. Mohamed AO, Abdel Ghaney MAS, Hosni YA. Evaluating the significance of platelet count, neutrophil-to-lymphocyte ratio and platelet-to-

lymphocyte ratio in critically ill children. *Sci Rep*. 2026;16:23494.

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