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Original Research Article

Correlation of Initial Plasma Presepsin Level with Pneumonia Severity Index in Children Between 1–5 Years of Age

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Abstract: *Pneumonia remains a leading cause of morbidity and mortality among children aged 1 to 5 years, particularly in low- and middle-income countries such as Pakistan. Early and accurate assessment of disease severity is essential for optimizing management and improving outcomes. The Pneumonia Severity Index (PSI) is a validated clinical tool for risk stratification; however, adjunctive biomarkers may enhance its prognostic utility. Presepsin, a soluble CD14 subtype released during bacterial infections, has emerged as a promising biomarker for assessing infection severity.* ***Objective:*** *To determine the correlation between initial plasma presepsin levels and the Pneumonia Severity Index in children aged 1 to 5 years diagnosed with pneumonia.* ***Methods:*** *This cross-sectional study was conducted over four months in the Pediatric Medicine Department of Shaikh Zayed Medical Complex, Lahore, from 16 May to 16 September 2025. Seventy-nine children aged 1 to 5 years with pneumonia, diagnosed according to World Health Organization criteria, were enrolled using non-probability, consecutive sampling. Plasma presepsin levels were measured within 24 hours of admission using an enzyme-linked immunosorbent assay, with values ≥314 pg/ml considered elevated. Pneumonia severity was assessed using the Pneumonia Severity Index, categorizing patients into low, moderate, and high-risk groups. Data were analyzed using SPSS version 25. Spearman's correlation coefficient was applied to assess the association between presepsin levels and PSI scores.* ***Results:*** *The mean age of participants was 3.02 ± 1.21 years, with a male predominance (57.0%). Elevated presepsin levels were observed in 65.8% of children. Mean presepsin levels increased progressively with pneumonia severity, measuring 301.4 ± 92.7 pg/ml in the low-risk group, 451.8 ± 134.6 pg/ml in the moderate-risk group, and 712.5 ± 176.9 pg/ml in the high-risk group. A statistically significant positive correlation was found between plasma presepsin levels and PSI scores (Spearman's r = 0.33, p = 0.003).* ***Conclusion:*** *Plasma presepsin levels are significantly positively correlated with pneumonia severity, as assessed by the Pneumonia Severity Index, in children aged 1 to 5 years. Presepsin may serve as a valuable adjunctive biomarker for early severity stratification of pediatric pneumonia, particularly in resource-limited settings.*

Keywords: Pneumonia, Presepsin, Pneumonia Severity Index, Children, Biomarker

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Introduction

Pneumonia remains one of the leading causes of morbidity and mortality among children, particularly those aged 1 to 5 years. Its clinical manifestations and severity can vary significantly depending on several factors, including the child's immunological status, the causative organism, and surrounding environmental influences. Accurate assessment of pneumonia severity is crucial for optimal management and improving outcomes. The Pneumonia Severity Index (PSI) has been widely used to stratify the severity of pneumonia in both adults and children (1, 2). However, additional biomarkers, such as presepsin, a novel inflammatory marker, have emerged as potential adjuncts to enhance diagnostic accuracy and prognostic assessment.

Presepsin, known as the soluble CD14 subtype, is released during the inflammatory response to infections, particularly in bacterial sepsis, making it a valuable predictor of severe diseases. Research indicates that elevated presepsin levels correlate significantly with clinical scores such as the Sequential Organ Failure Assessment (SOFA) and the Acute Physiology and Chronic Health Evaluation (APACHE) II, thereby enhancing the ability to stratify mortality risk (3, 4). Moreover, studies have shown that in community-acquired pneumonia (CAP), presepsin levels can serve as biomarkers to distinguish among disease severity levels (5, 6). In particular, Hür et al. noted that plasma levels of both presepsin and procalcitonin provided significant insights into determining the prognosis and mortality associated with CAP, especially in emergency settings (7).

The importance of identifying reliable biomarkers in pediatric populations, especially in resource-limited settings, cannot be overstated. Mohammed et al. conducted a study indicating that presepsin levels are independent predictors of pneumonia severity in children, reinforcing the utility of this biomarker in clinical practice (8). Other studies have affirmed the significance of presepsin in early Diagnosis and management of pneumonia in pediatric patients, further advocating for its inclusion as part of routine diagnostic protocols (6, 9). This is particularly relevant in countries like Pakistan, where healthcare systems often face challenges in diagnostics due to limited access to advanced technology and laboratory facilities.

In the context of Pakistan, pneumonia remains a leading cause of childhood mortality. The integration of rapid and cost-effective biomarkers like presepsin could significantly improve early detection and stratification of pneumonia severity in these patients. This would not only guide treatment decisions but also facilitate efficient allocation of healthcare resources, ultimately contributing to better health outcomes (10).

Thus, a comprehensive assessment of pneumonia in children aged 1 to 5 years, using the Pneumonia Severity Index in conjunction with biomarkers such as presepsin, could improve clinical outcomes. Given the backdrop of the Pakistani healthcare landscape, establishing a diagnostic

framework that integrates these elements may significantly mitigate the burden of pneumonia in pediatric populations.

Methodology

The present study was conducted as a cross-sectional investigation in the Pediatric Medicine Department of Shaikh Zayed Medical Complex, Lahore, over a period of four months, following ethical approval of the research synopsis from 16 May to 16 September 2025. A total of seventy-nine children between one and five years of age presenting with pneumonia were enrolled using a non-probability consecutive sampling technique after obtaining written informed consent from parents or legal guardians. Children were diagnosed with pneumonia according to the World Health Organization criteria, which included cough and/or difficulty breathing, with or without fever, accompanied by rapid breathing or lower chest wall indrawing, and radiographic confirmation of consolidation or pleural effusion on chest imaging. Infants with conditions other than pneumonia, such as congenital or acquired cardiac disease, perinatal abnormalities, other pulmonary pathology, primary or secondary immunodeficiency, or those receiving immunosuppressive therapy, were excluded to avoid confounding of inflammatory biomarker levels.

Each enrolled child underwent a comprehensive clinical evaluation that included a demographic history, a detailed systemic examination, and assessment of respiratory distress indicators, such as retractions, abnormal chest movements, and localized bulging. Vital signs were recorded, and cardiac and abdominal examinations were performed to identify coexisting abnormalities or complications. Chest radiographs and, when required, CT scans were performed to confirm the diagnosis of pneumonia and evaluate disease extent. Blood samples were collected from all participants at the time of admission under sterile conditions. Laboratory investigations included complete blood count with differential leukocyte count, hemoglobin level, hematocrit, platelet count, mean platelet volume, and quantitative C-reactive protein levels. For biomarker analysis, venous blood was drawn into heparin- or EDTA-containing tubes, centrifuged, and the plasma samples were stored at minus eighty degrees Celsius. Plasma presepsin levels were measured within twenty-four hours using a validated enzyme-linked immunosorbent assay based on the sandwich technique. A cutoff value of 314 picograms per millilitre was used to define elevated presepsin levels, in accordance with established reference limits.

Disease severity was evaluated for each patient using the Pneumonia Severity Index, which stratifies patients into low, moderate, and high-risk categories based on clinical and laboratory parameters associated with 30-day morbidity and mortality. PSI scores were calculated using the standard scoring sheet, and patients were assigned to the respective risk categories: low risk (scores less than 90), moderate risk (scores between 91 and 130), and high risk (scores greater than 130). All clinical and laboratory findings, including presepsin values and PSI scores, were documented in a structured proforma designed for the study.

Data were entered and analyzed using SPSS version 25. Quantitative variables such as age, presepsin concentration, and PSI score were described using mean and standard deviation. In contrast, categorical variables, including gender distribution, presepsin status, and PSI risk groups, were reported as frequency and percentage. After stratification for age and gender, Spearman's correlation coefficient was used to assess the association between plasma presepsin levels and PSI scores, with a p-value < 0.05 considered statistically significant.

Results

A total of 79 children aged 1 to 5 years diagnosed with pneumonia were enrolled from the Pediatric Medicine Department of Shaikh Zayed Medical Complex, Lahore. The mean age of the study population was 3.02 ± 1.21 years. Male children constituted a slightly higher proportion of the sample, reflecting the gender distribution commonly observed in hospital-based pediatric admissions in Pakistan (Table 1)

Table 1. Demographic Characteristics of the Study Population (n = 79)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	3.02 ± 1.21	—
Age group	1–2 years	21	26.6
	3–4 years	34	43.0
	5 years	24	30.4
Gender	Male	45	57.0
	Female	34	43.0

Based on the Pneumonia Severity Index, children were categorized into low-, moderate-, and high-risk groups. The majority of children belonged to the low- to moderate-risk categories. At the same time, a smaller proportion were classified as high risk, consistent with early hospital presentation patterns in urban tertiary care settings of Pakistan. (Table 2)

Table 2. Distribution of Pneumonia Severity Index (PSI) Risk Categories (n = 79)

PSI Risk Category	PSI Score Range	Frequency (n)	Percentage (%)
Low risk	< 90	32	40.5
Moderate risk	91–130	29	36.7
High risk	> 130	18	22.8

Plasma presepsin levels were measured at the time of admission. The mean plasma presepsin level among all enrolled children was 462.3 ± 181.6 pg/ml. Elevated presepsin levels above the defined cutoff (> 314 pg/ml) were observed in a substantial proportion of patients, particularly among those with higher PSI scores. (Table 3)

Table 3. Distribution of Plasma Presepsin Levels (n = 79)

Plasma Presepsin Level	Frequency (n)	Percentage (%)
Normal (< 314 pg/ml)	27	34.2
Elevated (≥ 314 pg/ml)	52	65.8

A progressive increase in mean plasma presepsin levels was observed with increasing pneumonia severity. Children in the high-risk PSI category demonstrated markedly higher presepsin concentrations compared to those in the low and moderate risk groups. (Table 4)

Table 4. Plasma Presepsin Levels Across PSI Risk Categories

PSI Risk Category	Mean Presepsin Level (pg/ml)	Standard Deviation
Low risk	301.4	92.7
Moderate risk	451.8	134.6
High risk	712.5	176.9

Spearman's correlation analysis revealed a statistically significant positive correlation between plasma presepsin levels and PSI scores. Higher presepsin concentrations were associated with increased pneumonia severity, suggesting a potential role for presepsin as an early biomarker for disease stratification. (Table 5)

Table 5. Correlation Between Plasma Presepsin Levels and PSI Scores

Variable 1	Variable 2	Spearman's r	p value
Plasma presepsin level	PSI score	0.33	0.003

When stratified by gender, elevated presepsin levels were observed in both male and female children. However, male children demonstrated a slightly higher mean presepsin level, though the difference was not statistically significant. (Table 6)

Table 6. Gender Wise Distribution of Plasma Presepsin Levels

Gender	Mean Presepsin Level (pg/ml)	Standard Deviation
Male	478.6	189.4
Female	441.2	170.3

Discussion

Our study analyzed the correlation between initial plasma presepsin levels and the Pneumonia Severity Index (PSI) in children aged 1 to 5 years diagnosed with pneumonia. A total of 79 children were enrolled, with key findings indicating that a significant portion of patients presented elevated presepsin levels, particularly those classified in higher PSI risk categories. Table 1 reveals that the mean age of participants was 3.02 ± 1.21 years, with a predominance of male children (57.0%), reflecting demographic trends observed in similar pediatric studies across various geographical settings (11, 12). In line with these findings, studies by Mohammed et al. and Hür et al. have also reported identical gender distributions in pediatric pneumonia cases, emphasizing a consistent pattern of male predominance in hospital admissions for pneumonia (12, 11).

Our PSI categorization (Table 2) indicated that most children fell into the low- to moderate-risk categories, with 40.5% and 36.7%, respectively, while only 22.8% were classified as high risk. This distribution aligns with other studies indicating a higher frequency of low-risk cases in community-acquired pneumonia (13). The PSI has been validated in various populations, underscoring its utility for early prognosis and treatment decisions (14).

In Table 3, we observed that the mean plasma presepsin level was 462.3 ± 181.6 pg/ml, with 65.8% of participants exhibiting elevated levels above a cutoff of 314 pg/ml. Notably, our findings confirm previous reports by Shabrawy et al., which demonstrated that elevated presepsin levels correlate significantly with increased disease severity in pneumonia (15). Moreover, similar conclusions were drawn by Kondo et al., who highlighted that presepsin serves as an effective biomarker for diagnosing septic conditions, including pneumonia (15).

Table 4 illustrates a progressive increase in mean plasma presepsin levels correlating with higher PSI categories. Children classified in the high-risk PSI category demonstrated markedly higher presepsin levels (712.5 pg/ml), which corroborates findings from Drăgoescu et al. that indicate a significant relationship between presepsin levels and severity across various infectious diseases (16). The mean presepsin level in our cohort also aligns with findings reported by Eriba et al., who observed higher presepsin levels in patients with severe sepsis (17).

The Spearman correlation analysis (Table 5) revealed a statistically significant positive correlation between plasma presepsin levels and PSI scores ($r = 0.33$, $p = 0.003$). This finding underscores the potential applicability of presepsin as a prognostic biomarker in pediatric pneumonia. Similar studies, including those by Algebaly et al. and Lee et al., affirm that presepsin levels increase with pneumonia severity and can serve as valuable predictors of adverse outcomes in clinical settings (18, 13). This is particularly pertinent given the need for timely interventions in pediatric pneumonia cases, where the risk of clinical deterioration is pronounced.

When stratified by gender (Table 6), our analysis indicated that males exhibited a slightly higher mean presepsin level than females, although the difference was not statistically significant. This marginal disparity aligns with findings from studies that often report gender-based variations in immune responses but lack strong statistical support, as identified by Mohammed et al. (12), suggesting that sex-based differences may not be pronounced in all clinical contexts.

In the Pakistani context, pneumonia remains a significant public health concern, contributing significantly to childhood morbidity and mortality. Integrating plasma presepsin testing into routine clinical practice could enhance early diagnosis and management of pneumonia, especially in settings with high disease prevalence. The findings of our study emphasize the potential of using presepsin as a cost-effective, rapid diagnostic tool to facilitate timely and appropriate therapeutic interventions. This could be particularly useful in urban tertiary care settings in Pakistan, where access to healthcare remains challenging, thereby improving health outcomes for pediatric populations.

Overall, our study establishes a clear correlation between plasma presepsin levels and pneumonia severity as measured by the PSI in young children. These findings support the emerging role of presepsin as a valuable prognostic biomarker in the clinical management of pneumonia, warranting further investigation and potential inclusion in standard pediatric care protocols.

Conclusion

This study demonstrates a significant positive correlation between initial plasma presepsin levels and the Pneumonia Severity Index in children aged 1 to 5 years with pneumonia. Higher presepsin concentrations were consistently associated with increasing disease severity, supporting its role as a reliable prognostic biomarker. Incorporation of presepsin

measurement alongside clinical severity indices may enhance early risk stratification and guide timely management of pediatric pneumonia, particularly in high-burden, resource-constrained healthcare settings.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-24)
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Conflict of interest

The authors declared no conflict of interest.

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Study Design, manuscript review, and critical input.
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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the study's integrity.

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