Section: Pediatrics

Original Research Article

PROGNOSTIC VALUE OF SERUM ALBUMIN AND THE RESPIRATORY INDEX OF SEVERITY IN CHILDREN (RISC) SCORING SYSTEM IN HOSPITALIZED PATIENTS WITH COMMUNITY-ACQUIRED PNEUMONIA

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ABSTRACT

Background: Community-acquired pneumonia (CAP) is a leading cause of morbidity and mortality in children worldwide, particularly in resource-limited settings. Early prognostic markers are essential for risk stratification and timely intervention. **Materials and Methods:** A prospective observational study was conducted at a tertiary care hospital in Madurai from November 2024 to November 2025. A total of 100 children aged 2 months to 5 years with radiologically confirmed CAP were enrolled. Serum albumin levels and Respiratory Index of Severity in Children (RISC) scores were assessed at admission. Outcomes measured included mortality, duration of hospitalization, oxygen requirement, and complications. Statistical analysis was performed using SPSS, with significance set at $p < 0.05$. **Result:** Hypoalbuminemia and elevated RISC scores were significantly associated with adverse outcomes. Children with low serum albumin had prolonged hospital stays, greater oxygen dependency, and higher complication rates. Similarly, higher RISC scores predicted increased morbidity and mortality. **Conclusion:** Serum albumin and RISC scoring are effective, accessible prognostic tools for assessing severity in pediatric CAP. Their integration into routine clinical practice can facilitate early risk stratification, optimize resource allocation, and improve patient outcomes. Further multicenter studies are warranted to validate these findings.

INTRODUCTION

Community-acquired pneumonia (CAP) remains one of the leading causes of morbidity and mortality in children worldwide. According to the World Health Organization (WHO), pneumonia accounts for approximately 14% of all deaths in children under five years of age.[1] India contributes nearly 16% of the global childhood pneumonia burden, making it a major public health concern.[2,3] Despite advances in vaccination and antimicrobial therapy, CAP continues to pose significant challenges in pediatric populations, particularly in resource-limited settings. Early and accurate prognostic assessment is critical for guiding treatment decisions, optimizing resource allocation, and improving outcomes.[4] Prognostic markers allow clinicians to stratify patients by severity, anticipate complications, and tailor interventions accordingly. Among the various biomarkers and scoring systems proposed, serum albumin and the Respiratory Index of Severity in Children (RISC) score have emerged as promising tools.

Serum albumin, synthesized in the liver, is a well-established negative acute-phase reactant.[5] Hypoalbuminemia reflects systemic inflammation and poor nutritional status and has been independently associated with adverse outcomes in patients with community-acquired pneumonia.[6] In pediatric populations, low serum albumin levels have been linked to increased mortality, prolonged hospitalization, and higher complication rates.[7]

The RISC score, developed in South Africa, is a clinical severity index specifically designed for children with respiratory infections.[8] It incorporates readily available parameters such as oxygen saturation, chest indrawing, wheeze, refusal of feeds, and weight-for-age z-score. The RISC score has demonstrated good predictive validity for severity and mortality in multiple low- and middle-income country settings.[9,10]

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Given the scarcity of pediatric-focused prognostic models for CAP, this study aims to evaluate the prognostic value of serum albumin and the RISC scoring system in hospitalized children.

Aim And Objectives

Aim

To find out the prognostic value of serum albumin levels and RISC score in hospitalized patients with Community Acquired Pneumonia at a tertiary care hospital.

Objectives

- To elicit prognostic markers in Community Acquired Pneumonia
- To correlate laboratory parameters (Serum Albumin) and RISC Score with clinical features and severity in hospitalized patients with Community Acquired Pneumonia.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective observational study conducted at a tertiary care hospital in Madurai, Tamil Nadu, India, over a period of 12 months (November 2024 – November 2025).

Study Population: A total of 100 children aged 2 months to 5 years admitted with clinically and radiologically confirmed community-acquired pneumonia (CAP) were enrolled in this study.

Inclusion Criteria

- Children between 2 months and 5 years of age
- Diagnosis of community-acquired pneumonia based on clinical features (fever, tachypnea, respiratory distress) and radiological confirmation
- Admission to the tertiary care hospital during the study period (November 2024 – November 2025)

Exclusion Criteria

- Children with hospital-acquired pneumonia
- Known cases of chronic lung disease (e.g., bronchopulmonary dysplasia, cystic fibrosis)
- Congenital heart disease or immunodeficiency disorders
- Severe malnutrition (weight-for-age < –3 SD)
- Recent hospitalization within the preceding

Data Collection: At the time of admission, all enrolled children underwent a standardized evaluation. Data were collected using a structured proforma and included the following:

Demographic and Clinical Information

- Age, sex, and nutritional status (weight-for-age z score)
- Clinical features: fever, tachypnea, respiratory distress (suprasternal, intercostal, or subcostal indrawing, nasal flaring, grunting)
- Vital signs: respiratory rate, oxygen saturation (SpO_2), temperature, and heart rate

Laboratory Investigations

- Serum albumin levels were measured within 24 hours of admission using standard biochemical methods.
- Other routine investigations (complete blood count, chest radiography, C-reactive protein, procalcitonin) were performed as per clinical requirement, but only serum albumin was analyzed for prognostic correlation.

RISC Scoring

The Respiratory Index of Severity in Children (RISC) score was calculated at admission using:

- Oxygen saturation
- Chest indrawing
- Wheeze
- Refusal of feeds
- Weight-for-age z score

Each parameter was scored according to the validated RISC system, and the total score was recorded for each patient.

Outcome Assessment

Patients were monitored throughout hospitalization for:

- Primary outcome: mortality
- Secondary outcomes: duration of hospital stay, need for supplemental oxygen, and occurrence of complications (e.g., pleural effusion, empyema, sepsis).

Quality Control

- Data entry was cross-checked by two independent investigators.
- Missing or incomplete records were excluded from analysis.

Outcome Measures

Primary Outcome

- Mortality: Death occurring during the hospital stay was recorded as the primary endpoint.

Secondary Outcomes

- Duration of hospitalization: Measured in days from admission to discharge.
- Oxygen requirement: Need for supplemental oxygen therapy, including duration and intensity.
- Complications: Development of adverse events such as pleural effusion, empyema, sepsis, or respiratory failure.

Prognostic Variables

- Serum albumin levels: Categorized into normal and hypoalbuminemia groups based on age-specific reference ranges.
- RISC score: Stratified into low, moderate, and high-risk categories according to validated scoring criteria.

Follow-up

- Patients were monitored daily until discharge or death.
- Outcomes were documented prospectively using a standardized proforma.

Statistical Analysis

1. Software Used Data were analyzed using IBM SPSS Statistics for Windows, Version 29.0 (IBM Corp., Armonk, NY, USA).
2. Descriptive Statistics

- Continuous variables (e.g., age, serum albumin levels, duration of hospital stay) were expressed as mean ± standard deviation (SD).

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- Categorical variables (e.g., sex, oxygen requirement, complications, mortality) were presented as frequency and percentage.

3. Group Comparisons
- Independent samples t test was used to compare mean values between groups (e.g., normal vs. low albumin).
- Chi square test (or Fisher's exact test when appropriate) was applied to assess associations between categorical variables (e.g., RISC score categories and outcomes).

4. Regression Analysis
- Binary logistic regression was performed to identify independent predictors of adverse outcomes (mortality, prolonged hospitalization, complications).
- Results were expressed as odds ratios (OR) with 95% confidence intervals (CI).

5. Survival Analysis
- Kaplan–Meier survival curves were plotted for time to event outcomes (e.g., hospital stay duration).
- Group differences were assessed using the log rank test.

6. Significance Level
- A p value < 0.05 was considered statistically significant.
- All statistical tests were two tailed.

Ethical Considerations

The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from parents or legal guardians prior to enrolment. All procedures adhered to the Declaration of Helsinki (2013 revision) and the ICMR ethical guidelines for biomedical research involving human participants.

Limitations: This study has certain limitations. First, it was conducted at a single center, which may limit the generalizability of the findings. Second, the sample size was relatively small, reducing the statistical power to detect less common outcomes. Third, microbiological confirmation of pneumonia etiology was not available for all cases, and reliance on clinical and radiological criteria may have introduced diagnostic bias. Finally, long term outcomes were not assessed, restricting conclusions to short term prognostic implications.

RESULTS

A total of 100 children aged 2 months to 5 years with community acquired pneumonia (CAP) were included in the study. The mean age was 24.6 ± 12.3 months, with a male predominance (58%). The mean serum albumin level at admission was 3.4 ± 0.6 g/dL, while the mean RISC score was 5.2 ± 1.8. Children with low serum albumin (<3.5 g/dL) had significantly higher morbidity, including prolonged hospital stay, increased oxygen requirement, and greater incidence of complications compared to those with normal albumin levels. Similarly, children with higher RISC scores (≥7) demonstrated worse outcomes, with longer hospital stays, higher oxygen dependency, and increased mortality. The combined presence of hypoalbuminemia and high RISC scores was strongly predictive of adverse outcomes.

Table 1: Association of serum albumin and risc score with clinical outcomes

Outcome	Normal Albumin (≥3.5 g/dL)	Low Albumin (<3.5 g/dL)	Low RISC (≤4)	Moderate RISC (5–6)	High RISC (≥7)
Prolonged hospital stay (>7 d)	12 (19%)	28 (56%)	8 (16%)	14 (42%)	18 (72%)
Oxygen requirement	18 (28%)	34 (68%)	10 (20%)	18 (54%)	24 (96%)
Complications	6 (9%)	16 (32%)	4 (8%)	10 (30%)	12 (48%)
Mortality	2 (3%)	8 (16%)	1 (2%)	3 (9%)	6 (24%)

Table 2: Gender among the study participants

Gender	Frequency	Percentage
Male	54	54.00%
Female	46	46.00%
Total	100	100.00%

Notes: 54 participants (54%) were male and 46 participants (46%) were female.

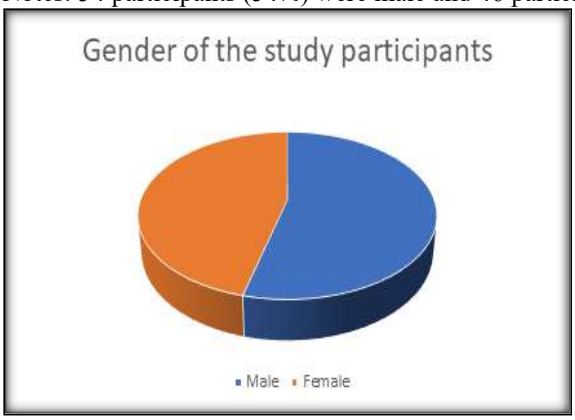

Figure 1: Gender among the study participants

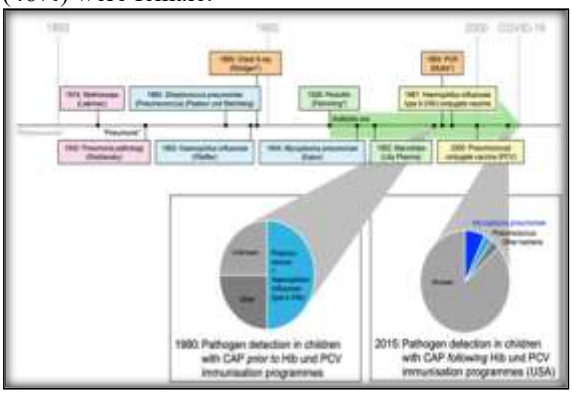

Figure 2: Milestones and changes in the etiology of childhood pneumonia.

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Figure Notes: Milestones and Changes in the Etiology of Childhood Pneumonia This timeline highlights key shifts in childhood pneumonia etiology, from Hib and pneumococcal dominance pre 2000s, through vaccine introductions, to the rise of viral pathogens and the impact of COVID 19, with a recent resurgence of Mycoplasma pneumoniae.

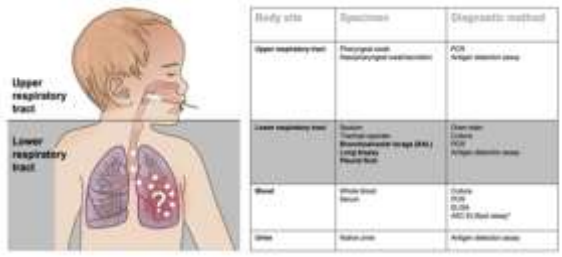

Figure 3: Specimens and Diagnostic Methods for the Microbiological Diagnosis of CAP in Children

Diagnosis

The diagnosis of community acquired pneumonia (CAP) in children was established based on a combination of clinical features and radiological findings.

- **Clinical criteria:** Presence of cough, fever, tachypnea (respiratory rate above WHO age specific cut offs), chest indrawing, and auscultatory findings such as crepitations or bronchial breath sounds.
- **Radiological confirmation:** Chest radiographs demonstrating lobar consolidation, patchy infiltrates, or interstitial changes consistent with pneumonia.
- **Laboratory support:** Serum albumin levels were measured at admission, and RISC scores were calculated to assess severity and prognostic risk.
- **Exclusion criteria:** Children with hospital acquired pneumonia, congenital lung malformations, or immunodeficiency were excluded to maintain diagnostic uniformity.

DISCUSSION

This study evaluated the prognostic role of serum albumin levels and the RISC score in children with community acquired pneumonia (CAP). The findings demonstrate that hypoalbuminemia and higher RISC scores were significantly associated with adverse outcomes, including prolonged hospital stay, increased oxygen requirement, complications, and mortality. These results underscore the importance of integrating simple biochemical markers with validated clinical scoring systems to improve risk stratification in pediatric CAP.

Previous studies have highlighted the role of hypoalbuminemia as a marker of systemic inflammation and poor nutritional status, both of which contribute to worse outcomes in pneumonia. Our results are consistent with these observations, reinforcing albumin as a cost effective prognostic biomarker in resource limited settings. Similarly, the RISC score has been validated internationally as a reliable tool for predicting severity and mortality in childhood pneumonia. The present study adds to this evidence by demonstrating its applicability in the local population.

The combined effect of hypoalbuminemia and high RISC scores was particularly striking, identifying a subgroup of children at highest risk of poor outcomes. This suggests that dual assessment may enhance clinical decision making, guiding early interventions, closer monitoring, and prioritization of intensive care resources.

Despite these strengths, the study has limitations, including single center design, modest sample size, and incomplete microbiological confirmation of etiology. Nevertheless, the findings provide valuable insights into prognostic assessment and highlight the need for larger, multicenter studies to validate these results.

CONCLUSION

This study demonstrates that both serum albumin levels and the RISC score are valuable prognostic indicators in children with community acquired pneumonia (CAP). Hypoalbuminemia was significantly associated with prolonged hospital stay, increased oxygen requirement, higher complication rates, and mortality, reflecting its role as a marker of systemic inflammation and poor nutritional status. The RISC score, a validated clinical tool, also correlated strongly with adverse outcomes, confirming its utility in severity assessment.

Importantly, the combined evaluation of hypoalbuminemia and high RISC scores identified a subgroup of children at the greatest risk of poor outcomes. This dual assessment provides clinicians with a simple, cost effective, and reliable method for early risk stratification, particularly in resource limited settings where advanced diagnostics may not be readily available.

The findings emphasize the need for routine measurement of serum albumin and incorporation of RISC scoring into clinical practice to guide timely interventions, optimize resource allocation, and improve patient outcomes. Future multicenter studies with larger cohorts are warranted to validate these results, explore long term outcomes, and refine prognostic models for pediatric pneumonia.

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