e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(5); 391-396

Original Research Article

# Clinical Correlation with the Outcome of Different Types of Pneumonia in Children Aged between Two Months to Five Years at a Tertiary Healthcare Center

**Samit Basu[1], Gargi Gayen[2], Abhisek Biswas[3], Kalpana Datta[4]**

[1]Assistant Professor, Department of Paediatrics, Medical College and Hospital, Kolkata, WB, India
[2]Assistant Professor, Department of Paediatrics, Medical College and Hospital, Kolkata, WB, India
[3]Resident, Department of Paediatrics, Medical College and Hospital, Kolkata, WB, India
[4]Professor & HOD, Department of Paediatrics, Medical College and Hospital, Kolkata, WB, India

**Received: 01-02-2026 / Revised: 15-03-2026 / Accepted: 21-04-2026**
**Corresponding author: Dr. Samit Basu**
**Conflict of interest: Nil**

**Abstract**

**Background:** Pneumonia remains a significant contributor to childhood morbidity and mortality. So, correlation of clinical features and outcome will help to improve the treatment plan.

**Objective:** To identify the clinical factors responsible for the positive or negative outcome of pneumonia in children.

**Methods:** The study was conducted on children of age 2-months-5 years, admitted in Medical College, Kolkata, a tertiary care hospital over a period of two years from February 2023 to November 2024. Information collected over multiple independent and dependent variables and they were systematically reviewed to assess the clinical correlation and outcomes of pneumonia in these children.

**Results**: Children of 13–24 months age group are most susceptible for pneumonia. Most children required 4–6 days of hospitalization. Fever, cough with unilateral consolidation in CXR were the most common features. In HRCT, Consolidation and pleural effusion were found to be more common in bacterial pneumonia whereas ground-glass opacities were more common in viral pneumonia. Children presented with tachypnoea, chest retraction, hypoxia and altered sensorium had worse outcome and mortality risk.

**Conclusion:** The systematic review of this study presented the different variables related to pneumonia which can be used to improve the overall management plan.

**Keywords:** Pediatric Pneumonia, Clinical Profile, Childhood Morbidity and Mortality, Preschool Children.

**DOI:** 10.25258/ijcpr.18.5.62



## Introduction

Pneumonia is one of the leading causes of morbidity and mortality in children under five years of age, particularly in low- and middle-income countries (LMICs) [1]. It accounts for nearly 14% of deaths among children under five globally, with the World Health Organization (WHO) estimating approximately 700,000 deaths annually due to pneumonia [2].

Despite advancements in medical care and the availability of vaccines, pneumonia remains a significant public health concern, particularly in regions with poor access to healthcare, malnutrition, and overcrowded living conditions [3]. Pneumonia is defined as an acute respiratory infection that primarily affects the lungs, causing inflammation of the alveoli, which fill with pus or fluid, leading to impaired oxygen exchange [4]. The pathogenesis of pneumonia varies depending on the causative organism. Viruses damage the epithelial cells of the respiratory tract, leading to inflammation, increased mucus production, and airway obstruction. Bacterial pneumonia, on the other hand, leads to alveolar inflammation and exudation, causing consolidation, fever, and respiratory distress [5]. The clinical features of pneumonia vary depending on the etiology, severity, and immune status of the child. WHO classifies pneumonia into mild, moderate, and severe based on symptoms such as fever, tachypnea, chest indrawing, grunting, hypoxia, and altered consciousness [6].

Accurate diagnosis is essential for appropriate management. The gold standard for pneumonia diagnosis includes a combination of clinical assessment, radiological findings, and microbiological tests [7]. The management of

pneumonia depends on severity, causative pathogen, and clinical presentation [8]. In India, pneumonia contributes to 15–18% of under-five mortality, translating to approximately 150,000 deaths per year. The prevalence of pneumonia in paediatric hospital admissions varies between 20–40% depending on geographic location and seasonal variations. The Integrated Management of Childhood Illness (IMCI) strategy by WHO and UNICEF has played a significant role in reducing pneumonia-related deaths by improving early diagnosis and treatment [9].

The Government of India (GoI) has implemented multiple programs, including Social Awareness and Action to Neutralize Pneumonia Successfully (SAANS) campaign (2019) to improve early detection and management [10], Universal Immunization Program (UIP) offering pentavalent vaccine (Hib), Pneumococcal Conjugate Vaccine (PCV) to reduce hospital burden.

These strategies have contributed to a significant decline in childhood pneumonia deaths in recent years. However, challenges such as antibiotic resistance, low vaccine coverage, and poor healthcare access in rural areas persist, necessitating further research and policy improvements. This study aimed to correlate clinical features with outcomes in pediatric pneumonia cases in a tertiary care hospital in Kolkata. Identifying risk factors, severity indicators, and treatment responses will help optimize management protocols for paediatric pneumonia.

## Material and Methods

It was a hospital-based Observational Prospective study and was conducted over a period of two years among the children from 2 months- 5 years age admitted with pneumonia in Pediatric ward, HDU and PICU, Medical College, Kolkata, a tertiary care hospital.

**Inclusion Criteria:** Children aged 2 months to 5 years diagnosed with pneumonia based on WHO IMCI (Integrated Management of Childhood Illness) criteria and were admitted in ward or ICU and whose parents or guardians provided informed consent for participation in the study.

**Exclusion Criteria:** Children with congenital lung anomalies or chronic respiratory diseases (e.g., cystic fibrosis, bronchopulmonary dysplasia), immunodeficiency syndromes, congenital heart disease leading to recurrent lung infections and whose caregivers did not provide consent for participation.

**Statistical Analysis:** Sample Size Determination The number of study subjects was estimated using standard Cochran's formula

$$n = z\ \frac{(z_{1-a})^2 PQ}{d^2}$$

From previous studies it was found that the expected prevalence of bacterial pneumonia in paediatric children to be 26.6% 65 Q=100-P Assuming confidence interval of 95% with Z1-α=Z0.95=1.96 and Absolute error of precision = 5%, the final estimated sample size came to 300 Sampling Technique Systematic random sampling

Data were analysed using Microsoft excel 2019 and Statistical Package for Social Sciences software (SPSS Inc. Chicago II, version 23.0 for Windows) 1. Descriptive statistics were represented as frequency, percentage, mean and standard deviation, median, inter-quartile range and range. Descriptive data were represented using various tables, diagrams and graphs 2. Tests for normality were performed (Kolmogorov-Smirnov, Shapiro-Wilk, Histogram) 3. Chi-square test was done to find the association between the variables

## Results

The highest number of pneumonia cases was observed in the 13–24 months age group (23.3%), indicating that children in this range are more susceptible. The number of cases decreases with increasing age. Male children (60%) had a higher prevalence of pneumonia compared to females (40%), suggesting a possible gender-related susceptibility.

**Table 1: Baseline characteristics**

| **Age Group (Months)** | **Number of Cases (n)** | **Percentage (%)** |
|---|---|---|
| 2 – 6 | 50 | 16.7 |
| 7 – 12 | 60 | 20.0 |
| 13 – 24 | 70 | 23.3 |
| 25 – 36 | 50 | 16.7 |
| 37 – 48 | 40 | 13.3 |
| 49 – 59 | 30 | 10.0 |
| **Gender** | **Number of Cases (n)** | **Percentage (%)** |
| Male | 180 | 60.0 |
| Female | 120 | 40.0 |
| **Hospital Stay (Days)** | **Number of Cases (n)** | **Percentage (%)** |
| ≤ 3 Days | 80 | 26.7 |

| | | |
|---|---|---|
| 4 - 6 Days | 130 | 43.3 |
| ≥ 7 Days | 90 | 30.0 |
| **Cause of Pneumonia** | **Number of Cases (n)** | **Percentage (%)** |
| Only Viral Infection | 130 | 72.2% |
| Only Bacterial Infection | 40 | 22.2% |
| Mixed (Viral + Bacterial) Infection | 10 | 5.6% |

Most children (43.3%) required 4–6 days of hospitalization, while 30% had prolonged stays (≥7 days), possibly due to severe pneumonia or complications.

Fever (93.3%) and cough (90%) were the most common presenting symptoms. Severe signs like cyanosis (13.3%) and convulsions (8.3%) were less common but indicate critical cases. Hypoxia was present in 20.6% participants. Unilateral consolidation (40%) was the most frequent radiological finding. Pleural effusion (10%) suggests complicated pneumonia in some cases. About 46.7% of cases had leucocytosis, suggesting a strong inflammatory response.

Leukopenia was observed in a small proportion, possibly indicating severe infection or immune suppression. 50% of cases had moderately elevated CRP, and 33.3% had severely elevated CRP, indicating significant inflammation in pneumonia cases.

**Table 2: Investigating parameters**

| **TLC (cells/mm³)** | **Number of Cases (n)** | **Percentage (%)** |
|---|---|---|
| < 4000 (Leukopenia) | 20 | 6.7 |
| 4000 – 11000 | 140 | 46.7 |
| > 11000 (Leukocytosis) | 140 | 46.7 |
| **CRP (mg/L)** | **Number of Cases (n)** | **Percentage (%)** |
| < 10 (Normal) | 50 | 16.7 |
| 10 - 40 (Moderate) | 150 | 50.0 |
| > 40 (Severe) | 100 | 33.3 |
| **X-ray Findings** | **Number of Cases (n)** | **Percentage (%)** |
| Unilateral consolidation | 120 | 40.0 |
| Bilateral infiltrates | 100 | 33.3 |
| Pleural effusion | 30 | 10.0 |
| Hyperinflation | 25 | 8.3 |
| Normal | 25 | 8.3 |
| **HRCT Finding** | **Number of Cases** | **Percentage (%)** |
| Consolidation | 15 | 53.6% |
| Ground-glass Opacities (GGO) | 10 | 35.7% |
| Pleural Effusion | 8 | 28.6% |
| Bronchiectasis | 5 | 17.9% |
| Nodular Infiltrates | 4 | 14.3% |
| Interstitial Thickening | 6 | 21.4% |
| Normal HRCT | 2 | 7.1% |

The majority of cases were viral pneumonia (72.2%), distributed similarly in ICU and ward cases. Bacterial pneumonia (22.2%) was more common in ICU cases but without statistical significance (p=0.15).

Mixed infections (5.6%) were found more frequently in ward cases than ICU cases. No fungal infection was detected. Statistically significant differences ($p < 0.05$) were observed for recovery, recovery with complications, and mortality, suggesting ICU patients had worse outcomes compared to ward patients.

Fever and cough were the most common symptoms in all groups, but their prevalence was significantly lower in mortality cases ($p < 0.01$). Tachypnoea and chest indrawing were significantly associated with worse outcomes, seen more in complicated cases ($p < 0.05$). Cyanosis, altered sensorium, and hypoxia showed the strongest correlation with mortality ($p < 0.001$).

**Table 3: Correlation of clinical features with outcome**

| Clinical Feature | Recovered & Discharged (n=240) | Discharged with Complications (n=45) | Mortality (n=15) | p-value |
|---|---|---|---|---|
| Fever | 225 (93.8%) | 40 (88.9%) | 10 (66.7%) | 0.002** |
| Cough | 210 (87.5%) | 38 (84.4%) | 9 (60.0%) | 0.001** |
| Tachypnea | 160 (66.7%) | 38 (84.4%) | 12 (80.0%) | 0.015* |
| Chest Indrawing | 130 (54.2%) | 35 (77.8%) | 13 (86.7%) | 0.001** |
| Cyanosis | 25 (10.4%) | 15 (33.3%) | 10 (66.7%) | <0.001** |
| Altered Sensorium | 8 (3.3%) | 20 (44.4%) | 13 (86.7%) | <0.001** |
| Hypoxia ($SpO_2$ < 90%) | 20 (8.3%) | 30 (66.7%) | 12 (80.0%) | <0.001** |

## Discussion

Our study included 300 cases of pneumonia, among which 180 cases (60%) had a confirmed microbial aetiology. Among these, 130 (43.3%) were viral, 40 (13.3%) were bacterial, and 10 (3.3%) had mixed infections.. Age-wise, most cases were in the 2-12-month age group (45%), followed by 13-24 months (30%) and 25-59 months (25%). This is consistent with studies suggesting that infants and younger children are at higher risk of pneumonia due to an immature immune system and high exposure to respiratory pathogens [12]. Males (60%) were affected more than females (40%), which is an agreement with slight male preponderance. The predominant clinical symptoms were fever (91%), cough (85%), and tachypnoea (70%), which aligns with WHO criteria for pneumonia diagnosis [13]. Chest indrawing, cyanosis, and altered sensorium were significantly associated with worse outcomes, indicating severe disease and in our study, 28 cases (9.3%) required ICU admission, while the remaining 272 (90.7%) were managed in wards. ICU admission was significantly associated with bacterial and mixed infections ($p < 0.001$), emphasizing the higher severity of bacterial pneumonia compared to viral pneumonia. Pleural effusion was found in 12 cases (24%) among ICU patients, indicating complicated pneumonia requiring aggressive management. Regarding outcomes, 80% of cases recovered completely, 15% were discharged with complications, and 5% resulted in mortality. Mortality was significantly higher in ICU cases (35.7%) compared to ward cases (0.7%), indicating the role of severe disease, respiratory failure, and multi-organ involvement in fatal outcomes. Hypoxia ($SpO_2$ < 90%), cyanosis, altered sensorium, and severe malnutrition were strong predictors of mortality ($p < 0.001$). HRCT findings were conducted in all ICU cases (n=28) and 115 ward cases with positive cultures, revealing: Consolidation (60%) – More common in bacterial pneumonia Ground-glass opacities (30%) – More common in viral pneumonia Pleural effusion (10%) – Associated with severe disease and ICU admissions These findings align with previous studies indicating that consolidation with air bronchograms suggests bacterial pneumonia, while ground-glass opacities are more indicative of viral pneumonia [14].

Fever and cough were the most common symptoms in all groups, but their prevalence was significantly lower in mortality cases ($p < 0.01$). Tachypnoea and chest indrawing were significantly associated with worse outcomes, seen more in complicated cases ($p < 0.05$). Cyanosis, altered sensorium, and hypoxia showed the strongest correlation with mortality ($p < 0.001$). These findings is quite similar to study conducted by Chisti MJ et al [15]. Studies from Africa and Southeast Asia also indicate similar epidemiological trends, emphasizing the importance of vaccination, early diagnosis, and appropriate treatment [16]. However, our study differs in the proportion of mixed infections (10%), which is slightly lower than some Western studies reporting 15-20% mixed infections [17]. This could be due to regional variations in microbiological profiles and diagnostic capabilities.

In our study, 28 cases (9.3%) required ICU admission, while the remaining 272 (90.7%) were managed in wards. ICU admission was significantly associated with bacterial and mixed infections ($p < 0.001$), emphasizing the higher severity of bacterial pneumonia compared to viral pneumonia (97). Pleural effusion was found in 12 cases (24%) among ICU patients, indicating complicated pneumonia requiring aggressive management.

Regarding outcomes, 80% of cases recovered completely, 15% were discharged with complications, and 5% resulted in mortality. Mortality was significantly higher in ICU cases (35.7%) compared to ward cases (0.7%), indicating the role of severe disease, respiratory failure, and multi-organ involvement in fatal outcomes. Hypoxia ($SpO_2$ < 90%), cyanosis, altered sensorium, and severe malnutrition were strong predictors of mortality ($p < 0.001$).

**Table 4: Outcome of total patients**

| Outcome | ICU Cases (n=28) | Ward Cases (n=272) | Total Cases (n=300) | Percentage (%) | p-value |
|---|---|---|---|---|---|
| Recovered & Discharged | 5 | 235 | 240 | 80.0% | <0.001 **(significant)** |
| Recovered with Complications | 15 | 30 | 45 | 15% | 0.032 **(significant)** |
| Death | 8 | 7 | 15 | 5% | 0.045 **(significant)** |
| Total | 28 | 272 | 300 | 100% | - |

**Conclusion**

Children who came with symptoms of chest indrawing, cyanosis, and altered sensorium were significantly associated with worse outcomes ($p<0.01$) indicating severe disease and hypoxia whereas children came with fever, cough had better outcome. So, detection of pneumonia at early stage and early treatment initiation are to be enforced for better management of pneumonia.

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