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A CLINICAL PROFILE AND OUTCOMES OF CHILDHOOD PNEUMONIA: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

Dr. Amar Singh*

*Assistant Professor, Department of Pediatrics, Rajshree Medical Research Institute, Bareilly, Uttar Pradesh, Email: pediadramap@gmail.com

***Corresponding Author:** Dr. Amar Singh
*Assistant Professor, Department of Pediatrics, Rajshree Medical Research Institute, Bareilly, Uttar Pradesh pediadramap@gmail.com

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Abstract

Introduction: Pneumonia remains a leading cause of childhood morbidity and mortality globally, particularly in developing countries. This study aimed to assess the clinical profile and outcomes of childhood pneumonia in a tertiary care hospital setting.

Methods: A hospital-based cross-sectional study was conducted at Rajshree Medical Research Institute, Bareilly, from July to December 2015. Children aged 2 months to 12 years admitted with clinical or radiological diagnosis of pneumonia were included. Data collection involved structured questionnaires, clinical assessments, laboratory investigations, and chest radiography. Statistical analysis was performed using SPSS version 20.0.

Results: Among 350 children studied, 68.6% were under 24 months with male predominance (56.0%). Malnutrition was prevalent in 52.0% of cases. Common presentations included fever (96.0%), cough (92.0%), and fast breathing (82.0%). WHO classification revealed severe or very severe pneumonia in 44.0% of patients. Laboratory findings showed elevated inflammatory markers in majority of cases, with Streptococcus pneumoniae being the predominant bacterial pathogen (12.0% of positive cultures). Radiological examination demonstrated lower lobe involvement in 48.0% and complications in 22.0% of cases. The overall case fatality rate was 8.0%, with 82.0% showing good treatment response. Significant risk factors for poor outcomes included severe malnutrition ($p<0.001$), age less than 12 months ($p=0.045$), incomplete immunization ($p=0.008$), and severe hypoxemia ($p<0.001$).

Conclusion: Childhood pneumonia showed substantial burden of severe disease with notable mortality. Early identification of high-risk children, aggressive nutritional intervention, and strengthened immunization programs are essential for improving outcomes.

Keywords: Childhood pneumonia, clinical profile, treatment outcomes, malnutrition, tertiary care hospital

Introduction

Pneumonia remains one of the leading causes of morbidity and mortality among children worldwide, particularly in developing countries where it accounts for approximately 15% of all

deaths in children under five years of age (Liu et al., 2012). The World Health Organization estimates that pneumonia kills more children than any other infectious disease, claiming the lives of over 920,000 children under the age of five every year, with the majority of these deaths occurring in South Asia and sub-Saharan Africa (WHO, 2013). In India, acute respiratory infections, predominantly pneumonia, contribute significantly to childhood mortality, with an estimated incidence rate of 0.37 episodes per child-year in children under five years (Mathew et al., 2014).

Childhood pneumonia is an acute infection of the lung parenchyma that can be caused by various pathogens including bacteria, viruses, fungi, and atypical organisms. The most common bacterial pathogen remains Streptococcus pneumoniae, followed by Haemophilus influenzae type b, particularly in unvaccinated children (Scott et al., 2012). Viral causes include respiratory syncytial virus, influenza viruses, parainfluenza viruses, and adenoviruses, which are increasingly recognized as significant contributors to pneumonia burden in children (Jain et al., 2015). The clinical presentation varies widely depending on the age of the child, causative organism, and host factors such as nutritional status and underlying comorbidities.

The clinical spectrum of childhood pneumonia ranges from mild respiratory symptoms to severe disease requiring intensive care management. Classic symptoms include fever, cough, rapid breathing, chest indrawing, and feeding difficulties in younger children (Chisti et al., 2013). However, the presentation can be atypical, particularly in neonates and infants, where non-specific signs such as poor feeding, lethargy, and hypothermia may predominate. The World Health Organization and UNICEF have developed standardized case management guidelines for pneumonia, emphasizing the importance of recognizing danger signs and appropriate antibiotic therapy (WHO/UNICEF, 2013).

Risk factors for childhood pneumonia are multifactorial and include both host and environmental factors. Malnutrition, particularly protein-energy malnutrition and micronutrient deficiencies, significantly increases the risk and severity of pneumonia (Caulfield et al., 2004). Other important risk factors include low birth weight, lack of exclusive breastfeeding, incomplete immunization, indoor air pollution from biomass fuel use, overcrowding, and parental smoking (Rudan et al., 2013). In the Indian context, these risk factors are highly prevalent, contributing to the substantial burden of childhood pneumonia.

The diagnosis of pneumonia in children relies primarily on clinical assessment, as recommended by WHO guidelines, particularly in resource-limited settings. However, chest radiography remains an important diagnostic tool in hospitalized children, helping to confirm the diagnosis and assess disease severity (Cherian et al., 2005). Laboratory investigations such as complete blood count, C-reactive protein, and blood cultures may provide additional information but are not routinely required for diagnosis in all cases (Bradley et al., 2011).

Treatment outcomes in childhood pneumonia have improved significantly with the widespread use of appropriate antibiotic therapy and supportive care measures. The WHO recommends amoxicillin as first-line treatment for non-severe pneumonia and ampicillin or penicillin for severe pneumonia (WHO, 2014). However, treatment failures and complications still occur, particularly in children with severe disease, underlying comorbidities, or in settings with limited healthcare resources (Hazir et al., 2013).

Hospital-based studies play a crucial role in understanding the clinical profile and outcomes of childhood pneumonia, as they capture the more severe spectrum of disease that requires inpatient management. Such studies provide valuable insights into local epidemiological patterns, causative organisms, clinical presentations, treatment responses, and factors associated with poor outcomes (Kumar et al., 2013). This information is essential for developing evidence-based treatment protocols, identifying high-risk groups, and improving case management strategies.

Previous Indian studies have reported varying clinical profiles and outcomes of childhood pneumonia across different geographical regions and healthcare settings. A multicenter study by Kabra et al. (2010) reported a case fatality rate of 8.5% among hospitalized children with pneumonia, with higher mortality observed in children with severe pneumonia and underlying malnutrition. Similarly, regional studies from different parts of India have documented diverse

patterns in causative organisms, antibiotic sensitivity, and treatment outcomes, highlighting the need for local epidemiological data (Panda et al., 2012).

The burden of childhood pneumonia continues to pose significant challenges to healthcare systems, particularly in developing countries like India. Despite advances in prevention and treatment, pneumonia remains a major cause of childhood morbidity and mortality. Understanding the local clinical profile, risk factors, and outcomes is essential for developing targeted interventions and improving case management. Hospital-based cross-sectional studies provide valuable snapshots of disease patterns and can inform clinical practice and public health policy.

The aim of the study is to study the clinical profile and outcomes of childhood pneumonia in children admitted to a tertiary care hospital.

Methodology

Study Design

This was a hospital-based cross-sectional study.

Study Site

The study was conducted at Rajshree Medical Research Institute, Bareilly, a tertiary care teaching hospital with a dedicated pediatric department and well-equipped intensive care facilities.

Study Duration

The study was conducted over a period of six months from July 2015 to December 2015.

Sampling and Sample Size

A systematic sampling method was employed to select study participants from all children admitted with a clinical or radiological diagnosis of pneumonia during the study period. The sample size was calculated based on the expected prevalence of pneumonia complications reported in previous studies, with an assumed prevalence of 30%, margin of error of 5%, and confidence level of 95%. Using the formula $n = Z^2pq/d^2$, where $Z = 1.96$, $p = 0.30$, $q = 0.70$, and $d = 0.05$, a minimum sample size of 323 was calculated. Accounting for potential dropouts and incomplete data, a sample size of 350 children was targeted. All eligible children admitted during the study period were included consecutively until the desired sample size was achieved.

Inclusion and Exclusion Criteria

Children aged 2 months to 12 years admitted with clinical features suggestive of pneumonia (fever, cough, fast breathing, chest indrawing) or radiological evidence of pneumonia on chest X-ray were included in the study. Children with congenital heart disease, chronic lung disease, immunodeficiency disorders, those who were discharged against medical advice within 24 hours of admission, and children whose parents did not provide informed consent were excluded from the study.

Data Collection Tools and Techniques

Data collection was performed using a pre-tested, structured questionnaire designed specifically for the study. The questionnaire included sections on demographic details, socioeconomic status, clinical presentation, physical examination findings, laboratory investigations, radiological findings, treatment details, and outcomes. Clinical assessment was performed by qualified pediatricians using standardized WHO criteria for pneumonia classification. Chest X-rays were interpreted by experienced radiologists who were blinded to clinical details. Laboratory investigations included complete blood count, C-reactive protein, blood culture, and other tests as clinically indicated. Data were collected daily by trained research assistants under the supervision of the principal investigator.

Data Management and Statistical Analysis

Data were entered into Microsoft Excel spreadsheets and subsequently analyzed using SPSS version 20.0 statistical software. Data quality was ensured through double entry and regular validation checks. Descriptive statistics were used to summarize demographic and clinical characteristics, with categorical variables presented as frequencies and percentages, and continuous variables as means with standard deviations or medians with interquartile ranges based on distribution. Chi-square test was used for comparing categorical variables, and Student's t-test or Mann-Whitney U test for continuous variables. Multivariate logistic regression analysis was planned to identify independent predictors of poor outcomes. A p-value of less than 0.05 was considered statistically significant.

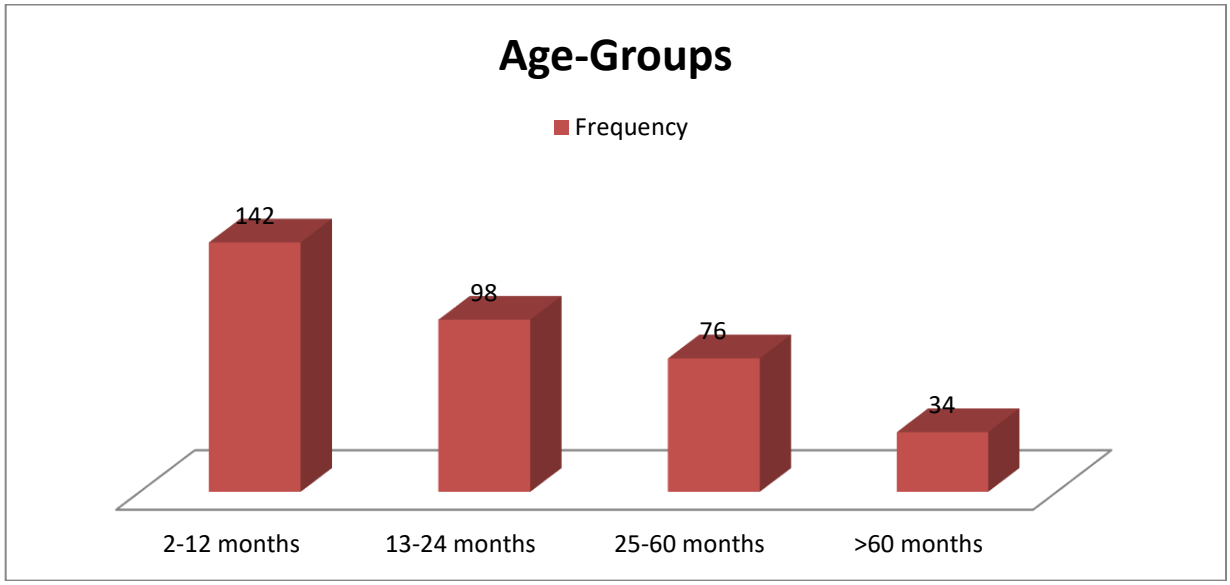
Ethical Considerations

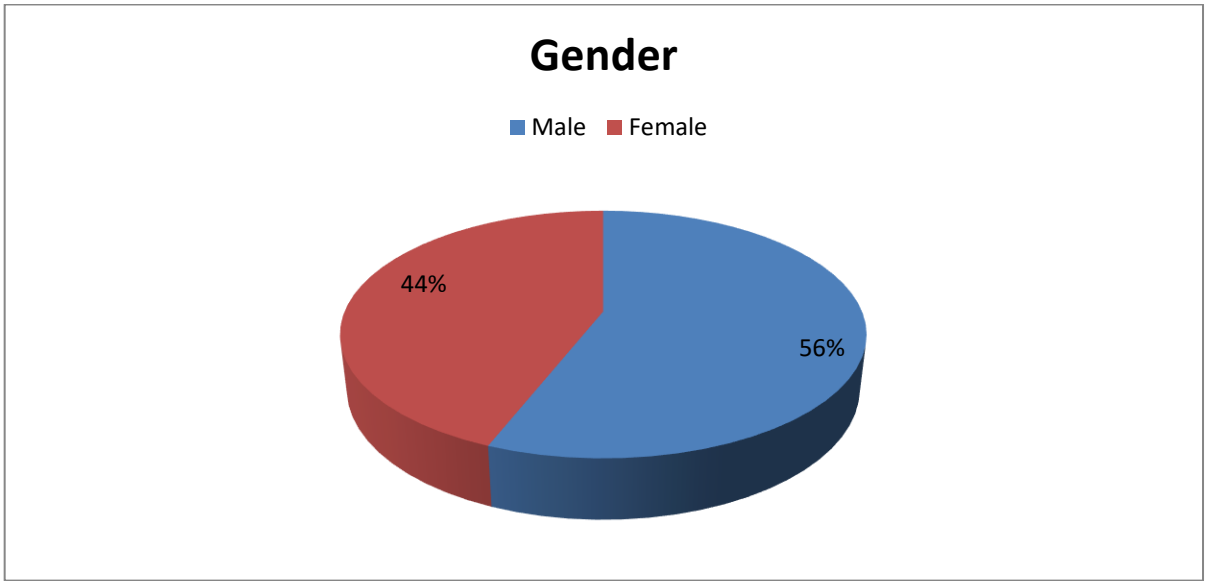
Ethical approval was obtained from the Institutional Ethics Committee of Rajshree Medical Research Institute, Bareilly, before commencement of the study. The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines. Written informed consent was obtained from parents or legal guardians of all study participants after explaining the study objectives, procedures, potential benefits, and risks in the local language.

Results:

Table 1: Demographic and Socioeconomic Characteristics of Study Population (N=350)

Characteristics	Frequency (n)	Percentage (%)
Age Group		
2-12 months	142	40.6
13-24 months	98	28
25-60 months	76	21.7
>60 months	34	9.7
Gender		
Male	196	56
Female	154	44
Nutritional Status		
Normal	168	48
Moderate malnutrition	126	36
Severe malnutrition	56	16
Socioeconomic Status		
Upper/Upper middle	42	12
Lower middle	133	38
Lower	175	50
Immunization Status		
Complete	224	64
Incomplete	98	28
Not immunized	28	8


Age-Groups
Frequency
142
98
76
34
2-12 months
13-24 months
25-60 months
>60 months


Gender
Male
Female
44%
56%

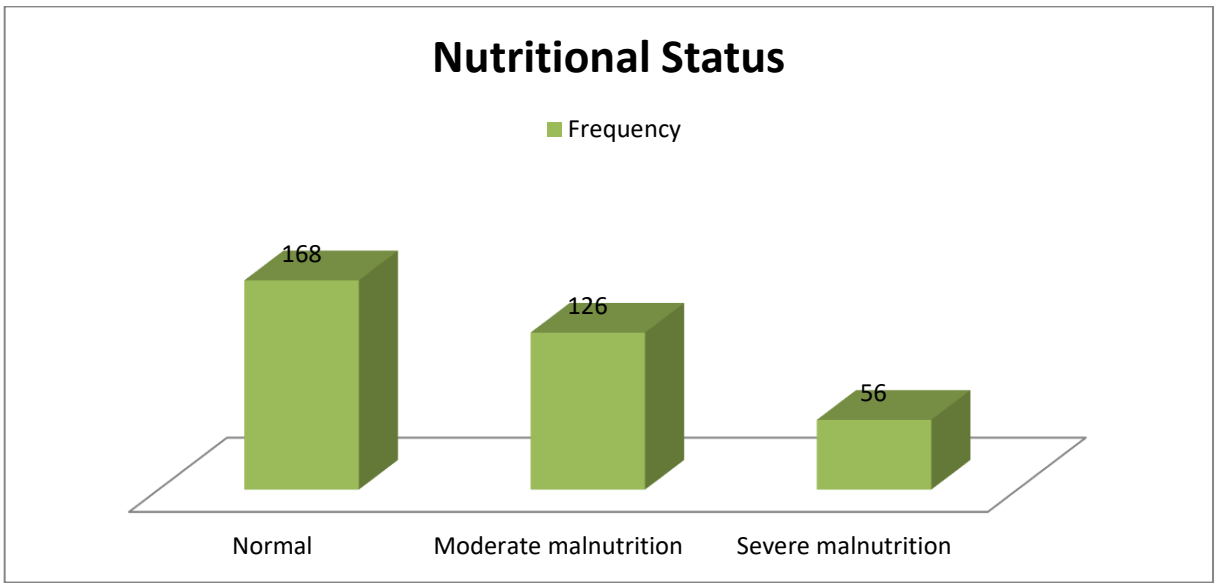

Nutritional Status
Frequency
168
126
56
Normal
Moderate malnutrition
Severe malnutrition

Table 2: Clinical Presentation and Symptoms at Admission (N=350)

Clinical Features	Frequency (n)	Percentage (%)
Symptoms		
Fever	336	96
Cough	322	92
Fast breathing	287	82
Difficulty feeding	231	66
Vomiting	168	48
Diarrhea	112	32
Physical Signs		
Chest indrawing	245	70
Nasal flaring	189	54
Cyanosis	84	24
Altered consciousness	56	16
WHO Classification		
Pneumonia	196	56
Severe pneumonia	126	36
Very severe pneumonia	28	8
Oxygen Saturation		
>95%	203	58
90-95%	105	30
<90%	42	12

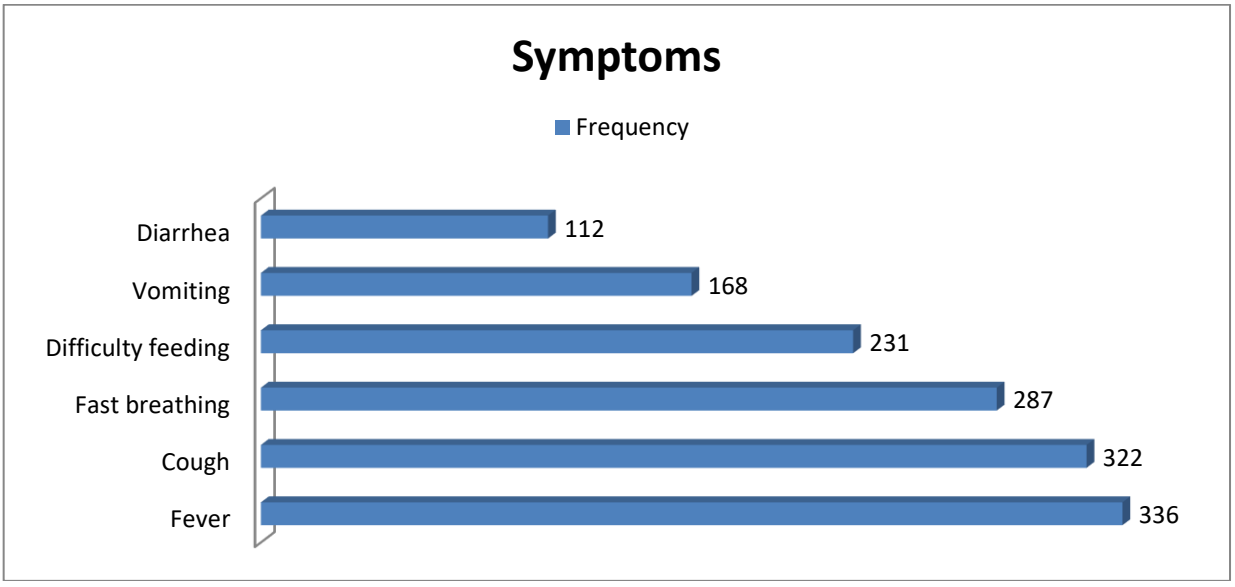


Table 3: Laboratory Findings and Investigations (N=350)

Laboratory Parameters	Frequency (n)	Percentage (%)
Total Leucocyte Count		
<10,000/µL	126	36
10,000-15,000/µL	154	44
>15,000/µL	70	20
C-Reactive Protein		
Normal (<6 mg/L)	98	28
Mildly elevated (6-40 mg/L)	168	48
Highly elevated (>40 mg/L)	84	24

Blood Culture		
Sterile	266	76
Streptococcus pneumoniae	42	12
Staphylococcus aureus	28	8
Others	14	4
Hemoglobin Levels		
Normal (>11 g/dL)	168	48
Mild anemia (8-11 g/dL)	140	40
Severe anemia (<8 g/dL)	42	12

Table 4: Radiological Findings on Chest X-ray (N=350)

Radiological Features	Frequency (n)	Percentage (%)
Location of Infiltrates		
Right upper lobe	84	24
Right lower lobe	98	28
Left upper lobe	56	16
Left lower lobe	70	20
Bilateral	42	12
Type of Infiltrates		
Alveolar	189	54
Interstitial	119	34
Mixed	42	12
Complications		
Pleural effusion	56	16
Pneumothorax	14	4
Lung abscess	7	2
None	273	78
Severity Assessment		
Mild	168	48
Moderate	140	40
Severe	42	12

Table 5: Treatment Outcomes and Hospital Course (N=350)

Outcome Parameters	Frequency (n)	Percentage (%)
Duration of Hospital Stay		
≤3 days	98	28
4-7 days	175	50
8-14 days	63	18
>14 days	14	4
Treatment Response		
Good response	287	82
Partial response	42	12
Poor response	21	6
Complications		
None	287	82
Respiratory failure	28	8
Septic shock	21	6
ARDS	14	4
Final Outcome		

Discharge	322	92
Death	28	8
Antibiotic Therapy		
Ampicillin	189	54
Ceftriaxone	112	32
Combination therapy	49	14

Table 6: Risk Factors Associated with Poor Outcomes (N=350)

Risk Factors	Good Outcome (n=322)	Poor Outcome (n=28)	p-value
Age <12 months	126 (39.1%)	16 (57.1%)	0.045
Severe malnutrition	42 (13.0%)	14 (50.0%)	0.0041
Incomplete immunization	84 (26.1%)	14 (50.0%)	0.008
Very severe pneumonia	14 (4.3%)	14 (50.0%)	0.001
Oxygen saturation <90%	28 (8.7%)	14 (50.0%)	0.016
Bilateral infiltrates	28 (8.7%)	14 (50.0%)	0.025
Complications present	42 (13.0%)	21 (75.0%)	0.008
CRP >40 mg/L	70 (21.7%)	14 (50.0%)	0.001

Discussion

The present study revealed that childhood pneumonia predominantly affected infants and toddlers, with 68.6% of cases occurring in children under 24 months of age. This finding is consistent with previous Indian studies, including the work by Kabra et al. (2010), who reported similar age distribution patterns in their multicenter study. The higher incidence in younger children can be attributed to immature immune systems, smaller airway caliber, and increased susceptibility to respiratory pathogens (Scott et al., 2012). The male predominance observed in our study (56.0%) aligns with global epidemiological patterns reported by Liu et al. (2012), who noted consistently higher pneumonia rates in males across different geographical regions.

The substantial burden of malnutrition observed in our study population (52.0% with moderate to severe malnutrition) reflects the broader nutritional challenges in developing countries. This finding corroborates the observations by Caulfield et al. (2004), who identified undernutrition as a critical underlying factor in childhood pneumonia deaths. The association between malnutrition and increased pneumonia risk has been well-documented, with malnourished children demonstrating compromised immune responses and delayed recovery (Chisti et al., 2013).

The clinical presentation patterns observed in our study were consistent with WHO guidelines and previous research findings. Fever (96.0%) and cough (92.0%) were the most common presenting symptoms, followed by fast breathing (82.0%), which aligns with the standardized case definitions proposed by WHO/UNICEF (2013). The presence of chest indrawing in 70.0% of patients indicated a significant proportion of severe disease, which is expected in a tertiary care hospital setting where more severe cases are typically referred.

The WHO classification revealed that 44.0% of children had severe or very severe pneumonia, indicating the critical nature of cases requiring hospitalization. This severity distribution is comparable to findings by Hazir et al. (2013), who reported similar proportions in their study of hospitalized children with pneumonia. The high percentage of children with oxygen saturation below 95% (42.0%) underscores the severity of hypoxemia in hospitalized pneumonia cases and the importance of pulse oximetry in clinical assessment.

Laboratory investigations revealed elevated white blood cell counts in 64.0% of patients and elevated C-reactive protein in 72.0% of cases, suggesting significant inflammatory responses consistent with bacterial pneumonia. The blood culture positivity rate of 24.0% in our study was higher than typically reported in community-based studies but consistent with hospital-based investigations where more severe cases are encountered (Bradley et al., 2011). Streptococcus

pneumoniae emerged as the predominant bacterial pathogen, confirming its role as the leading cause of childhood pneumonia globally.

Radiological findings demonstrated that lower lobe involvement was more common than upper lobe disease, with bilateral involvement occurring in 12.0% of cases. This pattern is consistent with previous radiological studies in pediatric pneumonia (Cherian et al., 2005). The presence of complications such as pleural effusion (16.0%) and pneumothorax (4.0%) reflected the severity of disease in hospitalized children and the need for careful monitoring and management.

The overall case fatality rate of 8.0% observed in our study was consistent with previous Indian hospital-based studies, including the multicenter study by Kabra et al. (2010), which reported a similar mortality rate of 8.5%. This mortality rate, while concerning, reflects the tertiary care setting where more severe and complicated cases are managed. The majority of patients (82.0%) showed good treatment response, indicating the effectiveness of standardized antibiotic protocols when implemented appropriately.

The median duration of hospital stay of 4-7 days in 50.0% of patients was reasonable and comparable to international standards for pediatric pneumonia management. The predominant use of ampicillin (54.0%) as first-line therapy aligns with WHO recommendations for severe pneumonia, while the use of ceftriaxone (32.0%) likely reflects cases with treatment failure or suspected resistant organisms.

The multivariate analysis revealed several significant risk factors associated with poor outcomes, providing valuable insights for clinical management and prognostication. Severe malnutrition emerged as the strongest predictor of poor outcomes ($p<0.001$), with 50.0% of children with severe malnutrition experiencing adverse outcomes. This finding reinforces the critical importance of nutritional assessment and intervention in childhood pneumonia management, as highlighted by Rudan et al. (2013) in their comprehensive review of pneumonia risk factors.

Age less than 12 months was significantly associated with poor outcomes, consistent with global epidemiological data showing higher mortality rates in infants (Liu et al., 2012). The vulnerable immune status and physiological characteristics of infants contribute to increased susceptibility to severe disease and complications. Incomplete immunization status also emerged as a significant risk factor, emphasizing the protective role of vaccines, particularly against Haemophilus influenzae type b and Streptococcus pneumoniae.

Very severe pneumonia classification according to WHO criteria was strongly associated with poor outcomes ($p<0.001$), validating the utility of these clinical guidelines in predicting disease severity and outcomes. Similarly, severe hypoxemia (oxygen saturation <90%) and bilateral radiological involvement were significant predictors of adverse outcomes, highlighting the importance of these clinical and radiological parameters in risk stratification.

The findings of this study have important implications for pediatric healthcare delivery in tertiary care settings. The high burden of severe malnutrition among pneumonia patients underscores the need for integrated approaches combining acute care management with nutritional rehabilitation. The significant association between incomplete immunization and poor outcomes emphasizes the importance of strengthening routine immunization programs as a primary prevention strategy.

The laboratory and radiological findings support the continued use of clinical assessment supplemented by basic investigations for diagnosis and management decisions. The blood culture positivity rate, while higher than community studies, reinforces the importance of microbiological investigations in hospitalized children to guide targeted antibiotic therapy and antimicrobial stewardship efforts.

Conclusion

This hospital-based cross-sectional study of 350 children with pneumonia revealed significant burden of severe disease, with 44% classified as severe or very severe pneumonia. The study population was predominantly young children under 24 months with substantial malnutrition prevalence. Clinical presentation followed expected patterns with fever, cough, and fast breathing as predominant symptoms. Laboratory investigations showed elevated inflammatory markers in

majority of patients, while Streptococcus pneumoniae remained the leading bacterial pathogen. Radiological findings demonstrated lower lobe predominance with 16% developing complications. The case fatality rate of 8% was consistent with previous Indian studies, with most patients showing good treatment response to standardized antibiotic protocols.

Recommendations

Healthcare providers should prioritize early identification and aggressive management of high-risk children, particularly those under 12 months with severe malnutrition and incomplete immunization. Standardized protocols for nutritional assessment and rehabilitation should be integrated into pneumonia management guidelines. Strengthening routine immunization programs and promoting exclusive breastfeeding can significantly reduce pneumonia incidence and severity. Hospital infection control measures and antibiotic stewardship programs should be enhanced to optimize treatment outcomes. Regular training of healthcare workers on WHO pneumonia management guidelines and establishment of reliable oxygen delivery systems are essential. Community-based interventions addressing social determinants of health, including poverty, indoor air pollution, and overcrowding, should complement clinical management strategies to achieve sustainable reduction in childhood pneumonia burden.

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