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Prevalence and Associated Factors of Pneumonia in Children Aged 2 Months to 15 Years: An Observational Study

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ABSTRACT

Pneumonia is a leading cause of mortality among children aged 2 months to 15 years worldwide, particularly in low- and middle-income countries (LMICs). Despite various interventions, pneumonia continues to claim the lives of millions of children annually. This study aims to assess the prevalence of pneumonia and identify associated risk factors in this vulnerable age group. The primary objective is to determine the prevalence of pneumonia in children aged 2 months to 15 years. Secondary objectives include identifying demographic, socioeconomic and environmental factors associated with increased pneumonia risk, evaluating the impact of nutritional status and breast-feeding practices and analyzing the effectiveness of preventive measures such as immunization. This descriptive cross-sectional study was conducted at the Sree Mookambika Institute of Medical Sciences, Kulasekharam, over 12 months. A total of 100 children aged 2 months to 15 years with cough and fast breathing were included. Exclusion criteria encompassed chronic respiratory illnesses, congenital anomalies and other conditions predisposing to pneumonia. Data collection involved detailed history-taking, clinical examinations, routine blood investigations and chest radiography, reviewed by two blinded pediatricians. Statistical analyses included descriptive statistics, Chi-square tests and logistic regression. Radiological confirmation of pneumonia was found in 44% of the study cohort. The highest prevalence was observed in children aged 1-5 years (50%), followed by those aged 2 months to 1 year (22.7%). Males were more affected (65.9%) than females (34.1%). Significant clinical parameters associated with pneumonia included fever (88.6%), refusal of feeds/fluids (77.3%) and respiratory signs such as nasal flaring, grunting, retractions and crepitations. Independent predictors of pneumonia were temperature=38.0°C, crepitations and malnutrition. Pneumonia remains a significant health concern for children, particularly those under 5 years. Clinical parameters like fever, nasal flaring, and retractions are vital for early diagnosis. The findings emphasize the need for targeted public health interventions and continuous surveillance to reduce the pneumonia burden. Future research should explore regional differences and validate predictive models to enhance healthcare strategies.

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Key Words

Pneumonia, children, prevalence, risk factors, LMICs, clinical predictors, epidemiology, public health

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INTRODUCTION

Pneumonia is a major public health concern, particularly in children aged 2 months to 15 years[1]. It is the leading cause of mortality in this age group worldwide, surpassing even diseases like malaria and HIV/AIDS. Despite numerous interventions and public health initiatives, pneumonia continues to claim the lives of millions of children each year, especially in low- and middle-income countries (LMICs)[2]. An observational study focusing on the prevalence and associated factors of pneumonia in children can provide critical insights into the burden of the disease and the effectiveness of current interventions.

An observational study on the prevalence and associated factors of pediatric pneumonia is necessary due to several compelling reasons:

Pneumonia is responsible for a substantial number of deaths among children under 5 years old, with nearly 1.2 million deaths annually, according to WHO estimates[3] . Despite a decline in mortality rates over the past few decades, pneumonia remains a leading cause of death in children, highlighting the need for ongoing surveillance and research.

Understanding the risk factors associated with pneumonia is crucial for developing effective prevention strategies. Factors such as malnutrition, lack of breast-feeding, air pollution and incomplete immunization are known to increase the risk of pneumonia in children[4]. An observational study can identify and quantify these risk factors, providing data that can be used to tailor public health interventions.

The prevalence of pneumonia varies widely based on geographic, socioeconomic, and environmental factors. In many LMICs, the burden of pneumonia is disproportionately high due to factors such as poor living conditions, inadequate healthcare infrastructure, and limited access to medical care[5]. A study focusing on these variables can help identify high-risk populations and regions, guiding resource allocation and intervention strategies.

Preventive measures such as vaccination, improved nutrition and better sanitation have been shown to reduce the incidence of pneumonia. However, the effectiveness of these measures can vary based on local contexts. Observational studies can provide real-world data on the impact of these interventions, helping to optimize strategies for different settings[6].

Policymakers and healthcare providers need robust data to make informed decisions about pneumonia prevention and treatment[7]. An observational study provides empirical evidence on the prevalence and associated factors of pneumonia, which can inform policy adjustments and clinical guidelines. Understanding the local epidemiology of pneumonia can also aid in the development of context-specific health policies and resource allocation.

Aims and Objectives: This observational study aims to assess the prevalence of pneumonia and identify associated risk factors in children aged 2 months to 15 years. By analyzing a broad range of demographic, clinical and environmental variables, the study seeks to provide comprehensive insights into the determinants of pediatric pneumonia and inform targeted interventions.

Primary Objective:

- To determine the prevalence of pneumonia in children aged 2 months to 15 years.

Secondary Objectives:

- To identify the demographic and socioeconomic factors associated with an increased risk of pneumonia.
- To evaluate the impact of environmental factors, such as indoor air pollution and living conditions, on the incidence of pneumonia.
- To assess the role of nutritional status and breast-feeding practices in the occurrence of pneumonia.
- To analyze the effectiveness of preventive measures, such as immunization, in reducing the incidence of pneumonia.

MATERIALS AND METHODS

Study Design: Descriptive cross-sectional study.

Study Place: Sree Mookambika Institute of Medical Sciences, Kulasekharam.

Study Period: 12 months.

Inclusion Criteria:

- Children aged 2 months to 15 years with cough and fast breathing on examination.

Exclusion Criteria:

- Children with chronic respiratory illnesses such as cystic fibrosis or broncho pulmonary dysplasia.
- Children with congenital anomalies of the heart and lungs.
- Children with anatomical defects like cleft lip and cleft palate.
- Children with conditions predisposing to pneumonia such as sickle cell anemia, immunosuppression and malignancy.
- Children who had chest radiography for reasons other than pneumonia evaluation, such as trauma or foreign body aspiration.
- Children whose caregivers/parents refused consent.

Sample Size: 100 children.

Sampling Technique:

- Purposive sampling technique on consecutive cases.
- Ethical clearance obtained from the institutional ethical committee.

Children aged 2 months to 15 years attending the emergency and outpatient department with cough and fast breathing were included after obtaining informed written consent from parents/caregivers and assent from the child. Detailed histories of present and past illnesses and socioeconomic status were taken. Clinical examinations included:

- Recording axillary temperature for 3 minutes using a digital thermometer.
- Counting pulse rate for one minute.
- Counting respiratory rate for one minute by observing abdominal or chest movements.
- Measuring capillary refill time (CRT) and oxygen saturation using pulse oximetry.
- Noting nasal flaring, grunting, pallor and cyanosis.
- Anthropometry and systemic examination, focusing on the respiratory system for signs like chest retractions, rhonchi and crepitations.
- Recording immunization status, feeding practices, and nutritional status.

Routine blood investigations included hemoglobin, total count, differential count and C-reactive protein (CRP). All children underwent chest radiography, independently reviewed by two blinded pediatricians using the WHO trialists' guidelines.

Definitions:

- **Fever:** Axillary temperature=37.5°C.
- **Cough:** Reflex act to remove mucus/material from airways.
- **Tachypnea:** Age-specific respiratory rates as per study guidelines.
- **Wheezing:** Musical sound during expiration due to airway obstruction.
- **Nasal Flaring:** Enlargement of nostrils with each inspiratory breath.
- **Grunting:** Low pitched sound during expiration.
- **Chest Retractions:** Inward movement of soft tissues of the chest wall during inspiration.
- **Crepitations:** Sharp, crackling sounds during inspiration, indicative of pneumonia.
- **Malnutrition:** Defined using weight-for-height (WFH) as per WHO standards.
- **Anemia:** Based on WHO hemoglobin cutoffs for different age groups.
- **Leukocytosis:** Increased WBC count as per age-specific normal ranges.
- **CRP:** Recorded as positive or negative, based on levels measured by immuno-turbidimetry.

Radiographic Pneumonia Diagnosis Radiographs were categorized as showing significant pathology, end-point consolidation, other infiltrates, or pleural effusion, according to WHO guidelines.

Statistical Analysis:

- Descriptive statistics using frequency and percentages.
- Inferential statistics with Chi-square test for bivariate analysis and logistic regression for multivariate analysis.
- Significance level set at 95% with $P<0.05$ considered significant.
- Data entry in Microsoft Excel 2013 and analysis using SPSS version 20.

RESULTS AND DISCUSSIONS

In our study of 100 children presenting with symptoms of pneumonia, radiological confirmation through chest X-rays (CXR) was achieved in 44 cases, representing 44% of the total sample. The remaining 56 cases (56%) did not show radiographic evidence of pneumonia. This distribution indicates that less than half of the clinically suspected pneumonia cases were confirmed radiologically, highlighting the potential discrepancy between clinical diagnosis and radiological findings. The high percentage of non-confirmed cases underscores the challenges in diagnosing pneumonia based solely on clinical presentation and the importance of using radiographic confirmation to ensure accurate diagnosis.

Among the 44 cases of radiologically confirmed pneumonia, the age distribution reveals a significant concentration of cases in younger children. The majority, 22 cases (50%), were found in the age group of 1-5 years. The second highest incidence was in the 2 months to 1 year age group, with 10 cases (22.7%). Children aged 6-10 years accounted for 9 cases (20.45%), while those in the oldest group, 11-15 years, had the least number of cases, with only 3 (6.8%). These results suggest that younger children, particularly those under 5 years, are more susceptible to developing pneumonia, consistent with global epidemiological trends.

The sex distribution among the 44 radiologically confirmed pneumonia cases shows a higher prevalence in males compared to females. Specifically, 29 of the confirmed cases (65.9%) were male, while 15 cases (34.1%) were female. This male predominance in pneumonia cases aligns with several studies that suggest boys are more prone to respiratory infections than girls. The reasons for this disparity could be

multifactorial, including biological, environmental and possibly behavioral differences between the sexes.

The association between various clinical parameters and radiologically confirmed pneumonia was analyzed. History of fever was significantly associated with pneumonia, present in 39 out of 44 cases (88.6%) compared to 39 out of 56 cases (69.6%) without pneumonia (P=0.023). This indicates that fever is a common and significant symptom in pneumonia cases. Refusal of feeds/fluids was also strongly associated with pneumonia, observed in 34 cases (77.3%) of pneumonia but only 14 cases (25%) without pneumonia, yielding a highly significant P value of <0.001. Vomiting, however, did not show a significant association with pneumonia (P=0.063), being present in 7 cases (15.9%) with pneumonia and 18 cases (32.1%) without.

Respiratory parameters showed strong associations with radiologically confirmed pneumonia. Nasal flaring was observed in 35 cases (79.5%) of pneumonia compared to 29 cases (51.8%) without pneumonia (P=0.004), indicating a significant association. Grunting was highly significant, present in 31 cases (70.5%) of pneumonia but only 3 cases (5.4%) without (P<0.001). Retractions were noted in 37 cases (84.1%) with pneumonia versus 8 cases (14.3%) without (P<0.001). Similarly, crepitations were significantly more common in pneumonia cases, observed in 38 cases (86.4%) compared to 4 cases (7.1%) without pneumonia (P<0.001). These findings highlight that specific respiratory signs, including nasal flaring, grunting, retractions and crepitations, are highly indicative of pneumonia and should be carefully evaluated during clinical assessment.

The findings of our study on radiologically confirmed pneumonia among children aged 2 months to 15 years provide valuable insights into the epidemiology and clinical predictors of pneumonia in this population. We observed a prevalence of radiographically confirmed pneumonia in 44% of the study cohort, consistent with similar studies by Al-Najjar[8]. (42.4%), Goel[9] (45.2%), and Nizam[10]. (50%).

Age Distribution and Risk Factors: Our study revealed a higher prevalence of pneumonia in children aged 1 to 5 years (50%) compared to younger infants (22.7% in 2 months to 1 year) and older children (6.8% in 11 to 15 years). This age distribution aligns with previous studies indicating that preschool-aged children are particularly vulnerable to pneumonia due to immature immune systems and higher exposure risks in daycare or school settings.

Contrary to some previous findings, which suggested higher pneumonia incidence in infants under 1 year, our study's results suggest a shift towards higher rates in slightly older children, possibly influenced by regional healthcare practices and environmental factors [Reference to Abuka[11] and Bony Mathews[12])

Table 1: Radiologically Confirmed (CXR Positive) Pneumonia in the Study

Radiologically Confirmed Pneumonia	Frequency	Percentage
Present	44	44%
Absent (No pneumonia)	56	56%
Total	100	100%

Table 2: Age Distribution in Radiologically Confirmed (CXR Positive) Pneumonia

Age Group	Pneumonia (N = 44)	Percentage
2 months - 1 year	10	22.7%
1 year - 5 years	22	50%
6 years - 10 years	9	20.45%
11 years - 15 years	3	6.8%

Table 3: Distribution of Sex in Radiologically Confirmed Pneumonia

Radiologically Confirmed Pneumonia	Male (N, %)	Female (N, %)
Total (N = 44)	29 (65.9%)	15 (34.1%)

Table 4: Association of Clinical Parameters with Pneumonia

Clinical Parameters	Pneumonia (Radiologically confirmed)	No Pneumonia	p-value
H/o fever	39 (88.6%)	39 (69.6%)	0.023*
Vomiting	7 (15.9%)	18 (32.1%)	0.063
Refusal of Feeds/fluids	34 (77.3%)	14 (25.0%)	<0.001*

Table 5: Association of Respiratory Parameters with Pneumonia

Respiratory Parameters	Pneumonia (Radiologically confirmed)	No Pneumonia	p-value
Nasal Flaring	35 (79.5%)	29 (51.8%)	0.004*
Grunting	31 (70.5%)	3 (5.4%)	<0.001*
Retractions	37 (84.1%)	8 (14.3%)	<0.001*
Crepitations	38 (86.4%)	4 (7.1%)	<0.001*

Gender Predilection: Similar to other studies, we observed a male predominance in pneumonia cases (65.9%), with a male-to-female ratio of approximately 1.93:1.This finding is consistent with studies by Falgas[13], attributing this trend to anatomical and hormonal differences affecting respiratory susceptibility.

Clinical Parameters: Our study identified several clinical parameters significantly associated with radiographically confirmed pneumonia, including history of fever (88.6%), refusal of feeds/fluids (77.3%), and respiratory signs like nasal flaring (79.5%), grunting (70.5%), retractions (84.1%), and crepitations (86.4%). These findings corroborate studies by Lynch[14]. and Silayach[15], highlighting the utility of these signs in clinical diagnosis and management protocols.

Independent Predictors: Binomial logistic regression analysis identified temperature ≥38.0°C, crepitations, and malnutrition (wasting) as independent predictors of pneumonia across all age groups. Temperature ≥38.0°C emerged as the strongest predictor (Adjusted Odds Ratio of 200.03), underscoring its clinical relevance in identifying pneumonia cases requiring further diagnostic evaluation[16].

Comparing our findings with previous studies, we note consistency in the predictive value of certain clinical signs (e.g., grunting, retractions and crepitations) and demographic factors (e.g., age distribution and male predominance). However, variations in prevalence rates across different age groups and regional disparities highlight the importance of context-specific epidemiological data for effective public health strategies[17].

Our study contributes to the existing literature by extending the age range of study participants up to 15 years and including children with prior wheezing history, enhancing the generalizability of our findings. The high sensitivity and specificity of clinical signs such as grunting and retractions emphasize their utility in clinical practice for prompt diagnosis and management of pneumonia.

Strengths and Limitations: Strengths of our study include a robust sample size, comprehensive data collection across multiple clinical and demographic variables and rigorous chest radiograph interpretation by consensus of pediatricians. Limitations include the potential for selection bias and variations in healthcare-seeking behavior among rural versus urban populations.

CONCLUSION

In conclusion, our study provides important insights into the epidemiology and clinical predictors of pneumonia in children aged 2 months to 15 years. The findings underscore the significance of clinical assessment and targeted interventions based on identified risk factors, aiming to reduce the burden of pneumonia in pediatric populations. Future research should focus on validating predictive models and exploring regional differences in pneumonia epidemiology to optimize healthcare delivery and outcomes.

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