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Original Research Article

A Hospital-Based Study to Identify the Risk Factors for Pneumonia and Severe Pneumonia in Children: An Observational Study

Pankaj Kumar[1], Samir Kumar[2], Kumar Saurabh[3]

[1]Senior resident, Department of Pediatrics, Government Medical College and Hospital, Bettiah, Bihar, India

[2]Senior Resident, Department of Pediatrics, Government Medical College and Hospital, Bettiah, Bihar, India

[3]Assistant professor, Department of Pediatrics, Government Medical College and Hospital, Bettiah, Bihar, India

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Corresponding author: Dr. Samir Kumar

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Abstract

Aim: The aim of the present study was to identify the risk factors for pneumonia and severe pneumonia in children.

Material & Methods: A case-control study including 200 children with ARI at Department of Pediatrics was conducted for the duration of 12 months. The source population of the study were all 2–59 months old children visiting pediatric OPD for different reasons during the study period.

Results: 200 children with ARI were enrolled. According to the WHO criteria, 30 (15%) and 170 (85%) of the enrolled children had pneumonia and no pneumonia, respectively. On univariate analysis, younger age, male gender and low weight for height, were significant risk factors for pneumonia. On multivariate analysis, one-unit increase in age in months (OR = 0.97; 95% CI: 0.97-0.98) and weight for height z-score (OR = 0.76; 95% CI: 0.72-0.79) had a protective effect.

Conclusion: Young age and under nutrition (low weight for height/length) in children are significant independent risk factors for pneumonia.

Keywords: Childhood pneumonia, Pneumonia, Risk factors, Under-five children, Acute respiratory infection treatment unit, Under-nutrition.

Introduction

Acute respiratory infections (ARI) are the most common cause of morbidity and mortality in children under five years of age. WHO estimate indicates 156 million new cases of pneumonia occurring annually worldwide in under-five children, with 95% of these occurring in developing countries. [1,2] Pneumonia accounts for 15% of all deaths in under-five children globally. [3] In the most recent estimate of Acute Lower Respiratory Infections associated mortality in India (2014), pneumonia was held responsible for 369,000 deaths (28% of all deaths), making it the single most important killer in this age group. [4]

Childhood clinical pneumonia is caused by exposure to risk factors related to the host, the environment and infection. Risk factors like lack of exclusive breastfeeding, low birth weight, under-nutrition, indoor air pollution, overcrowding and lack of measles immunization are associated with pneumonia. These risk factors are categorized as definite, likely and possible based on the evidence pointing to their role in pneumonia. [5,6] Children whose immune systems are compromised are at higher risk of developing pneumonia. Risk factors for pneumonia include malnutrition, indoor air pollution (air polluted by cigarette smoke of family members who smoke in the room of the house, the use of mosquito coils, and the use of firewood stoves for cooking in the house), high population density in the house, zinc deficiency, educational status of the mother and any previous experience she might have caring for children, presence of comorbidities, day care, humidity, cold, lack of vitamin A in the diet, birth sequence, and low birth weight (LBW). [7,8]

Symptomatic human immunodeficiency virus (HIV) infection, measles, malnutrition, indoor air pollution, living in crowded homes, and parental smoking are among the globally known factors increasing a child's risk of contracting pneumonia.

[9] Factors considered to be of primary importance toward prevention of pneumonia are exclusive breastfeeding until the age of 6 months and completed basic immunizations. [10]

Therefore to study this problem, a prospective study was conducted to determine the risk factors for the development of pneumonia and severe pneumonia in under-five children.

Material& Methods

A case-control study including 200 children with ARI at Department of Pediatrics, Government Medical College and Hospital, Bettiah, Bihar, India was conducted for the duration of 12 months. The source population of the study were all 2–59 months old children visiting pediatric OPD for different reasons during the study period.

Previously healthy children of either gender, 2 months to 59 months of age attending the Pediatrics outpatient department were recruited over 24 months, with ARI – defined as any cough and/or breathing difficulty, for less than 2 weeks. [11] Children with any of the following were excluded from the study, a) Patients with chronic respiratory diseases (such as asthma, cystic fibrosis, bronchopulmonary dysplasia, airway anomalies), diagnosed in a health care facility; b) Patients with congenital heart disease (suspected based on the history of the suck-rest-suck cycle and cyanosis) – confirmed by echocardiography or presence of murmur; c) Patients with GER/ recurrent aspirations (based on the history of choking or coughing while feeding or barium swallow/GER scan); d) Known or suspected HIV positive/ immunocompromised patient – based on the history of recurrent, documented multisite infection or on immunosuppressive therapy; e) Place of residence outside the city where the study site is based; f) Unable to attend follow up; g) History of radiologically confirmed pneumonia in the last 2 months; h) Terminally sick children - impending respiratory failure, cyanosis at room air and shock.

The study was initiated after clearance by the respective Ethics Committees of all five study sites.

All children who fulfilled the case definition of ARI [11], were enrolled in the study after written informed consent from parents or legally authorized representative. Children were assessed for a history of cough or breathing difficulty by counting respiratory rate and presence of chest indrawing by a trained study staff nurse under the supervision of the doctor. A detailed clinical history and examination findings of the enrolled patient were recorded on a pre-designed case record form before any radiological investigation. An X-ray film of the chest was obtained in every fifth child assessed to have ARI.

The outcome variable was the diagnosis of pneumonia defined by WHO criteria [12] as cough or difficulty breathing and age-specific tachypnea (>60 breaths per minute for children less than 2 months of age, >50 breaths per minute for children 2-11 months of age and >40 breaths per minute for children 1-5 years of age). Severe pneumonia was defined as oxygen saturation <90%, severe respiratory distress, inability to drink or breastfeed or vomiting everything, altered consciousness, and convulsions.[12] Variables examined as risk factors were age, gender, nutritional status, and immunization status.

Statistical analysis: Data were recorded on a pre-designed proforma and managed on an Excel spread-sheet. All the entries were double-checked for any possible typographical error. Data analysis was performed using STATA 11.0 (STATA Corp). Categorical variables were analyzed using both absolute and relative frequencies; continuous variables were analyzed based on the median. Pearson chi-square and Fisher exact tests were used to compare the categorical variables. Numerical variables were analyzed using the nonparametric Mann-Whitney U test. The odds ratio with 95% CI were calculated for risk factor for pneumonia which were identified as those with P ≤0.05 in the univariate analysis.

Results

Table 1: Baseline Demographic and Clinical Characteristics of Enrolled Children

Characteristics	Values
Weight for age, z-score	-0.65 (-1.83, 0.35)
Height/length for age, z-score	-0.78 (-2.36, 0.77)
Weight for-height, z-score	-0.24 (-1.14, 0.53)
Mid-upper arm circumference, z-score	-1.44 (-2.13, -0.8)
Cough	196 (98)
Fever	114 (56)
Audible wheeze	16 (8)
Fast breathing	20 (10)
Chest indrawing	14 (7)

200 children with ARI were enrolled. According to the WHO criteria, 30 (15%) and 170 (85%) of the enrolled children had pneumonia and no pneumonia, respectively.

Table 2: Risk Factors Associated With Development of Community-Acquired Pneumonia

Characteristics	No pneumonia (170)	Pneumonia (30)	P value	OR (95%CI)
Age (mo)	26 (11, 42)	16 (8, 25)	<0.001	0.97 (0.97,0.98)
Boys, n (%)	102 (60)	20 (66.66)	0.04	1.12 (0.97, 1.29)
Weight for height/length z-score	-0.24 (-0.99, 0.56)	-0.77 (-1.96, 0.3)	<0.001	0.76 (0.72, 0.79)
Vaccination				
Influenza, n	10	2	0.50	1.81 (1.53, 2.13)
Pneumococcal, n	10	3	0.08	
H. influenzae, n	50	10	0.01	

On univariate analysis, younger age, male gender and low weight for height, were significant risk factors for pneumonia. On multivariate analysis, one-unit increase in age in months (OR = 0.97; 95% CI: 0.97-0.98) and weight for height z-score (OR = 0.76; 95% CI: 0.72-0.79) had a protective effect.

Discussion

Globally, Streptococcus pneumonia is the most common pathogen causing community-acquired pneumonia. Pneumonia ranks among the 5 main causes of infant mortality. The high mortality rate caused by pneumonia makes it called 'The Forgotten Pandemic.' Based on 2015 data from United Nations Children's Fund, 100 children died each hour due to causes related to pneumonia, and in developing countries, death due to pneumonia occurs at a rate of 20% compared to a rate of 4% in developed countries. [13] Risk factors for pneumonia include malnutrition, indoor air pollution (air polluted by cigarette smoke of family members who smoke in the room of the house, the use of mosquito coils, and the use of firewood stoves for cooking in the house), high population density in the house, zinc deficiency, educational status of the mother and any previous experience she might have caring for children, presence of comorbidities, daycare, humidity, cold, lack of vitamin A in the diet, birth sequence, and low birth weight (LBW). [14] Childhood clinical pneumonia is caused by exposure to risk factors related to the host, the environment and infection. Risk factors like lack of exclusive breastfeeding, low birth weight, under-nutrition, indoor air pollution, overcrowding and lack of measles immunization are associated with pneumonia. These risk factors are categorized as definite, likely and possible based on the evidence pointing to their role in pneumonia. [15,16] Reduction of these risk factors is suggested as a primary strategy to protect against pneumonia. Community-Based Interventions(CBI) including mother's education for reduction of risk factors is an important intervention measure for the long-term sustainability. [17,18] In India, there is a lack of evidence on epidemiology and etiology of pneumonia posing as an important barrier for effective planning and implementation of preventive measures.[19]

Younger children were more prone for pneumonia possibly because of a relatively immature immune system in younger children. [20,21] Male gender was found to be significantly associated with pneumonia in univariate analysis, but not in multivariate analysis. Similar findings were reflected in the earlier study. [22,23] It may be because males are more vulnerable to pneumonia and are given more preference for hospitalization. Females may have a greater resistance due to their enhanced Th1 immune response. [24] Undernutrition is a significant risk factor for the development of pneumonia in children25 as also seen by us. Undernutrition is associated with secondary immune deficiency and an increase in the risk of infections, including pneumonia. [26,27] Vaccination with Hib reduces the incidence of pneumonia in children [28], unlike the results of the present study. The possible reason may be the higher number of viral pneumonia than bacterial pneumonia in the present study as the etiology of pneumonia was not investigated. Pneumococcal and influenza vaccines are also associated with a decrease in the incidence of pneumonia. [29,30] In view of very few children immunized with these vaccines in this study, we were not able to find any significant association with these vaccines.

Conclusion

We concluded that younger and malnourished children are at increased risk of developing pneumonia. Further studies are required from developing countries considering host factors, etiology, including viral causes, and the effect of vaccination to understand the risk factors for pneumonia and severe pneumonia in children. At the same time, it is also important to address undernutrition in children, to reduce pneumonia-related mortality, and ensure their growth and development.

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