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Original Research Article

Determinants of Severe Pneumonia in Children Below Five Years

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Abstract:

Background: Pneumonia remains a leading cause of morbidity and mortality among children under five years of age, particularly in low- and middle-income countries. Identification of modifiable risk factors is essential to reduce disease severity and improve outcomes.

Aim: To identify socio-demographic, environmental, nutritional, and clinical factors associated with severe pneumonia among children under five.

Methodology: A hospital-based analytical cross-sectional study was conducted over one year in the Department of Pediatrics, Sheikh Bhikhari Medical College Hospital, Hazaribagh, Jharkhand, India. A total of 110 children aged 2–59 months diagnosed with pneumonia as per WHO IMNCI guidelines were enrolled using consecutive sampling. Data were collected through caregiver interviews and medical records and analyzed using SPSS version 25.

Result: Pneumonia was more common among males and children from rural areas. Severe pneumonia was significantly associated with incomplete immunization, undernutrition, exposure to biomass fuel, overcrowding, parental smoking, low maternal education, and recent diarrhea or upper respiratory tract infection. Antibiotic use prior to hospitalization was associated with a reduced risk of severe pneumonia.

Conclusion: Severe pneumonia in children under five is strongly linked to preventable and modifiable risk factors. Strengthening immunization coverage, nutritional interventions, environmental improvements and early community-based management may reduce pneumonia severity and related morbidity.

Keywords: Pneumonia, Under-five children, Risk factors, Immunization, Malnutrition, Severe pneumonia.

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Introduction

An acute respiratory illness that affects the lungs is known as acute pneumonia [1]. According to research [2], it is a major source of illness and mortality, especially in children under the age of five, with 704,000 deaths and 60.6 million Disability-Adjusted Life Years (DALYs). Estimates indicate 231 cases of clinical pneumonia per 1000 children in low-income countries each year [3]. Pneumonia remains a major cause of morbidity and mortality among children under five. Despite national and international efforts, pneumonia is still a major issue.

Children with pneumonia who also have severe acute malnutrition (SAM) are at a greater risk of dying [4], with mortality rates reportedly 15 times higher than those of children without SAM [5]. Most SAM children who die from pneumonia and diarrhea do so in critical care units in impoverished nations. Previous research has shown that some of the most prevalent risk factors for pneumonia include not exclusively breastfeeding, indoor air pollution, parental cigarette smoking and malnutrition.

Health professionals may be less confident in their ability to recognize clinical signs of pneumonia in children with SAM, especially in resource-limited settings. As a result, they may prescribe only oral antibiotics in accordance with recent WHO guidelines if the SAM children have no complications [6]. The most common avoidable cause of mortality for children under five worldwide is still pneumonia. Previous research has shown that in low-resource settings, risk factors for pneumonia in children have included malnutrition, inadequate paternal education, poorly ventilated living rooms and smoking habits of parents.

Pneumonia has been shown to be associated with poverty-related variables, including indoor air pollution, family congestion, malnutrition, vitamin A and zinc deficiencies, birth order, and mother's educational attainment [7]. Given that diarrhea is a recognized risk factor for pneumonia, vaccination may have indirectly contributed to the decline in pediatric pneumonia [8]. Tanzania, like other nations, has responded by implementing the WHO's recommendation to incorporate the Haemophilus influenzae type B (Hib) and pneumococcal conjugate (PCV) vaccines into the regular national immunization schedule [9]. Few advancements have improved treatment in wealthy countries, and most of these deaths occur in developing countries with limited access to healthcare.

To inform and educate policymakers, program planners, healthcare implementers, and the public, the contributing variables of pneumonia must be systematically examined. Designing focused preventive and management measures requires identifying and analyzing pertinent factors. There is little information available in the current study context on the factors contributing to pneumonia in children under five. Thus, the purpose of this study was to determine the risk factors for pneumonia in children under five who were receiving care at Sheikh Bhikhari Medical College Hospital in Hazaribagh, Jharkhand, India.

Methodology

Study Design: A hospital-based analytical cross-sectional study was conducted to identify factors associated with pneumonia among children aged under 5 years.

Study Duration: The study was carried out over a period of one year.

Study Area: The study was conducted in the Department of Pediatrics, Sheikh Bhikhari Medical College Hospital, Hazaribagh, Jharkhand, India.

Sample Size: A total sample of 110 children aged 5 years was included in the study. The sample size was chosen based on feasibility, patient flow during the study period, and comparison with similar hospital-based studies.

Sampling Technique: A consecutive sampling technique was used. All eligible children under 5 years of age who were diagnosed with pneumonia and admitted to or attending the pediatric outpatient department during the study period were enrolled until the required sample size was reached.

Inclusion Criteria

- Children aged under 5 years.
- Clinically diagnosed cases of pneumonia based on WHO Integrated Management of Childhood Illness (IMNCI) guidelines.
- Children whose parents or caregivers provided informed consent.

Exclusion Criteria

- Children with congenital heart disease, chronic lung disease or known immunodeficiency disorders.
- Children with incomplete medical records.
- Children whose parents or caregivers declined consent.

Data Collection: Data were collected using a predesigned and pretested structured questionnaire administered to parents or caregivers through face-to-face interviews. Information collected included socio-demographic characteristics, environmental factors, nutritional status, immunization history, feeding practices, exposure to indoor air pollution, recent history of diarrhea or upper respiratory tract infections and parental smoking habits. Clinical details such as diagnosis, severity of pneumonia, nutritional assessment, and laboratory findings were obtained from the patient's medical records. Data collection was carried out by trained pediatric staff under the supervision of senior faculty members.

Procedure: Eligible children aged 2–59 months diagnosed with pneumonia as per WHO IMNCI guidelines were identified from the pediatric outpatient and inpatient services of Sheikh Bhikhari Medical College Hospital. Parents or caregivers were informed about the study objectives, and written informed consent was obtained prior to enrollment. Data were collected using a pretested structured questionnaire administered through face-to-face interviews, capturing information on sociodemographic characteristics, environmental exposures, feeding and immunization practices and recent illness history. Anthropometric measurements were recorded using standard equipment, and relevant clinical details were extracted from medical records. Data completeness and accuracy were verified daily under faculty supervision, and confidentiality was maintained throughout the study.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using SPSS (version 25). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data. Associations between pneumonia and potential risk factors were assessed using the chi-square test for categorical variables. Variables with a p-value less than 0.05 were considered statistically significant. Results were presented in tables and charts.

Result

According to Table 1, children aged 24-59 months had the highest percentage of pneumonia cases (39.1%), followed by those aged 2-11 months (34.5%). This suggests that pneumonia is common

across all age groups under five. Male children were more often affected than female children (56.4%), which may reflect a biological predisposition or differences in healthcare-seeking behavior. 60% of children lived in rural regions, which may indicate greater exposure to environmental risk factors and reduced access to prompt medical treatment. A significant percentage of women had little or no formal education, which may influence their understanding of preventive childcare practices.

Table 1: Age and sex distribution of under-five children with pneumonia (n = 110)

Variable	Category	Frequency (n)	Percentage (%)
Age of children (months)	2–11 months	38	34.5
	12–23 months	29	26.4
	24–59 months	43	39.1
Age group (WHO classification)	Infants (2–11 months)	38	34.5
	Young children (12–59 months)	72	65.5
Sex	Male	62	56.4
	Female	48	43.6

Table 2 shows that the research group frequently had environmental variables known to put children at risk of pneumonia. Indoor air pollution resulted from the majority of households (64.5%) using biomass fuels for cooking. 61.8% of houses were found to be overcrowded, raising the risk of respiratory infection transmission. 42.7% of homes had poor ventilation, worsening indoor air quality. Parental smoking is still a major source of secondhand smoke exposure for children under five, even though it was reported in a lesser percentage of families (21.8%).

Table 2: Environmental and household-related factors among children with pneumonia (n = 110)

Variable	Category	Frequency (n)	Percentage (%)
Type of cooking fuel used	Biomass (wood/coal)	71	64.5
	LPG/Electricity	39	35.5
Kitchen location	Inside living area	29	26.4
	Separate kitchen	81	73.6
Household crowding	Overcrowded	68	61.8
	Not overcrowded	42	38.2
Ventilation	Poor	47	42.7
	Adequate	63	57.3
Parental smoking	Yes	24	21.8
	No	86	78.2

Table 3 shows that 62.7% of children were exclusively breastfed for the first six months of their life, although a sizable percentage were not, leaving them more susceptible to respiratory illnesses. With only 52.7% of children receiving all recommended vaccinations, immunization coverage was below ideal levels. The fact that almost one-third (32.7%) of children were malnourished supports the known link between pneumonia and malnutrition. 41.8% of children had not received zinc supplementation, a protective factor against respiratory infections, suggesting deficiencies in preventative care services.

Table 3: Nutritional and child-care related factors (n = 110)

Variable	Category	Frequency (n)	Percentage (%)
Exclusive breastfeeding (first 6 months)	Yes	69	62.7
	No	41	37.3
Immunization status	Fully immunized	58	52.7
	Partially immunized	33	30
	Unimmunized	19	17.3
Nutritional status	Normal	74	67.3
	Underweight/Wasted	36	32.7
Zinc supplementation	Yes	64	58.2
	No	46	41.8

As presented in Table 4, a significant number of children had recent illnesses prior to the onset of pneumonia. Nearly 43.6% had experienced diarrhea during the previous two weeks, and 47.3% had upper respiratory tract infection symptoms, underscoring their significance as risk factors. 31.8% of

children had a history of prior hospitalization, which may indicate underlying susceptibility or recurring disease. Many cases (65.5%) were categorized as non-severe pneumonia, but a significant percentage showed signs of severe illness, highlighting the clinical burden of pneumonia in children under five.

Table 4: Recent illness history and clinical factors associated with pneumonia (n = 110)

Variable	Category	Frequency (n)	Percentage (%)
History of diarrhea (past 2 weeks)	Yes	48	43.6
	No	62	56.4
URTI in past 2 weeks	Yes	52	47.3
	No	58	52.7
Previous hospitalization	Yes	35	31.8
	No	75	68.2
Severity of pneumonia	Non-severe	72	65.5
	Severe	38	34.5

Discussion

In this study, we examine children under five who were admitted to a paediatric inpatient department, Hazaribagh, for either severe or non-severe pneumonia. Our primary findings are: (1) Among children under five, hospitalization for pneumonia (regardless of severity) primarily affects male patients under one year of age; (2) incomplete immunization status, parental smoking, low maternal education, and related infectious diseases were strongly associated with severe pneumonia, as previously documented [10]; and (3) use of antibiotics prior to hospitalization reduces the risk of severe pneumonia by almost sixfold.

Measles, influenza, pertussis, Haemophilus influenzae type B infections, and Streptococcus pneumoniae infections can all be prevented by vaccination [11]. In 2011, government figures showed that 90% of children of appropriate ages were fully immunized against the illnesses covered by the routine immunization program. Compared with other studies, our patients had a two-fold increased relative risk of diarrhea in cases of severe pneumonia.

It is well recognized that stool loss in children may be linked to a number of infectious disorders. On the other hand, diarrhea mostly results in zinc deficiency, which leads to malnutrition and, therefore, a compromised immune response [12]. When two successive boluses of isotonic fluid are administered to extremely malnourished children who do not recover from septic shock, the WHO advises blood transfusion.

Even with proper care, the mortality rate in this demographic can be quite high, both in wealthy and developing nations [13]. Oral amoxicillin treatment for patients with severe pneumonia in the community can reduce the risk of pneumonia sequelae, such as needle-borne infections and the need for injections, as well as the need for referrals or unnecessary hospital admissions. Additionally, oral amoxicillin lowers the likelihood of antimicrobial resistance developing due to the extensive use of ineffective second-line antibiotics [14].

According to research, pediatric pneumonia can have serious economic repercussions for the society it impacts, in addition to being fatal. This is particularly true for children born into low-income families, in rural areas, or to women who have not had a basic education; these children are more likely to die before reaching five years of age. There hasn't been much progress in reducing infant death over the past 20 years, despite a steady decline in under-five mortality [15]. According to recent research, in well-nourished infants with septic shock, circulatory collapse rather than fluid overload is the cause of increased mortality following fast fluid resuscitation.

This study emphasizes the strong, persistent correlation between avoidable and modifiable risk factors and severe pneumonia in children under five years of age in Hazaribagh. Early infancy is a crucial time for intervention, as evidenced by the greater impact on male newborns under 1 year of age. The persistent socioeconomic and behavioral determinants of child health in this area are reflected in the substantial correlation between severe pneumonia and concurrent infectious illnesses, parental smoking, low maternal education, and inadequate immunization. Antibiotic use before hospitalization was significantly associated with a lower risk of severe illness, suggesting potential benefits of early, effective community-level care when antibiotics are used judiciously. The bidirectional association among infection, malnutrition, and immune dysfunction is further highlighted by the reported increased incidence of diarrhea among children with severe pneumonia, especially in settings with minimal resources. In addition to integrated care for childhood diseases, these results support bolstering preventive interventions, including vaccine coverage, parental education, tobacco control, and prompt access to effective first-line antibiotics. Addressing these determinants through community-based and health-system interventions may significantly reduce illness severity, hospital admissions, and avoidable deaths from pediatric pneumonia.

Conclusion

This study highlights pneumonia as a significant health burden in children under five, with several avoidable sociodemographic, environmental, dietary and clinical variables greatly influencing the severity of the illness. Severe illness was more common in male children, children from rural and crowded homes, children exposed to indoor air pollution, children whose parents smoked, children who were not fully immunized, and undernourished children. The importance of integrated management of childhood illnesses is highlighted by the strong correlation between the severity of pneumonia and recent diarrhea and upper respiratory tract infections. Furthermore, the protective effect of prior adequate antibiotic use underscores the potential importance of early community-level intervention. All things considered, these results emphasize the necessity of bolstering immunization programs, enhancing maternal education and awareness, encouraging healthy eating and breastfeeding practices, reducing indoor air pollution, and ensuring timely access to quality primary healthcare. In areas with limited resources, implementing comprehensive preventative and early-treatment methods may significantly lower the severity, complications, and healthcare burden of pneumonia in children under five.

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