

Evaluation of Risk Factors Associated with Pneumonia Severity in Children

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ABSTRACT

Background: Pneumonia is the most common cause of mortality for children worldwide, with the majority of these deaths occurring in environments with insufficient resources. Approximately 152 million children under five worldwide get clinical pneumonia each year, primarily in low- and middle-income nations. 8.7% of them developed severe pneumonia that needed to be hospitalized. There are, however, few statistics that may be used to identify children who are most likely to have severe pneumonia from pneumonia. **Objectives:** This study was done to evaluate of risk factors associated with pneumonia severity in children. **Methods:** The cross-sectional Observational study was conducted in the Department of Pediatrics, Sir Salimullah Medical College & Mitford Hospital from July 2022 to June 2023. A total of 83 subjects of both sexes with the age range from 1 month to 60 months were included in the study. Data were collected over a period of 12 months and analyzed by appropriate computer based programmed software Statistical Package for the Social Sciences (SPSS), version 22.

Results: In this study, about 26 (31.3%) children lies between 1 month to 12 months and 24 (28.9%) children lies between 13 months to 24 months. Most of the children 55 (66.30%) were male and 28 (33.70%) children were female. Among the total 83 children 16 (19.3%) were stunted and about 13 (15.7%) had underweight. Most of the patients 67 (80.7%) immunization status was up to date. The temperature of most of the children 42 (50.6%) was $>38^{\circ}\text{C}$. Most of the children's 43 (51.8%) pulse rate was $>140/\text{min}$. Duration of illness of 52 (62.7%) children were ≥ 3 days and 31 (37.3%) children were < 3 days. In the final diagnosis 34 (40.9%) children had bronchopneumonia and Pneumonia was in 31 (37.3%) children. Asthma, Bronchiolitis and Pulmonary tuberculosis was in 2 (2.4), 3 (3.6%) and 8 (9.6%) children.

Conclusion: The development of WHO-defined severe childhood pneumonia was substantially correlated with male sex, longer duration of illness, fever, receiving prior medical care, and severe stunting. The findings of this study could be useful in the development of therapies aimed at lowering the morbidity and fatality rates of children with severe pneumonia.

Key words: Risk Factors, Pneumonia, Children.

I. INTRODUCTION:

Pneumonia is the most common cause of mortality for children under five worldwide, accounting for almost 90% of cases in environments with insufficient resources [1]. Although the number of under-five pneumonia deaths has significantly decreased from 13.6 per 1000 livebirths in 2000 to 6.6% per 1000 livebirths in 2015 due to the implementation of workable and efficient therapies, pneumonia still ranks highest in terms of mortality [2,3]. Pneumonia-related deaths in childhood are disproportionately seen in low- and middle-income countries (LMICs), with South Asia and sub-Saharan Africa accounting for the highest number of these deaths [3, 4].

Pneumonia-related mortality are decreasing more slowly than those from other pediatric illnesses [5]. According to Rudan et al., in LMICs around the world, the incidence of clinical pneumonia in children under five was roughly 0.29 occurrences per child-year [6]. This indicates that there are 151.8 million cases annually, of which 13.1 million (8.7%) develop pneumonia and become severe enough to require hospitalization [6, 7].

Numerous established risk factors for pneumonia include undernourishment, early age, insufficient immunization history, and bad birth outcomes (being born small for gestational age, low birth weight, or preterm). Patients with severe pneumonia may have a combination of risk factors that work together to intensify the symptoms of their illness.

The significant advancements in preventative measures are demonstrated by the national and international trend toward a decreased burden of disease from pneumonia in children under the age of five. Reductions in both indoor and outdoor air pollution, better nutrition for children, increased immunization rates for children, advancements in HIV therapy, and pneumonia case management are remarkable efforts [8,9].

The World Health Organization (WHO) has classified childhood community-acquired pneumonia (CAP) by clinical characteristics, dividing them into nonsevere and severe pneumonia. WHO defines non-severe pneumonia in children as the presence of cough or difficulty breathing associated with fast breathing or chest indrawing in children 2–59 months of age. Severe pneumonia is defined as pneumonia plus the inability to drink, persistent vomiting, convulsions, lethargy, stridor, or severe malnutrition [10]. Studies show that clinical definitions of severity correlate with case fatality rates. Most childhood pneumonia deaths are due to severe pneumonia [11]. Case management is one of the cornerstones of CAP management strategies [12]. Early identification of cases using simple clinical signs and appropriate treatment is needed. Recognizing the risk for the severe outcome is essential to further morbidity and mortality. Identifying children at risk of pneumonia-related mortality could signal the need for closer monitoring, hospital admission, or more intensive therapy [13, 14].

According to World Health Organization (WHO), United Nations Children’s Fund (UNICEF), and others, risk factors for severe childhood pneumonia in LMICs include bacterial etiology, young age, low birth weight, malnutrition, household crowding, exposure to indoor air pollution, and low-level schooling of mothers [15-17]. Factors associated with severe pneumonia in different contexts and their changes over time in LMICs are incompletely defined [18,19]. In Bangladesh, severe pneumonia is the main cause of hospitalization among under-five children. Among 156,847 admitted children identified in a surveillance performed in seven hospitals in Bangladesh from May 2004 through April 2007, the most frequent diagnosis was pneumonia (32%) [17].

II. METHODOLOGY:

The cross-sectional Observational study was conducted in the Department of Pediatrics, Sir Salimullah Medical College & Mitford Hospital from July 2022 to June 2023. A total of 83 subjects of both sexes with the age range from 1 month to 60 months were included in the study according to the physical sign-symptoms suggestive of severe pneumonia. Purposive sampling was done according to the availability of the patients who fulfilled the selection criteria. Face to face interview was done to collect data with a semi-structured questionnaire. After collection, the data were checked and cleaned, followed by editing, compiling, coding, and categorizing according to the objectives and variable to detect errors and to maintain consistency, relevancy and quality control. Statistical evaluation of the results used to be obtained via the use of a window-based computer software program devised with Statistical Packages for Social Sciences (SPSS-24).

III. RESULT:

Table I: Distribution of the patients according to age (n = 83)

Table I shows that, about 26 (31.3%) children lies between 1 month to 12 months and 24 (28.9%) children lies between 13 months to 24 months

Age group	Frequency	%
1 – 12 months	26	31.3
13 - 24 months	24	28.9
25 - 36 months	16	19.3
37 - 48 months	11	13.3
49 - 60 months	6	7.2
Total	83	100.0

Figure I: Distribution of the patients according to sex (n=83)

Figure I shows that, most of the children 55 (66.30%) were male and 28 (33.70%) children were female.

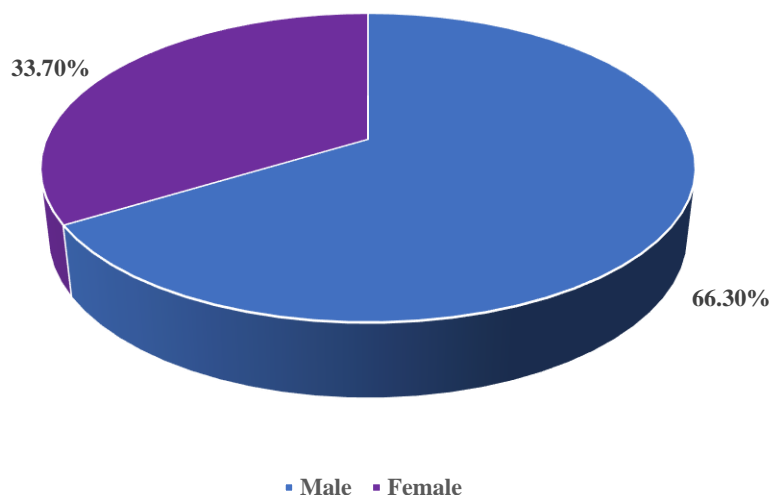


Table II: Distribution of the patients according to nutritional status (n = 83)

Table II shows that, among the total 83 children 16 (19.3%) were stunted and about 13 (15.7%) had underweight

Nutritional status	Frequency	%
Underweight	13	15.7
Stunted	16	19.3
Total	29	100.0

Table III: Distribution of patients according to immunization up to date (n = 83)

Table III shows that, most of the patients 67 (80.7%) immunization status was up to date

Immunization up to date	Frequency	Percent
Yes	67	80.7
No	16	19.3
Total	83	100.0

Table IV: Distribution of the patients according to temperature (n = 83)

Table IV shows that, the temperature of most of the children 42 (50.6%) was >38°C

Temperature	Frequency	%
36°C - 37°C	18	21.7
37°C - 38°C	23	27.7
>38°C	42	50.6
Total	83	100.0

Table V: Distribution of the patients according to pulse rate/min (n=83)

Table V Shows that, most of the children's 43 (51.8%) pulse rate was >140/min

Pulse rate/min	Frequency	%
120 - 130	16	19.3
131 - 140	24	28.9
>140	43	51.8
Total	83	100.0

Table VI: Distribution of Patients according to duration of illness (n=83)

Table VI shows that, duration of illness of 52 (62.7%) children were ≥ 3 days and 31 (37.3%) children were <3 days

Duration of illness	Frequency	%
<3 days	31	37.3
≥ 3 days	52	62.7
Total	83	100.0

Table VII: Distribution of Patients according to diagnostic classification (n=83)

Table VII shows that, in the final diagnosis 34 (40.9%) children had bronchopneumonia and Pneumonia was in 31 (37.3%) children. Asthma, Bronchiolitis and Pulmonary tuberculosis was in 2 (2.4), 3 (3.6%) and 8 (9.6%) children

Diagnostic classification	Frequency	%
Pneumonia	31	37.3
Bronchopneumonia	34	40.9
Asthma	2	2.4
Bronchiolitis	3	3.6
Pulmonary tuberculosis	8	9.6
Other	5	6.0
Total	83	100.0

IV. DISCUSSION:

Pneumonia remains an important public health burden and determining factors that may mitigate severe disease have beneficial implications in resource limited settings. These factors may help inform interventions and policy decisions in an already constrained health-care system. Numerous established risk factors for pneumonia include undernourishment, early age, insufficient immunization history, and bad birth outcomes (being born small for gestational age, low birth weight, or preterm). Patients with severe pneumonia may have a combination of risk factors that work together to intensify the symptoms of their illness. The significant advancements in preventative measures are demonstrated by the national and international trend toward a decreased burden of disease from pneumonia in children under the age of five. Reductions in both indoor and outdoor air pollution, better nutrition for children, increased immunization rates for children, and pneumonia case management are significant efforts.

The cross-sectional Observational study was conducted in the Department of Pediatrics, Sir Salimullah Medical College & Mitford Hospital from July 2022 to June 2023. A total of 83 subjects of both sexes with the age range from 1 month to 60 months were included in the study according to the physical sign-symptoms suggestive of severe pneumonia.

In this study, about 26 (31.3%) children lies between 1 month to 12 months and 24 (28.9%) children lies between 13 months to 24 months. Most of the children 55 (66.30%) were male and 28 (33.70%) children were female. In another study, the study comprised of 2597 children aged 2–59 months for the analysis. Of these, 1693

were cases and 904 were controls. The median age of study children was 9.2 months (IQR, 5.1–17.1), 1576 (60%) were male, and 1534 (59%) were in the 2-11-month age group. Another study revealed that they enrolled 305 children, of which 134 (43.9%) were categorized as severe pneumonia and 171 (56.1%) as non-severe pneumonia. Baseline characteristics of children were similar in both groups of participants with severe pneumonia and non-severe pneumonia. More than three-quarters of the participants (75.7%; n = 231) were younger than 18 months with 66.9% (n = 204) younger than 12 months of age.

Among the total 83 children 16 (19.3%) were stunted and about 13 (15.7%) had underweight. Most of the patients 67 (80.7%) immunization status was up to date. Another study shows, age-appropriate immunization coverage was recorded in 86.9% (n = 265) of children with no significant differences between groups. Children who were HIV exposed or HIV infected were similar between groups with 75.4% (43/57) on appropriate cotrimoxazole prophylaxis.

The temperature of most of the children 42 (50.6%) was $>38^{\circ}\text{C}$. Most of the children's 43 (51.8%) pulse rate was $>140/\text{min}$. In another study, cases often had higher fever (41% vs 20%), and higher pulse rate (17% vs 16%) compared to controls. Hypoxemia was only observed in cases (11% of cases).

Duration of illness of 52 (62.7%) children were ≥ 3 days and 31 (37.3%) children were < 3 days. In the final diagnosis 34 (40.9%) children had bronchopneumonia and Pneumonia was in 31 (37.3%) children. Asthma, Bronchiolitis and Pulmonary tuberculosis was in 2 (2.4), 3 (3.6%) and 8 (9.6%) children. In another study, the final diagnosis in 78.3% (n=239) of children was pneumonia or bronchopneumonia. The most prevalent comorbidity was congenital heart disease occurring in 4.6% (n=14) of all children with pneumonia. The most frequent concomitant diagnoses included anaemia (3.9%; n=12), failure to thrive [18] (3.3%; n=10), acute gastroenteritis (3.0%; n=9) and urinary tract infection (2.6%; n=8).

Male children were predominant in the severe pneumonia group (63%) in other study. Yet in the pneumonia groups their proportion reached 56% as well; overall male children thus were more affected significantly by severe pneumonia corroborating findings of other studies [20]. The cause behind the high susceptibility of male children could be either genetic, or higher reporting for male children by the mothers due to gender bias, which potentially causes mothers to notice symptoms due to a higher attention to male children particularly for seeking health care much earlier than female children [21]. Nevertheless, boys have greater likelihood of being affected or of care seeking in general for common acute respiratory illness than girls, as reported in several studies from Bangladesh [22–24]. Another possibility of male children to be in the high risk of infection could be the testosterone suppressing the immune response [23]. However, clarification of this trend is multifaceted, as the role of social determinants of health, such as sex, socio-economic status (SES), and water, sanitation, and hygiene (WASH) practices, with disease are often not included in studies.

For safety reasons children with severe acute malnutrition were excluded from the main effectiveness trial although children with moderate malnutrition were included as mentioned earlier. One systematic review suggested that like the severely malnourished children, children

with moderate degrees of malnutrition may also be at increased the risk of death due to pneumonia [25, 26]. Studies that evaluated the impact of moderate malnutrition are comparatively few as moderate degree of malnutrition in health facilities in developing countries is not recorded as an admission diagnosis. Notably, we found severe stunting to be associated with severe pneumonia. Stunting is established to have long-term sequels on lung development and growth and to be associated with prolonged acute course of pneumonia treatment and delay in recovery [27]. Malnutrition in children results in an immunocompromised state and subsequent increase in infectious morbidity and mortality due to impairments in multiple aspects of the immune system including cell mediated and complement responses, inefficient chemotaxis, reduced mature T cells, compromised phagocytic activity, among others. The results of our study highlight the importance of stunting in children being treated for severe pneumonia [28, 29].

On the World Pneumonia Day on Nov 12, 2015, action was sought to improve the early identification and treatment of childhood pneumonia at community and outpatient level to reduce disease severity and deadly outcomes [30]. It was apparent that the case–mortality rate in untreated children with pneumonia is high, sometimes reaching as high as 20%, and deaths can occur as early as 3 days after illness onset [31]. We also found that duration of illness at home for 3 days or more was significantly associated with the likelihood of disease progression to severe pneumonia. The same observation was reported from Kenya [32]. In our study fever was significantly associated with severe pneumonia. Studies in diverse LMICs like South Africa, Papua New Guinea, and Indonesia reported no association between fever and pneumonia severity. However, one study in USA indicated temperature to be associated with severe pneumonia (not defined by WHO classification) and another study reported duration of fever (at day 6) was associated with severity. Although WHO did not consider fever in their pneumonia severity criteria, the British Thoracic Society (BTS) includes fever in their guideline.

V. CONCLUSION:

This study discovered that male children, longer illness duration, fever, receiving prior medical care, and severe stunting were substantially linked with severe pneumonia. The findings of this study may facilitate decisions about the best treatment location (home vs. hospital) or the necessity of further supportive care, which could enable case managers in nations with limited resources make more informed decisions. More studies in larger populations are desperately needed to identify important community-based risk factors for severe pneumonia and to fill in important knowledge gaps. These studies will allow the development of optimal management approaches that could result in significant drops in morbidity and mortality.

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