# A Study of Risk Factors for Acute Lower Respiratory Tract Infections (ALRTI) in Children Aged 1 Month to 5 Years

## Archana Singh[1], Arunabh Kumar[2], Binoy Shankar[3]

[1,2]Senior Resident, Department of Pediatrics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar

[3]Assistant Professor, Department of Pediatrics, Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar

**Abstract:**

**Background:** Nearly 156 million new episodes of acute respiratory infections occur each year, the majority of which (43 million) occur in India. These infections are the primary cause of morbidity and mortality in children under the age of five in poor nations. The most recent estimates from the Child Health Epidemiology Reference Group (CHERG) for 2010 indicate that pneumonia caused 0.397 million of the projected 1.682 million deaths of children under the age of five in India. This study's objectives are to identify the various Acute Lower Respiratory Tract Infection (ALRTI) risk factors in children between the ages of 1 month to 5 years.

**Methods:** In the current study, 100 ALRTI cases who had been examined at the department of pediatrics, SKMCH, Muzaffarpur, Bihar from November 2022 to April 2023 and who met the WHO criteria for pneumonia were assessed for risk variables after obtaining parental consent.

**Results:** Potential risk factors for severe ALRTI included parental illiteracy ($p=0.000^*$), overcrowding ($p=0.0000^*$), incomplete immunization ($p=0.0000^*$), lack of exclusive breastfeeding ($p=0.0004^*$), low birth weight ($p=0.000^*$), use of biomass fuels for lighting ($p=0.0002^*$), and mud/cow dung flooring ($p=0.0088^*$).

**Conclusion:** Numerous sociodemographic, dietary, and environmental risk factors for ALRTI have been discovered in the current study. These factors can be addressed by the community's effective health education and the effective training of peripheral health staff.

**Keywords:** ALRTI (Acute lower respiratory tract infection), Pneumonia, risk factors.

## Introduction

With almost 156 million new episodes per year, acute lower respiratory tract infection (ALRTI) is the main cause of morbidity in children under 5 years old worldwide. Of these, 43 million occur in India. A total of 1.9 million people die each year, with India being responsible for about 400,000 of those deaths[1].

The most recent estimates from the Child Health Epidemiology Reference Group (CHERG) for 2010 indicate that 0.397 million of the projected 1.682 million deaths of children under the age of five in India were caused by pneumonia[2]. Pneumonia was the cause of roughly 18% of all infant fatalities in India [3].

Pneumonia in children is brought on by a mix of host, environmental, and infection-related risk factors. Numerous studies [4,5,6] have identified undernutrition, the use of solid fuels in the home, crowded living conditions, a lack of exclusive breastfeeding, and low levels of maternal education as frequent risk factors for the development of

ALRTI. As a result, it's important to research the risk factors that could keep ALRTI from developing. The illness burden may be reduced by identifying these modifiable risk factors for ALRTI, and knowledge of these factors can assist avoid the development of ALTRI and associated sequelae. Therefore, the current study was carried out to examine the risk factors for ALRTI in kids between the ages of 1 month and 5 years.

## Materials and Methods

From November 2022 to April 2023, the Department of Pediatrics at Sri Krishna Medical College and Hospital in Muzaffarpur, Bihar, conducted a prospective study on ALRTI in children aged one month to five years. Children admitted to the hospital with an ALRTI clinical diagnosis according to WHO guidelines. The study excluded participants with any underlying chronic respiratory illness, any underlying chronic cardiac illness, children younger than 1 month old, and those older than 5 years old.

Children who were admitted with ALRTI between the ages of 1 month and 5 years were included in the study as cases. Pneumonia or severe pneumonia can be an ALRTI condition [17,18].

A thorough history of any pertinent symptoms was collected, including fever, coughing, fast breathing, chest tightness, refusing to eat, lethargy, and wheezing. The past details of comparable complaints were also recorded. Birth weight history, family history, and information about the parents' literacy are noted. Parents were questioned about their family's immunization history, and wherever documentation were available, they were checked. It was documented when weaning and exclusive breastfeeding began and continued.

A 24-hour dietary recall approach was used to calculate the child's nutritional intake prior to the current sickness. The family's history of URI in the two weeks prior was noted. Details of the cooking fuel utilized and the family members' smoking history were noted.

Details about the living quarters, such as the type of flooring, the lighting source, and the type of kitchen, were also gathered.

Grading of socioeconomic status was carried out using a modified Kuppuswamy's classification. Every child was examined in great detail. While the youngster was silent, the child's heart rate and respiration were monitored for a full minute.

Malnutrition was assessed using the Indian Academy of Pediatrics classification after a thorough anthropometric analysis. Each child's level of respiratory distress was evaluated. Pallor and other vitamin deficiency symptoms were noted.

A thorough comprehensive analysis was conducted. A chest x-ray was performed in every patient to classify the ALRTI into clinical entities and to detect complications, if any, as well as routine hematological tests to determine the degree of anemia and blood count.

Depending on the kind of ALRTI, additional particular investigations were carried out as needed in each case, and all cases were handled in accordance with the standard protocol.

The data were shown using appropriate tables and graphics. The odds ratio was determined using the Chi square test. Significant data was defined as a "p" value <0.05.

**Results**

In the 100 cases of ALRTI examined, pneumonia affected 78 (78%) and 22 (22%) of the children, respectively. Out of these 100 cases, 62 (or 62%) involved infants, and 14 (or 63.6%) of the 22 severe pneumonia cases involved infants. Out of the 100 instances of ALRTI, 69 (69%) of the cases were in male and 31 (31%) were in female. Of the 22 cases of severe pneumonia, 15 (68.1%) of the cases were in male and 7 (31.9%) were in female.

**Table 1: Maternal literacy and severity of pneumonia**

| Literacy | Severe pneumonia | Pneumonia | Total |
|---|---|---|---|
| Illiterate | 15 (68.1%) | 16 | 31 |
| Literate | 07(31.9%) | 62 | 69 |
| **Total** | **22 (100%)** | **78** | **100** |

Odds ratio 8.30 Chi$^2$ =16.07p=0.0001*

In the study, 31% of the 100 ALRTI cases were illiterate mothers. Maternal illiteracy was linked significantly (p=0.0001*) to severe pneumonia. 20% of the 100 ALRTI patients in the research had fathers who were illiterate. The severity of the pneumonia was significantly correlated (p=0.000*) with parental illiteracy. Odds ratio 10.50 Chi$^2$ =18.36 CI =3.8-28.7p=0.000*

**Table 2: Birth Weight and severity of pneumonia**

| Low birth weight | Severe Pneumonia | Pneumonia | Total |
|---|---|---|---|
| Present | 14 (63.6%) | 04 | 18 |
| Absent | 08 (36.4%) | 74 | 82 |
| **Total** | **22 (100%)** | **78** | **100** |

Odds ratio 32.38 Chi$^2$ =35.93CI 11.0-95.4p=0.000*

18% of the 100 cases with ALRTI involved low birth weight. Low birth weight was significantly associated with severe pneumonia (p=0.000*).

**Table 3: Exclusive breast feeding and severity of pneumonia**

| Exclusive breast feeding | Severe Pneumonia | Pneumonia | Total |
|---|---|---|---|
| Absent | 16 (72.8%) | 22 | 38 |
| Present | 06 (27%) | 56 | 62 |
| **Total** | **22 (100%)** | **78** | **100** |

Odds ratio 6.79 Chi$^2$ =12.61CI = 2.5-18.2p=0.0004*

38% of the 100 ALRTI cases were not breastfed exclusively. Significant correlation between severe pneumonia

and non-exclusive breastfeeding was discovered (p=0.0004*).

**Table 4: Immunization and severity of pneumonia**

| Immunization | Severe Pneumonia | Pneumonia | Total |
|---|---|---|---|
| Incomplete for age | 18 (81.9%) | 21 | 39 |
| Complete for age | 04 (18.1%) | 57 | 61 |
| **Total** | **22 (100%)** | **78** | **100** |

Odds ratio 12.21Chi$^2$ =19.49CI= 4.3-35.0p=0.0000*

39% of the 100 ALRTI cases studied had insufficient age-appropriate immunization. Significant correlation between severe pneumonia and incomplete immunization status (p=0.0000*) was discovered.84% of the 100 ALRTI cases lived in homes with pucca flooring, it was discovered. A significant correlation between severe pneumonia and mud or cow dung flooring (p=0.0088*) was discovered. Odds ratio = 5.00Chi$^2$ =8.702CI=1.7-14.6p=0.0088*

**Table 5: Source for lighting and severity of pneumonia**

| Source for lighting | Severe Pneumonia | Pneumonia | Total |
|---|---|---|---|
| Biomass fuels | 14 (63.6%) | 15 | 29 |
| Electricity | 08 (36.4%) | 63 | 71 |
| **Total** | **22 (100%)** | **78** | **100** |

Odds ratio = 7.35Chi$^2$ =14.35CI=2.8-19.3p=0.0002*

Seventy-one percent of the 100 ALRTI cases were discovered to be residing in homes with electricity-powered illumination. The remaining 29% of people resided in homes lit by a variety of biomass fuels. The use of biomass fuels for illumination was shown to be significantly associated (p=0.0002*) with severe pneumonia.

Among the 100 ALRTI instances, overcrowding was observed in 86% of the cases. There was a strong correlation between crowded living conditions and pneumonia severity (p=0.0000*). Odds ratio = 0.02 Chi$^2$ =34.31CI = 0.0-0.1p=0.0000*

14% of the 100 ALRTI cases had a history of at least one family member being sick or having been sick with the flu in the two weeks prior. However, there was no correlation between the severity of pneumonia and the family's history of upper respiratory infections (p=0.0923). Odds ratio = 3.28 Chi$^2$ =2.83CI = 1.0-10.3 p=0.0923.

**Table 6: Risk Factors for Severe pneumonia**

| Risk factor | Severe pneumonia | Association |
|---|---|---|
| Maternal Illiteracy | 68.1% | Significant p= 0.0001* |
| Paternal Illiteracy | 54.5% | Significant p = 0.000* |
| Low birth weight | 63.6% | Significant p= 0.000* |
| Non Exclusivebreast feeding | 72.8% | Significant p= 0.0004* |
| Incomplete Immunization | 81.9% | Significant p= 0.0000* |
| Mud/Cowdung flooring | 36.4% | Significant p= 0.0088* |
| Usage of Biomass fuels as source of lighting | 63.6% | Significant p= 0.0002* |
| Overcrowding | 45.5% | Significant p= 0.0000* |
| H/o URI in the family | 27.2% | Non-Significant p= 0.0923 |

## Discussion

In the current study, risk factors that when combined can cause pneumonia to escalate into severe pneumonia were examined in 100 ALRTI cases. The most frequent causes of morbidity and mortality in children under the age of five, particularly in underdeveloped nations, are acute lower respiratory tract infections (ALRTI). Amitoj et al. [13] found that 61% of ALRTI cases were in newborns, Banajeh et al. [14] found that 74.1% of cases were in children, and Zhang Q et al.[15] found that 76% of cases were in children. By raising awareness of preventive measures and encouraging early medical consultation, parental literacy may extend a protective effect on children and so protect them from ALRTI. According to

Savitha et al.[4], there is a high correlation between maternal illiteracy (63.46%) and the prevalence of LRTI. 31% of mothers in the current study were illiterate, which is similar to the results of investigations by Yousif et al. [5] and Broor et al. [7], which found maternal illiteracy rates of 16.2% and 34.8%, respectively.

Compared to children of literate mothers, children of illiterate mothers had an 8.30 times higher risk of developing severe pneumonia (odds ratio 8.30). In the current investigation, a strong correlation between maternal illiteracy and pneumonia severity (p=0.0001*) was discovered. Yousif et al.[5] reported similar outcomes. 20% of the dads in the current study were illiterate, and similar results from Yousif et al.[5] and Broor et al.[7] studies

showed paternal illiteracy rates of 16.2% and 17.4%, respectively. In comparison to children of literate dads, children of illiterate fathers had a (odds ratio 10.50) 10.50 times higher risk of developing severe pneumonia. Similar to the findings of Yousif et al.[5], a significant correlation (p=0.000*) between the severity of pneumonia and paternal illiteracy was discovered in the current study.

The importance of vaccination in preventing ALRTI has been emphasized repeatedly. The results of the current study, which revealed 39% of children to be incompletely immunized, are comparable to those of studies by Savitha et al.[4] and Yousif et al.[5], which found 21.15% and 38.2% of children to be incompletely immunized, respectively.

A child's risk of developing serious pneumonia was (odds ratio 12.21) 12.21 times higher in children with incomplete immunization for their age than in those with full immunization. Similar to the findings of Broor et al.[8], Yousif et al. [5], and Savitha et al.[4], a significant correlation (p=0.0000*) between inadequate immunization status and pneumonia severity was discovered in the current study. Mothers who use immunization services are more aware of medical facilities and are likely to seek advice early if their children become ill, which likely prevents serious disease. Additionally, vaccinations against infections like measles and Haemophilus influenza type b may shield the youngster from ALRTI. Overcrowding may exacerbate the spread of infection via respiratory droplets. According to the current study's findings, 86% of instances were related to crowding, which is comparable to the findings of Yousif et al.[5] (71.6%). In the current investigation, a strong correlation between overcrowding and pneumonia severity (p=0.0000*) was discovered. Savitha et al findings [4] likewise demonstrated a significant relationship (p=<0.001).

38% of the 100 ALRTI cases in the current investigation were not exclusively breastfed, and there was a significant correlation (p=0.0004*) between this finding with the severity of pneumonia. When compared to children who received exclusive breastfeeding, those who did not had a 6.79 times higher risk of developing severe pneumonia (odds ratio). newborns who additionally received artificial milk had a risk of death that was 1.6 times higher than non-breastfed newborns in a research by Victoria CG et al.[8] on acute lower respiratory tract infection specific mortality compared to breastfed infants. By transferring maternal anti-infective elements that protect the infant from serious microbial disease, breastfeeding offers preventive effects. In addition to protecting against severe pneumonia during the first six months of life, nursing exclusively also helps prevent the development of asthma and other allergy diseases. Respiratory syncytial virus antibodies, as well as significant concentrations of C3, IgA, and lactoferrin that guard against gram-negative microorganisms, are present in the colostrum [9].

In the current investigation, cases with a history of low birth weight made up 18% of the cases. This was comparable to the Yousif et al. study[5] (17.2%). When compared to children of normal birth weight, children with a history of low birth weight had a (odds ratio 32.38) 32.38 times greater risk of developing severe pneumonia. In the current investigation, a strong correlation between low birth weight and the severity of pneumonia (p=0.000*) was discovered. Low birth weight babies have weak lungs and weak immune systems, which increases their risk of developing respiratory infections.

Mud floors often crumble, act as bug breeding grounds, and may contain contagious bacteria. Additionally, the floor breaking apart may produce an excessive amount of dirt, which could raise the risk of ALRTI. In the current study, 16% of instances had cow dung and mud as their flooring, which was comparable to the results from Brooret al. [7] (12.9%). Children who lived in homes with mud or cow dung floors were (odds ratio 5.00) 5.00 times more likely than those who did not to get serious pneumonia. In the current investigation, a significant correlation (p=0.0088*) between the severity of pneumonia and the kind of flooring either mud or cow dung was discovered.

In the current study, electricity (71%) is the most common type of light source. 29% of the energy in the current study came from other sources including kerosene lamps and biomass fuels. Similar findings were found by Savitha et al. [4] with 66% of respondents using electricity. Compared to children living in homes with electricity as the source of lighting, children who lived in homes with biomass fuels had an increased chance of developing severe pneumonia (odds ratio 7.35).In the current study, a strong correlation (p=0.0002*) between the severity of pneumonia and the use of biomass fuel for lighting was discovered. Because dangerous hydrocarbon particles with a size smaller than 2.5 can enter the lungs deeply and increase the risk of lower respiratory illness, kerosene lamps release harmful hydrocarbon particulate matter[10]. In the current study, 14% of cases had a family history of upper respiratory tract infections.

Similar outcomes (9%) were discovered in the study by Savitha et al. However, in the current study, no significant association (p=0.0923) was found between history of upper respiratory tract

infection in the family and pneumonia severity. Children with a history of URI in the family had (odds ratio 3.28) 3.28 times the risk of having severe pneumonia compared to children with no history of URI in the family.

## Conclusion

The current investigation found a number of risk factors for severe pneumonia. Parental illiteracy, lack of age-appropriate immunization, and crowding were the sociodemographic risk variables that were significant.

Other significant risk variables were those related to nutrition, such as inadequate exclusive breastfeeding and low birth weight, as well as environmental risk factors such the use of biomass fuels for lighting and mud or cow dung floors in homes.

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