

Assessment of modifiable risk factors for acute lower Respiratory tract infections in under-five children

Syed M Azad¹, Rohit Bannerji¹, Jaydeb Ray¹, Monjori Mitra¹, Anwasha Mukherjee², Garima Biyani²

From ¹Associate Professor; ²Post Graduate Trainee, Department of Pediatrics, Institute of Child Health, Kolkata, West Bengal, India

Correspondence to: Rohit Bannerji, CK-148, Sector 2, Salt Lake, Kolkata - 700 091, West Bengal, India. E-mail: rohitbannerji@gmail.com

Received – 18 April 2018

Initial Review – 18 May 2018

Published Online – 21 June 2018

ABSTRACT

Background: Acute lower respiratory tract infection (ALRTI) continues to be the biggest killer worldwide of children under 5 years of age. **Objective:** The objective of this study is to identify and assess the modifiable risk factors for ALRTI in children under 5 years of age. **Materials and Methods:** This prospective case–control study was conducted in the pediatrics department of a tertiary care pediatric hospital. A sample size of 106 cases and 106 controls were selected. A detailed general and systemic examination (including respiratory and heart rate measurements, anthropometry, and nutritional assessment) along with the routine hematological investigations and chest X rays was done in both cases and controls. Other specific investigations were done as per requirement in individual cases, and all the cases were treated as per the standard protocol depending on the type of ALRTI. Chi-square-test was used and $p < 0.05$ was taken as statistically significant. **Results:** Statistically significant risk factors identified with increased incidence of ALRTI included incomplete immunization for age, low socioeconomic status, families having more than two under-five children at home, family history of smoking, respiratory infections, overcrowding, use of biomass as fuel for cooking, lack of ventilation, not having separate kitchen, low birth weight, pre-lacteal feeding, lack of exclusive breastfeeding for 4–6 months, malnutrition, and anemia. **Conclusion:** The present study identifies various significant risk factors for severe pneumonia in under-five children.

Key words: Bronchiolitis, Nutrition, Pneumonia, Under-five mortality, Wheeze

Infections of the respiratory tract are perhaps the most common human ailment. While they are a source of discomfort, disability, and loss of time for most adults, they are a substantial cause of morbidity and mortality in young children [1]. Acute respiratory infections (ARIs) may cause inflammation of the respiratory tract from nose to alveoli, with a wide range of combination of symptoms and signs. Acute lower respiratory tract infection (ALRTI) continues to be the biggest killer worldwide of children under 5 years of age. Although the implementation of safe, effective, and affordable interventions has reduced pneumonia mortality from 4 million in 1981 [2] to just over one million in 2013 [3,4] to around 880,000 in 2016 [5], pneumonia still accounts for nearly one-fifth of childhood deaths worldwide.

The incidence of pneumonia is more than 10-fold higher (0.29 episodes vs. 0.03 episodes) and the number of childhood-related deaths due to pneumonia is around 2000-fold higher in developing than in developed countries [6]. The difference is due to high prevalence of malnutrition, low birth weight (LBW), and indoor air pollution in developing countries [7]. The burden that pneumonia places on families and health system in low resource countries, in turn, exacerbates inequalities; overwhelmingly, children who are poor, hungry, and living in remote areas are most likely to be visited by this “forgotten killer [8].” Hospital records show that up to 13% of inpatient deaths in pediatric wards

are due to pneumonia [7] while the proportion of deaths due to pneumonia is much higher in the community as many children die at home [7].

Many modifiable risk factors for ALRTI have been identified which include poor socioeconomic status, environmental factors like overcrowding, and indoor pollution. Few nutritional risk factors are also been linked to increased occurrence of ALRTI as shown by studies conducted in Mysore [8], Middle East [9], and New D [10]. There is a need to explore the association between these modifiable risk factors and ALRTI at the level of health care to bring down the incidence of ALRTI. However, evidence on the association between these factors and pneumonia in children is scarce in this region; hence, we planned this study to assess the modifiable risk factors for ALRTI in under-five children admitted to our hospital which is a tertiary pediatric hospital in Kolkata.

MATERIALS AND METHODS

This prospective case–control study was conducted the department of pediatrics of a tertiary care pediatric hospital in Kolkata from May 1, 2015, to April 30, 2016. Prior approval from the institutional ethics committee was obtained. The sample size was 106 cases and 106 controls. Sample size was selected using simple random data sampling method using software in SPSS package.

Children aged 2–60 months admitted either in pediatric ward or pediatric intensive care unit with clinical diagnosis of ALRTI as per the WHO criteria [11] were included in the study. Controls were children of similar age group attending immunization clinics and outpatient department for illness other than RTI during same time period without a history of severe or very severe pneumonia.

The exclusion criteria were as follows: Children <2 months and >60 months, children with clinical or confirmed diagnosis of bronchial asthma, congenital heart disease, pulmonary tuberculosis, cystic fibrosis, immunodeficiency, aspiration pneumonia, foreign body inhalation, and any other chronic illness.

A case of ALRTI was defined as per ARI control program: Pneumonia was defined as the presence of cough with fast breathing (>50/min in 2–12 months of age and >40/min in 12–60 months of age) with no chest indrawing. Severe pneumonia was defined as fast breathing, chest indrawing, nasal flaring, grunting, and cyanosis, whereas very severe pneumonia was defined as not able to drink, convulsions, abnormally sleepy or difficult to wake, stridor in calm child, and severe malnutrition [11].

For both cases and controls, a detailed history and physical examination was done according to a pre-designed pro forma to elicit various potential risk factors. Age of the child was recorded in the completed months. A detailed history of relevant symptoms such as fever, cough, rapid breathing, chest retraction, refusal of feeds, lethargy, and wheezing was taken. A history of similar complaints was also taken. A history of, until date, immunization was elicited from parents and verified by checking the documents wherever available. A history of breastfeeding and weaning was recorded. A history of RTI in family members in the preceding 2 weeks was recorded. A history of smoking by various family members and details of cooking fuel used was recorded along with details of the housing conditions. Socioeconomic status grading was done according to Modified Kuppaswamy scale [12].

A detailed examination of each child was done where the respiratory rate and heart rate were measured for 1 min, when the child was quiet. A detailed anthropometry was done and malnutrition was graded according to Indian Academy of Pediatrics Classification. Severity of respiratory distress was assessed in each child. Pallor was checked, and a detailed systemic examination was done in both cases and controls.

Routine hematological investigations including complete blood count (CBC) and C-reactive protein along with chest X-rays were done in all cases to know the type of ALRTI. Other specific investigations were done as per requirement in individual cases and all the cases were treated as per the standard protocol depending on the type of ALRTI. Chi-square test was used for the analysis and $p < 0.05$ was considered as statistically significant. SPSS version 11.5 (Statistical Package for the Social Sciences: IBM) was used to analyze the data.

RESULTS

The results of each factor and its incidence or occurrence are given in Table 1. As regard to the final diagnosis, of the 106 cases

Table 1: Results

Factors studied	n=106 (%)		p
	Cases	Controls	
Age (years)			
<1	48 (45)	52 (49)	0.582
1–5	58 (54.7)	54 (51)	
Sex			
Male	64 (60.4)	65 (61.3)	0.888
Female	42 (39.6)	41 (38.7)	
Type of family			
Nuclear	49 (46)	54 (51)	0.69
Joint	28 (26.4)	25 (23.6)	
Three generations	29 (27.3)	27 (25.5)	
Mothers literacy			
Illiterate	9 (8.5)	4 (3.8)	0.413
Primary school	39 (36.8)	36 (34)	
Higher school	31 (29.2)	32 (30)	
Graduate/PUC	27 (25.5)	34 (32)	
Fathers literacy			
Illiterate	6 (5.7)	2 (1.9)	0.437
Primary school	34 (32)	30 (28.3)	
Higher school	36 (34)	41 (38.7)	
Graduate/PUC	30 (28.3)	33 (31)	
Socioeconomic class			
Class I	13 (12.3)	19 (18)	0.044, significant
Class II	35 (33)	49 (46)	
Class III	47 (44)	35 (33)	
Class IV	11 (10.4)	3 (3)	
Class V	0	0	
Number of under-five children			
<2	65 (61.3)	83 (78.3)	0.007
>2	41 (38.6)	23 (21.7)	Significant
Immunization			
Complete for age	71 (67)	91 (85.8)	0.0012
Incomplete for age	35 (33)	15 (20.2)	Significant
Family history of RTI			
Present	46 (43.4)	28 (26.4)	0.0095
Absent	60 (56.6)	78 (73.6)	Significant
Family history of smoking			
Present	69 (65)	54 (51)	0.037
Absent	37 (35)	52 (49)	Significant
Overcrowding			
Present	49 (46.2)	34 (32)	0.035
Absent	57 (53.8)	72 (68)	Significant
Type of flooring			
Mud	12 (11.3)	10 (9.4)	0.626
Cow dung	4 (3.8)	2 (1.9)	Not significant
Cement	90 (84.9)	94 (88.7)	

(Contd...)

Table 1: (Continued)

Factors studied	n=106 (%)		p
	Cases	Controls	
Ventilation			
Adequate	64 (60.4)	79 (74.5)	0.028
Not adequate	42 (39.6)	27 (25.5)	Significant
Lighting			
Kerosene lamp	5 (4.7)	1 (0.9)	0.098
Electricity	101 (95.3)	105 (99.1)	Not significant
Kitchen			
Separate	60 (56.6)	74 (70)	0.046
Not separate	46 (43.4)	32 (30)	Significant
Fuel used			
LPG	75 (70.75)	89 (84)	0.02
Other than LPG	31 (29.25)	17 (16)	Significant
Birth weight			
<2.5 kg	40 (37.7)	25 (23.6)	0.025
>2.5 kg	66 (62.3)	81 (76.4)	Significant
History of pre-lacteal feeding			
Given	12 (11.3)	4 (3.8)	0.037
Not given	94 (88.7)	102 (96.2)	Significant
Duration of exclusive breastfeeding (months)			
<4	22 (20.75)	12 (11.3)	0.0009
4–6	46 (43.4)	73 (68.9)	Significant
>6	38 (35.85)	21 (19.8)	
Malnutrition			
Absent (>80% of wt. for age)	51 (48)	73 (68.9)	0.0026
Grade I (70–80%)	28	25 (23.6)	Significant
Grade II (60–70%)	15	7 (6.6)	
Grade III (50–60%)	11	1 (0.9)	
Grade IV (<50%)	1	0	
Anemia			
Present	56 (52.8)	29 (27.4)	0.00015
Absent	50 (47.2)	77 (72.6)	Significant

RTI: Respiratory tract infection, LPG: Liquefied petroleum gas

with ALRTI, 30.2% of cases had bronchiolitis, 23.6% of cases had bronchopneumonia, 12.3% of cases had lobar pneumonia, 28.3% of cases had wheeze-associated lower respiratory infection, 3.8% had croup, and 1.9% had empyema. The various risk factors for ALRTI were broadly classified under three headings, namely, sociodemographic variables, nutritional variables, and environmental variables. The age and sex distributions were comparable between cases and controls, and both these variables were found to have no significant impact on the incidence of ALRTI. Similarly, area of residence, religion, type of family, and literacy of both parents have no significant association with ALRTI.

Lower middle and upper lower class, families having >2 under-five children at home, incomplete immunization for age,

and family history of upper RTI in the preceding two weeks were the four factors found to be significantly more in cases than controls. Family history of smoking, inadequate ventilation in their house, not having a separate kitchen and cooking their food in the living place, using cooking fuel other than liquid petroleum gas, and overcrowding were five variables found to be much significantly more in the cases compared to the controls. However, no significant association was seen with mud and cow dung flooring and use of kerosene as the lightning source.

Infants with a history of LBW (<2.5 kg), infants given pre-lacteal feeds, infants with both early (<4 months) and late (>6 months) weaning, malnutrition, and anemia were the five factors found to be significantly more in the cases than controls.

DISCUSSION

In our study, most of the ALRTI cases were infants (45%), similar to previous studies by Savitha *et al.* [8] and Thamer *et al.* [9], where infants with ALRTI constituted 62.5% and 58.4% of cases, respectively. This might be due to the fact that in younger children, immunity is not well established, and also, because of narrow airways, relatively short bronchial tree and incomplete development of lungs, the incidence of ALRTI could be higher.

Male (60%) preponderance in cases was seen in our study, similar to many previous studies such as Savitha *et al.* [8], Thamer *et al.* [9], and Broor *et al.* [10]. However, the possibility of gender bias in seeking care cannot be ruled out. Majority of the cases in our study were from urban area, and there was no significant association between area of residence and ALRTI. Although the similar result was not reported by Thamer *et al.* [9], this may probably be due to the location of the study area in the urban region making it more accessible to the urban dwellers and also reflect a greater health-seeking behavior from the urban areas than the rural areas.

Majority of the cases in our study were Muslims and from nuclear families, probably reflecting the distribution of local population where Muslims and nuclear families are a predominant group. As seen in other studies [8-10] which reported higher illiteracy rates among both the parents and their strong association with ALRTI, we also found similar results in that there were twice the number of illiterate mothers and thrice the number of illiterate fathers in cases as compared to controls; although it was statistically not significant.

A significant association was found between social class and ALRTI showing that the risk of severe ALRTI increases as the socioeconomic class worsens. In our study, 54.7% of children were living under low socioeconomic status (class III and IV) when compared to 35.8% of controls. Many other studies [7,13] also showed that significantly more children were belonging to low socioeconomic status. In a study by Rahman *et al.* [14], poverty was significantly associated with the occurrence of pneumonia and Biswas *et al.* [15] revealed low per capita income being significantly associated with ARI.

Similar to other studies [8,10], the present study also identifies families having more than two under-five children at home, to

be a statistically significant risk factor for ALRTI. There was a significant association between incomplete immunization and risk of severe pneumonia probably because immunization against measles and pertussis may prevent infections that can lead to pneumonia as a complication and also probably because mothers utilizing immunization services are better aware of health-care facilities and probably seek early consultations for illness in their children which avoids severe illness. In the present study, 33% of cases were partially immunized children, which is similar to other studies [9,13]. Broor *et al.* [10] showed that more (69%) children were partially immunized.

Almost twice the number of cases had family H/O respiratory infections (≤ 2 weeks) as compared to controls (43.4% vs. 23.4%), which was another significant risk factor in our study. Similar results were found by Broor (40%) *et al.* [10] study, whereas in the study done by Hemagiri *et al.* [16] in Karnataka, only 14.4% were exposed to respiratory infection in family members within the past 2 weeks. History of LRTI in family was an independent risk factor for ALRTI which probably results from family members sharing common environment that predisposed them for LRTI. The possibility of asthma/chronic bronchitis in the family members identified as LRTI cannot be ruled out as the diagnosis was based on the history. History of URI in the mother or siblings was associated with higher risk of ALRTI in cases with most cases of URI being caused by viral infections that are highly contagious and likely to occur in many members of the family and may predispose a child to ALRTI.

A significant association was found between family history of smoking and ALRTI, whereas other studies reported rates as low as 32.8% [10] to as high as 73.08% [8]. In the present study, there was a significant association between overcrowding (46.2% cases) and ALRTI, while other studies reported higher percentages of overcrowding [8,9,17]. Overcrowding may increase the probability of transmission of infections among family members.

In our study, 15% of cases (vs. 11.3% of controls) had mud and cow dung as flooring in their houses in our study, which was not significantly associated with ARI. This was similar to the study results of Broor *et al.* [10] (12.9%); however, Savitha *et al.* [8] study reported that 61.54% of cases had mud and cow dung as a flooring in their house. Similar to other studies [8], we found that 39.6% of cases did not have adequate ventilation in their house. The main mode of the light source was electricity in our study, with the usage of kerosene lamps having decreased these days with only 4.7% of cases using kerosene lamps in our study which differs from Sikolia [17] in which the main mode of light source used was kerosene lamp (93.88%).

In our study, significantly more number of cases (43.4% vs. 30.2%) did not have a separate kitchen and cooking was done in the living place, leading to bulk emissions being released into the living area, which is similar (69.85%) to a study done by Sikolia *et al.* [17]. However, Savitha *et al.* [8] showed that 85.55% had separate kitchen. A total of 29.2% of ALRTI cases used biomass fuels such as firewood, cow dung, and kerosene as fuel for cooking in our study, which was higher in other studies [8,17].

Biomass fuels, coal, and other media like kerosene are significant contributors to air pollution and are burnt in simple stoves with incomplete combustion generating a lot of toxic products that adversely affect specific and non-specific local defenses of the respiratory tract. The risk is higher for mothers and young children due to longer stay indoors and close proximity during cooking. A recent systematic review conducted on studies pertaining to indoor air pollution from biomass fuels concluded that there is a strong consistent increase in ALRTI in young children even after adjusting for the confounders such as poverty [10].

Infants with a history of LBW appeared to have a significant association with ALRTIs in our study (37.7%) in contrast to other reports which showed much lower percentages of LBW [8,9]. This might be due to poor pulmonary function and low immunity in LBW babies which make them liable to have ALRTI mainly in its severe form. A significant association was found between ALRTI and pre-lacteal feeding (11.3% vs. 3.8% had history of pre-lacteal feed) while other studies [8,10] showed higher rates of pre-lacteal feeds administration. Savitha *et al.* [8] and Broor *et al.* [10] showed that early weaning (37.5% and 39.4%, respectively) before 4 months of age and late weaning (20.19% and 27.4%, respectively) after 6 months of age were significantly associated with ALRTI. Our study also showed both early and late weanings to be statistically significant risk factors for ALRTI with the exception that much lower rates of early weaning were found in cases (only 20.7%) as compared to the above two studies. This can be explained because our hospital is baby friendly and awareness of breastfeeding is more.

The presence of malnutrition was significantly associated with ALRTI in our study (52% vs. 31%), similar to the study by Savitha *et al.* [8]. In a study done in New Delhi, Sehgal *et al.* [18] also revealed severe malnutrition as the predictor of mortality in ALRTI in under-five children. Anemia was a very significant risk factor for ALRTI in studies done by Savitha *et al.* [8], Ramakrishnan *et al.* [19], and Shah *et al.* [20] which was similar to our study which showed 52.8% of cases being associated with anemia.

Possible effective interventions to reduce the respiratory morbidity and mortality due to environmental factors include anti-smoking campaigns, improved biomass-burning stoves, as well as birth spacing and improved housing to reduce overcrowding, alongside efficient antenatal care, promotion of breastfeeding, and appropriate maternal child health and family welfare services to tackle the nutritional factors. It should be noted that most of the above interventions would have other beneficial effects in addition to their impact on respiratory infections among young children.

There were some limitations of the study as the sample size could have been more to achieve a better representation of population. Second, it may not represent the real picture of the community as this study was conducted in a tertiary center. Furthermore, we could not follow the children, and although bronchial asthma has been excluded, many children with the first or second episode of wheeze would still be classified with ALRTI which will later be diagnosed with asthma.

CONCLUSION

The present study identifies various significant risk factors for severe pneumonia in under-five children, and the socioeconomic factors represent the ultimate determinants of a large proportion of the burden of severe ALRTI.

REFERENCES

- World Health Organization Programme for the Control of Acute Respiratory Infections. Acute Respiratory Infections in children: Case Management in small Hospitals in Developing Countries. A Manual for Doctors and other Senior Health Workers. Geneva: WHO; 1990. p. 90-5.
- Levels and Trends in Child Mortality: Report 2014. United Nations Inter Agency Group for Child Mortality Estimation. New York: UNICEF, WHO, The World Bank, United Nations Population Division; 2014.
- Global Health Observatory. Proportions of Child Deaths by Cause. Geneva: WHO. Available from: http://www.who.int/gho/child_health/mortality/causes/en/. [Last accessed on 2014 Jul 24].
- Sandora TJ, Sectish TC. Community-Acquired Pneumonia. Nelson Textbook of Paediatrics. 20th ed., Vol. 2. Philadelphia, PA: Elsevier Saunders; c2011. p. 2088-94.
- United Nations Inter-Agency Group for Child Mortality Estimation (IGME). Levels and Trends in Child Mortality: Report 2015. New York: WHO and UNICEF; 2015.
- Park K. Epidemiology of Communicable Disease. Text Book of Preventive and Social Medicine. 23rd ed. Jabalpur, India: Bhanot; 2015. p. 167-74.
- UNICEF/World Health Organization (WHO). Pneumonia: The Forgotten Killer of Children. In: UNICEF, editor. A Book. New York: The United Nations Children's Fund; 2006. p. 4-40.
- Savitha MR, Nandeeshwara SB, Kumar MJ. Modifiable risk factors for acute lower respiratory tract infections. Indian J Pediatr 2007;74:477-82.
- Yousif TK, Khaleq BA. Epidemiology of acute lower respiratory tract infections among children under five years. Middle East J Fam Med 2006;4:4-23.
- Broor S, Pandey RM, Ghosh M, Maitreyi RS, Lodha R, Singhal T, *et al.* Risk factors for severe acute lower respiratory tract infection in under-five children. Indian Pediatr 2001;38:1361-69.
- Gove S, Pio A, Campbell H, Cattane O. WHO guideline on detecting pneumonia in children. Lancet 1991;338:1453-60.
- Kuppuswamy B. Manual of Socioeconomic Status (Urban). New Delhi: Manasayan; 1981.
- Cunha AL, Margolis PA, Wing S. Community Economic Development and Acute Lower Respiratory Infection in Children. Available from: <http://www.jhpdnc.unc.edu/journal41/ecdel.pdf>. [Last accessed on 2018 Jan 10].
- Rahman MM, Rahman AM. Prevalence of acute respiratory tract infection and its risk factors in under five children. Bangladesh Med Res Counc Bull 1997;23:47-50.
- Biswas A, Biswas R, Manna B, Dutta K. Risk factors of acute respiratory infections in under fives of urban slum community. Indian J Public Health 1999;43:73-5.
- Hemagiri K, Sameena AR, Wahid AK, Vasanta SC. Risk factors for severe pneumonia in under fivechildren – A hospital based study. Int J Res Health Sci 2014;2:47-57.
- Sikolia DN, Mwololo K, Cherop H. The prevalence of acute respiratory infections and the associated risk factors: A study of children under five years of age in Kibera Lindi Village, Nairobi, Kenya. J Natl Inst Public Health 2002;51:67-72.
- Sehgal V, Sethi GR, Sachdev HP, Satyanarayana L. Predictors of mortality in subjects hospitalized with acute lower respiratory tract infections. Indian Pediatr 1997;34:213-18.
- Ramakrishnan K, Harish PS. Hemoglobin Level as a Risk Factor for Lower Respiratory Tract Infections. Indian J Pediatr 2006;73:35-7.
- Shah N, Ramankutty V, Premila PG, Sathy N. Risk factors for severe pneumonia in children in south Kerala: A hospital-based case-control study. J Trop Pediatr 1994;40:201-6.

Funding: None; Conflict of Interest: None Stated.

How to cite this article: Azad SM, Bannerji R, Ray J, Mitra M, Mukherjee A, Biyani G. Assessment of modifiable risk factors for acute lower respiratory tractinfections in under-five children. Indian J Child Health. 2018;5(5):376-380.

Doi: 10.32677/IJCH.2018.v05.i05.015