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Original Article

A study of modifiable risk factors for acute lower respiratory tract infections among under five children in a tertiary care hospital in Gulbarga, Karnataka

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Abstract

Background: Acute respiratory infection includes any infection of the upper or lower respiratory system, as defined by the International Classification of Diseases. Acute respiratory infection is a leading cause of morbidity and mortality in under-five children in developing countries. **Objective:** This study was undertaken to identify various modifiable risk factors for acute lower respiratory tract infections (ALRI) in children aged from2 months to 5 years. **Methodology:** This hospital-based case–control study was conducted at Basaveshwar and Sangameshwar general hospital, Gulbarga over 1½. year 200 ALRI cases fulfilling WHO criteria for pneumonia, in the age group of 2 months to 5 years were interrogated for potentially modifiable risk factors as per a predesigned preformed. 200 healthy control children in the same age group were also interrogated. **Results:** The significant socio-demographic risk factors were incomplete immunization for age, low parental education, low socioeconomic status, and overcrowding ($p<0.05$ in all). Significant nutritional risk factors include malnutrition, anemia, and rickets ($p<0.05$ in all). Significant environmental risk factors were parental smoking, use of biomass fuel, and mud/cow dung flooring ($p<0.05$ in all). Using multiple logistic regression analysis, the factors which were found to be significantly associated were younger age ($p=0.000$), anemia ($p=0.000$), incomplete immunization for age ($p=0.002$), malnutrition ($p=0.00$), low literacy level of father ($p=0.000$), and overcrowding ($p=0.000$). **Conclusion:** This study has identified various socio-demographic, nutritional, and environmental modifiable risk factors for ALRI which can be tackled by effective education of the community and appropriate initiatives taken by the government.

Key words: *Acute lower respiratory tract infection, Risk factors, Under five children*

Acute lower respiratory tract infections (ALRI) are the leading cause of morbidity and mortality in young children [1]. The incidence of pneumonia is more than 10-fold higher (0.29 episodes versus (0.03 episodes) and number of childhood related deaths due to pneumonia are around 2000 fold higher in developing than in developed country. This difference is due to high prevalence of malnutrition, low birth weight (LBW) and indoor pollution in developing countries [2]. 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 [3]."

The Global Action Plan for Prevention and Control of Pneumonia (GAPP) has been developed by WHO and UNICEF (2009) to increase the awareness of pneumonia as a major cause of child death, call for scaling up the use of interventions of proven benefit, and provide guidance on how this can be done. The vision of the GAPP is that every child is protected against pneumonia through a healthy environment, and has access to preventive and treatment measures.

Apart from infectious agent, child's genetic and immunological status, certain other factors such as malnutrition, LBW, and duration of breast feeding have been identified as pneumonia risks. Some other inciting factors are smoking habit of parents, parental literacy, household crowding, and indoor smoke pollution [4]. Many of these risk factors are amenable to corrective measures. Therefore, knowledge of these risk factors related to acquisition of ALRI will help in its prevention, through effective health education of the community and appropriate initiative taken by the government, leading to a healthy community and healthy nation as a whole.

However, evidence on the association between these factors and pneumonia in children is scarce in this region. Therefore, this study was planned to identify various modifiable risk factors for ALRI in children less than five of age admitted

to Basaveshwar and Sangameshwar Teaching and General Hospitals, Gulbarga.

METHODOLOGY

The present hospital-based case–control study was carried out over a period of 1½. year in Basaveshwar and Sangameshwar Teaching and General Hospital both attached to M.R. Medical College, Gulbarga, Karnataka, India. Ethical Committee approval for the study was obtained from the College Ethics Committee. Previous 1 year, hospital statistics showed that the proportion of ALRI cases among total hospital admissions of children below 5 years was 25%. Based on this, sample size calculated was 184 cases as per the formula, n=Z2pq/e2. Where n=sample size, Z=1.96 point on the normal, distribution at 95% confidence level, p=proportion of cases=25%, e=allowance of error (25% of proportion, e=6.25).

We took total 200 children were taken as cases, and an equal number of age and sex-matched healthy children were taken as controls. Thus, 200 cases and 200 controls (total=400) constituted the study population. All the consecutive cases of ALRI as defined by WHO [1,3] from 2 to 60 months of age of both genders were included in the study. Controls were normal siblings of children admitted for non-respiratory complaints as well as those attending immunization clinic and OPD for non-respiratory complaint without previous history of severe or very severe pneumonia. A detailed systemic examination was done in both cases and controls. Data were collected was recorded in a pretested and pre-structured preformed.

Children less than 2 months and more than 60 months, children with clinical diagnosis of bronchial asthma, congenital heart disease, pulmonary tuberculosis, cystic fibrosis, immunodeficiency, aspiration pneumonia, foreign body inhalation, and any other chronic illness and whose parents not willing to co-operate were excluded from the study.

Children with hemoglobin value of 11 g/dl or higher were considered as normal while hemoglobin level between 10 g dl and 10.9 g/dl was considered as mild anemia, 7-9.9 g/dl as moderate, and lower than 7 g/dl was considered as severe anemia. Children were classified according to IAP classification of malnutrition and rickets was diagnosed by clinical examination and relevant investigations. Immunization for age was elicited by checking the immunization card and children were classified as complete, incomplete and unimmunized.

Data were managed on Microsoft® Excel spreadsheet, all the entries were double checked, and analysis was performed using SPSS version 15 software package. Association of each of the categorical variable with ALRI (outcome variable) was assessed with Chi-square test and the strength of their association was computed by unadjusted odds ratio (95% confidence interval). Univariate analysis was done initially on all parameters to find out association, later all the variables which were significant were taken for multivariate analysis to know the impact of multiple variables together on the morbidity of the children.

RESULTS

Majority (46%) of the children were between the age group of 2-12 months with 60.7% of them from the rural areas. Around 79.8% of the children were Hindu by religion, and 63.8% of them were from nuclear family. Socio-demographic profile of the study population is given in Table 1.

Malnutrition was present in 150 cases while only 26 controls were malnourished (Table 2). There was a very significant association between nutritional status and ALRI. Of 150 cases with malnutrition, 89 (44.5%) had Grade I malnutrition,

Table 1: Socio-demographic profile of the under five children

Socio-demographic profile	Cases (200)	Controls (200)	p value
Age			
2-12	100	84	>0.05
13-24	46	44	
25-36	22	29	
37-48	18	26	
49-60	14	17	
Sex			
Male	121	125	>0.05
Female	79	75	
Place			
Rural	132	111	>0.05
Urban	68	89	
Religion			
Hindu	164	155	>0.05
Muslim	35	43	
Others	1	2	
Type of family			
Nuclear	141	112	>0.05
Joint	32	51	
Three generation	27	37	

Table 2: Distribution of study subjects by degree of PEM

PEM	Cases (%)	Controls (%)	Totals (%)
Absent	50 (25.0)	174 (87.0)	224 (56.0)
Grade I	89 (44.5)	22 (11.0)	111 (27.8)
Grade II	46 (23.0)	04 (2.0)	50 (12.5)
Grade III	12 (6.0)	0	12 (3.0)
Grade IV	3 (1.5)	0	3 (0.8)
Total	200 (100)	200 (100)	400 (100)

Chi-square value - 159.36, p<0.001 significant.
PEM: Protein energy malnutrition

46 (23.0%) Grade II, 12 (06.0%) Grade III, and 03 (01.5%) had Grade IV malnutrition. Anemia was present in 134 (67%) of cases as compared to 10 (5%) of controls. There was a significant association between anemia and ALRI (Table 3). Rickets was present in 18 (9.0%) cases as compared to 3 (1.05%) controls. There was a significant association between rickets and ALRI (Table 4). Using multiple logistic regression analysis, the factors which were found to be significant with $p<0.05$ were younger age (p=0.000), anemia (p=0.000), incomplete immunization for age (p=0.002), and malnutrition in the child (p=0.00) (Table 5).

Variables entered on step 1 and used in the statistical analysis while performing the regression analysis: Age, location, sex, religion, anemia, rickets, type of family, history of respiratory infection, birth weight, prelacteal feed, duration of breastfeeding, immunization, malnutrition, maternal literacy, father literacy, socioeconomic status, parental smoking, type of housing, floor, overcrowding, cooking fuel, and type of kitchen.

The variables which were found to be statistically significant on univariate analysis were considered for multivariate analysis, and logistic regression was done. Using multiple logistic regression analysis, the factors which were found to be significant were younger age (p=0.000), anemia (p=0.000), incomplete immunization for age (p=0.002), malnutrition in the child (p=0.00), low literacy level of father (p=0.000), overcrowding (p=0.000), and use of biomass fuels (p=0.006) (Table 6).

Tables 3: Relation between anemia and study subject

Anemia	Cases (%)	Controls (%)	Total (%)
No	66 (33.0)	190 (95.0)	256 (64.0)
Mild	103 (51.5)	10 (5.0)	113 (28.3)
Moderate to severe	31 (15.5)	0	31 (07.7)
Total	200 (100)	200 (100)	400 (100)

Chi-square value - 167.6, p<0.001 significant

Table 4: Relation between rickets and study subject

Rickets	Cases (%)	Controls (%)	Total (%)
Present	18 (9.0)	3 (1.5)	21 (5.3)
Absent	182 (91.0)	197 (98.5)	379 (94.7)
Total	200 (100)	200 (100)	400 (100)

Chi-square value - 11.30, p<0.001 significant

DISCUSSION

In our study, malnutrition was found to be very significantly associated with ALRI, which is comparable to other studies. Malnourished children have defective cell-mediated immunity secondary to thymolymphatic depletion leading to severe gram-negative infections and sepsis. They may also have qualitatively abnormal immunoglobulins and impairment of key enzymes involved in the bactericidal action of leukocytes [5].

In a study done in New Delhi, Sehgal et al. [5] also revealed severe malnutrition as the predictor of mortality in ALRI in under five children. A similar study conducted by Broor et al. [6] observed that children with severe malnutrition were at 1.85 times (odds ratio: 1.85; 95% confidence interval: 1.14-3.0) greater risk of developing ALRI as compared to children with mild or normal nutritional status. Overall, malnutrition is associated with a two to three-fold increase in mortality from ALRI [7-9].

In the present study, there was a statistically significant association between anemia and risk of ALRI. A study done by Savitha et al. [8] in Mysore, anemia was present in 76.9% of ALRI cases compared to 6.7% of controls. Ramakrishna et al. [10] observed low hemoglobin level as a risk factor and found that anemic children were 5.75 times more susceptible to ALRI. Similarly, Malla et al. showed that anemic patients were 3.2 times more susceptible [11]. The role of anemia in infection is debated extensively. The proposed pathophysiologic basis for increased risk of infection is that neutrophils have a decreased

Table 6: Model summary

Step	−2 log likelihood	Cox and Snell R^2	Nagelkerke R^2
1	170.178	0.617	0.823

Table 5: Multiple logistic regression (multivariate analysis)

Variables	B	SE	Wald	df	Significant	Exp (B)	95% CI for Exp (B)	
							Lower	Upper
Age	0.055	0.015	12.66	1	0.000	1.05	1.025	1.089
Anemia	−3.41	0.644	28.16	1	0.000	0.33	0.009	0.116
Prelacteal feeds			6.005	2	0.05			
Immunization			14.975	3	0.002			
Malnutrition	−1.68	0.39	18.565	1	0.000	0.186	0.087	0.400
Father Literacy	0.853	0.208	16.84	1	0.000	2.34	1.56	3.52
Overcrowding	−1.93	0.467	17.203	1	0.000	0.144	0.058	0.36
Cooking fuel	−1.408	0.514	7.510	1	0.006	0.245	0.089	67

SE: Standard error, CI: Confidence interval

capacity to kill *Staphylococcus aureus* due to decreased myeloperoxidase activity. The proportion and an absolute number of circulating T-cells are also reduced, and they have defective DNA synthesis due to decreased ribonucleotide reductase activity [12].

Vitamin D has also been found to have immune modulating properties by virtue of its ability to induce monocyte differentiation and inhibit lymphocyte proliferation. Vitamin D has antimicrobial properties as it stimulates phagocytosis-dependent and antibody-dependent macrophages. Severe deficiency of vitamin D leads to chest wall deformity and hypotonia, leading to reduced lung volume, poor compliance of the chest wall, atelectasis, and fibrosis. The presence of rickets was found to be a significant risk factor for ALRI in the present study. Similar findings were observed by Savitha et al. [8], and Ahmad et al [13].

Large proportion of the burden of ALRI can be tackled through effective health education of the community, increased access to immunization, and measures to improve female literacy. Other interventions include efficient antenatal care, birth spacing, promotion of breastfeeding, nutritional supplements, and appropriate family welfare services. The limitation of the study was that the hospitalized cases may not be representative of all the cases in the community. Second, vitamin A deficiency, an important risk factor for ALRI, was not considered. Finally, because of fixed sample size, the periodicity of ALRI could not be studied.

CONCLUSION

In our study, younger age of the child, incomplete immunization for age, malnutrition, anemia, overcrowding, and low literacy level of parents was found to be significantly associated with increased risk of ALRI in children.

REFERENCES

1. Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al. Global, regional, and national causes of child mortality: An updated systematic analysis for 2010 with time trends since 2000. Lancet. 2012;379(9832):2151-61.
2. Sandora TJ, Theodore CS. Community-acquired pneumonia. Nelson Textbook of Pediatrics. 19th ed., Vol. 2. Philadelphia: Elsevier Saunders; 2012. p. 1474-9.
3. UNICEF and World Health Organization. Pneumonia: The Forgotten Killer of Children. New York: The United Nations Children's Fund (UNICEF)/World Health Organization (WHO); 2006.
4. Rudan I, Boschi-Pinto C, Biloglav Z, Mulholland K, Campbell H. Epidemiology and etiology of childhood pneumonia. Bull World Health Organ. 2008;86(5):408-16.
5. Sehgal V, Sethi GR, Sachdev HP, Satyanarayana L. Predictors of mortality in subjects hospitalized with acute lower respiratory tract infections. Indian Pediatr. 1997;34(3):213-9.
6. 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(12):1361-9.
7. Allwyne GA. Interaction between infection and malnutrition. In: Protein Energy Malnutrition. 1st ed. New Delhi: Jaypee Brothers; 1989. p. 93-102.
8. Savitha MR, Nandeeshwara SB, Pradeep Kumar MJ, ul-Haque F, Raju CK. Modifiable risk factors for acute lower respiratory tract infections. Indian J Pediatr. 2007;74(5):477-82.
9. Ballard TJ, Neumann CG. The effects of malnutrition, parental literacy and household crowding on acute lower respiratory infections in young Kenyan Children. J Trop Pediatr. 1995;41(1):8-13.
10. Ramakrishnan K, Harish PS. Hemoglobin level as a risk factor for lower respiratory tract infections. Indian J Pediatr. 2006;73(10):881-3.
11. Malla T, Pathak OK, Malla KK. Is low hemoglobin a risk factor for acute lower Respiratory tract infections. J Nepal Pediatr Soc. 2010;30:1-7.
12. Lukens JN. Iron metabolism and iron deficiency. In: Miller DR, Bachner RL, Miller LP, editors. Blood Diseases of Infancy and Childhood. 7th ed. USA; Mosby – Year Book, Inc.; 1990. p. 193-215.
13. Ahmad I, Shaheen N, Khan S. Risk factors for pneumonia among hospitalized children between 2 months to 5 years. J Med Sci. 2011;19(2):89-94.

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