International Journal of Contemporary Pediatrics
Gupta N et al. Int J Contemp Pediatr. 2019 May;6(3):949-954
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20191493

Original Research Article

Risk factors for acute severe pneumonia in under five children

Neerupam Gupta[1]*, Naine Bhadrala[2]

[1]Department of Pediatrics, Government Hospital Sarwal, Directorate of Health Services, Jammu, Jammu and Kashmir, India
[2]Department of Anesthesiology, Government Medical College Jammu, Jammu and Kashmir, India

Received: 23 March 2019
Accepted: 30 March 2019

***Correspondence:**
Dr. Neerupam Gupta,
E-mail: neroped@gmail.com

ABSTRACT

Background: Acute severe pneumonia is the leading cause of death in children below five years of age. India tops in the list amongst the 15 countries having a high incidence of childhood pneumonia with 43 million episodes of pneumonia annually. Identification of modifiable risk factors of acute severe pneumonia can help in reducing the burden of disease.
Methods: A hospital-based case control study was undertaken to determine risk factors associated with acute severe pneumonia in under-five children. A case definition of acute severe pneumonia as given by world health organization (WHO) was used for cases. Healthy children attending Pediatrics outpatient Department for immunization during study period were enrolled as controls. Details of potential risk factors in cases and controls were recorded in pre-designed proforma. 732 children including 366 cases and 366 controls were enrolled in the study.
Results: On stepwise logistic regression analysis it was found that low literacy status of the mother (OR:9.46; 95%CI:7.31-19.0); inappropriate immunization for age (OR:38.04; 95%CI 14.59-110.18);cooking fuel other than liquid petroleum gas (OR:3.79; 95%CI: 2.40-6.78); low socioeconomic status (OR: 6.12; 95%CI: 2.42-35.48); overcrowding (OR:1.21; 95%CI: 1.03- 2.21) and upper respiratory infection in family (OR:5.08; 95%CI: 3.79-7.67) were the significant contributors to the occurrence of acute severe pneumonia in children under five years.
Conclusions: Low literacy status of mother, incomplete immunization status, use of fuel other than LPG, low socioeconomic status, overcrowding, family history of URTI emerged as risk factors for occurrence of acute severe pneumonia in under five children.

Keywords: Breastfeeding, Immunization, Malnutrition, Passive smoking, Pneumonia

INTRODUCTION

Acute respiratory infection (ARI) is the chief cause of global ill health today. Global burden of diseases estimate 2010, stated that acute lower respiratory infection is the leading cause of death among children after under five year in developing countries.[1] Estimate showed for developing nations, that more than 150 million episodes of pneumonia occurs every year in under five years age group.[2] India tops in the list amongst the 15 countries having a high incidence of childhood pneumonia with 43 million episodes of pneumonia annually.[3] The problem can be assumed to have a greater magnitude because of poor reporting and inadequacies in delineating the cause of death in young children. Various social, demographic, nutritional and environmental risk factors predispose the children to pneumonia. Berman in a review of epidemiology of acute lower respiratory tract infection (ALRTI) in developing countries identified low birth weight, malnutrition, vitamin A deficiency, lack of breastfeeding and passive smoking as risk factors for

ALRTI.[4] Further studies have added other risk factors to the list including poor socioeconomic status, large family size, and family history of bronchitis, advanced birth order, crowding, young age, air pollution, and the use of non-allopathic treatment in early stages of illnesse.[5-17] More recent reviews suggest that indoor air pollution is one of the major risk factor for acute lower respiratory tract infection in children in developing countries.[18,19] Many of the factors mentioned are amenable to corrective measures and may help in reducing the alarmingly high global burden of acute severe pneumonia.

METHODS

The study was carried out for one year in the Pediatric wards of SMGS Hospital, Government Medical College Jammu after obtaining approval from the ethical committee of the Institute. Children admitted with acute severe pneumonia in the absence of under-lying chronic illnesses during the study period were enrolled in the study as cases. Informed written consent was obtained from the parents of the children enrolled in the study.

Acute respiratory tract infection was defined as presence of cough with or without fever for less than two weeks.[20] Severe pneumonia was defined (WHO case definition) as presence of severe chest in-drawing or respiratory rates of more than 60 per minute in an infant less than 2 months, chest in-drawing with or without respiratory rates of more than 50 per minute in infants between age group 3-12 months and more than 40 per minutes in children between 13-60 months of age.[21] Controls included in the study were healthy children below 5 years of age attending Pediatric out-patient department during the study period for immunization.

For both cases and controls, clinical review including history, physical examination and routine investigations, was undertaken to elicit various potential risk factors and these were recorded in pre-designed proforma.

Children sick right from the birth, suffering from respiratory illness related to perinatal problems and with congenital anamolies predisposing to respiratory illness excluded from the study. Age of the child was recorded in completed months and the age of mother and father were recorded in completed years.

Education of mother and father was recorded in completed years of formal education. If a mother or father of the child were not able to read or write, they were labeled as illiterate. For analysis, ages of the mother, father and child were converted to categorical variables (mother as <25 years and >25 years, father <30 years and >30 years, children (<2 months, 2 months -1 year and >1 year). History of immunization was elicited from parents and verified by checking the written document wherever available. A child was assessed to be completely immunized if he/she had received all vaccinations due for his age according to national immunization schedule.

History of smoking by various members in the family and details of cooking fuel used was recorded. A history of upper respiratory infection ((URI)/LRTI) in any family member was elicited. Information on the type of house (thatched or cemented) was recorded. Overcrowding was defined as >2persons/room, >3persons/2rooms, >5persons/3rooms, 7.5persons/4rooms and >10 persons/5 rooms. Children <12months were not counted and children between 1-10 years were counted as half a unit (1). Socioeconomic status was assessed using Kuppuswamy socio-economic scale.[22]

History of breastfeeding and the age of introduction of supplementary feeding were elicited. Caloric intake of the child was calculated by recording the food items given to the child regularly prior to the current illness by recall. Child was examined for assessing the malnutrition grade (Indian Academy Pediatrics (IAP) classification) and any evidence of vitamin A deficiency. Child was examined for pallor and hemoglobin of every case /control was assessed by Sahli's method. WHO classification of anemia was used.[23]

Statistical analysis

Data was recorded on a pre-designed proforma and managed on excel spread sheet. All the entries were double checked for any possible key-board error. Association of each of the categorical variable with occurrence and mortality of acute severe pneumonia (outcome variables) was assessed with chi-square test and the strength of their association was computed by unadjusted odds ratio (95% confidence interval). Variables showing statistically significant association with the outcome variables ($p < 0.05$) were considered as potential risk factors for acute severe pneumonia. Subsequently, these variables were simultaneously subjected to stepwise multiple logistic regression model to determine the significant independent risk factors for occurrence of acute severe pneumonia and mortality due to it. Data analysis was performed using statistical software statistical and SPSS.

RESULTS

In this study majority of the children (81.6% cases and 81.7% controls) were infants. Sex distribution was comparable in both cases (50.5% males and 49.5% females) and controls (5.8% males and 43.1% females). There were significantly higher numbers of younger mothers (<25 years) in acute severe pneumonia group (73.8%) as compared to controls (66.4%). Low literacy status of mother was significantly associated with occurrence of acute severe pneumonia (57.9% cases, 13.1% controls, p=0.00). Inappropriate immunization for age was significantly associated with pneumonia (p=0.00). It was also observed that complete

immunization as per IAP schedule ensures better protection against acute severe pneumonia as compared to UIP schedule (UIP 31.4% cases, IAP 6.8% cases). URTI in family was significantly positively associated with acute severe pneumonia (p=0.00) whereas LRTI in family was not found to be associated with pneumonia in this study.

Low birth weight, overcrowding and low socioeconomic status were significantly associated with acute severe pneumonia (Table 1).

Amongst the nutritional variables considered in this study anemia, malnutrition, bottle feeding, Vitamin A deficiency and improper weaning were significantly associated with acute severe pneumonia. The use of cooking fuel other than LPG (P=0.00) (Table 2) and smoking by a family member (p=0.00) were significantly associated with acute severe pneumonia. When the variables showing significant association were simultaneously considered in stepwise multivariate logistic regression analysis with acute severe pneumonia as outcome it was observed that low literacy status of mother, incomplete immunization status, family history of URTI, overcrowding, low socioeconomic status and use of fuel other than LPG were significantly associated (Table 3).

Table 1: Bivariate relationship between various socio-demographic variables and acute severe pneumonia.

Variable		Cases		Control	%	Unadjusted odd ratio	Confidence intervals	P - value
		No.	%					
Age (months)	1- 2	27	7.3	121	33	0.24	0.14 - 0.42	0.00
	2 -12	272	74.3	177	48.4	1.69	1.14 - 2.50	
	>12	62	16.9	68	18.3	1.00		
Sex	Male	185	50.5	208	56.8	0.78	0.58-1.04	0.08
	Female	181	49.5	158	43.1	1		
Residence	Rural	197	53.8	186	50.8	1.13	0.84-1.51	0.41
	Urban	169	46.2	180	49.2	1		
Mother's age (years)	≤25	270	73.8	243	66.4	1.42	1.04-1.96	0.02
	>25	96	26.2	123	33.6	1		
Father's age (years)	≤30	252	68.9	250	68.3	1.03	0.75-1.40	0.93
	> 30	114	31.1	116	31.7	1		
Mother's education	Illiterate	212	57.9	48	13.1	13.06	8.64-19.74	0.00
	Up to 5years	57	15.6	26	7.1	6.48	3.79-11.09	
	6-9 years	26	7.1	82	22.4	0.94	0.56-1.57	
	>10 years	71	19.4	210	57.4	1		
Father's education	Illiterate	99	27	90	24.6	1.23	0.85-1.78	0.50
	Up to 5 years	71	19.4	60	16.4	1.32	0.87-2.00	
	6-9 years	65	17.8	70	19.1	1.03	0.69-1.56	
	>10 years	131	35.8	146	39.9	1		
Immunization status	Unimmunized	97	26.5	6	1.6	45.27	17.64-116.18	0
	Partially immunized	129	35.2	48	13.1	7.53	4.28-13.23	
	Complete as per UIP	115	31.4	242	66.1	1.33	0.80-2.21	
	Complete as per IAP	25	6.8	70	19.1	1		
LRTI	Yes	40	10.9	35	9.6	1.16	0.72-1.87	0.54
	No	326	89.1	331	91.4	1		
URTI	Yes	228	62.3	102	27.9	4.24	3.11-5.79	
Birth weight (grams)	≤ 2500	133	41.3	76	22	2.49	1.78-3.49	0
	>2500	189	58.7	269	78	1		
Overcrowding	Yes	150	40.98	72	19.7	2.84	2.04-3.95	0
	No	216	59.02	294	80.3	1		
Socio-economic status	Class 5	13	3.6	14	3.8	7.43	1.42-38.78	0.02
	Class 4	165	45.1	150	40.9	8.8	1.99-38.91	
	Class 3	132	36	131	35.8	8.06	1.82-35.76	
	Class 2	54	14.8	55	15.02	7.85	1.72-35.81	
	Class 1	2	0.55	16	4.04	1		
	No	151	41.3	251	68.7	1		

Table 2: Bivariate relationship between various nutritional and environmental variables and acute severe pneumonia.

Variable		Cases		Control	%	Unadjusted odd ratio	Confidence intervals	P - value
		No.	%					
Anemia	Yes	145	39.6	57	15.6	3.56	2.5-5.06	0
	No	221	60.4	309	84.4	1		
Malnutrition	Grade IV	9	2.5	1	0.27	22.6	2.82-179.19	0
	Grade III	59	16.1	1	0.27	147.26	20.18-1074.68	
	Grade II	85	23.2	8	2.2	26.52	12.47-56.39	
	Grade I	85	23.2	49	13.7	4.33	2.82-6.38	
	Nil	123	33.6	307	83.9	1		
Type of feeding	Only bottle feeding	48	13.1	1	0.27	53.02	7.26-387.35	0
	Mixed feeding	98	26.8	122	33.3	0.89	0.64-1.22	
	Exclusive breast feeding	220	60.1	243	66.4	1		
Duration of breast feeding	<4 months	119	40.8	137	41.8	0.96	0.70-1.32	0.79
	>4 months	173	59.2	191	58.2	1		
Vitamin A deficiency	Yes	34	9.3	6	1.8	6.14	2.55-14.82	0
	No	332	90.7	360	98.2	1		
Weaning	Improper	199	63.4	61	21.5	6.3	4.37-9.07	0
	Adequate	115	36.6	222	78.5	1		
Fuel used	Others	201	54.9	70	19.1	5.15	3.70-7.18	0
	LPG	165	45.1	296	80.9	1		
Type of home	Thatched	195	53.3	190	51.9	1.06	0.79-1.41	0.71
	Cemented	171	46.7	176	48.1	1		
Smoking by a family member	Yes	215	58.7	115	31.4	3.11	2.29-4.21	0.00
	No	151	41.3	251	68.7	1		

Table 3: Risk factors for acute severe pneumonia using stepwise multivariate logistic regression analysis.

Risk factors	Adjusted odds radio	95% CI
Low literacy status of mother	9.46	7.31-19.0
Incomplete immunization status	38.04	14.59-110.18
Family history of URTI	5.08	3.79-7.67
Overcrowding	1.21	1.03-2.21
Low socio-economic status	6.12	2.42-35.48
Use of fuel other than LPG	3.79	2.40-6.78

DISCUSSION

Low literacy status of mother emerged as an independent risk factor for occurrence of acute severe pneumonia similar result has been observed by Nirmolia et al.[16] The beneficial effects of maternal education may be due to better health awareness and health care practices. Major emphasis on maternal literacy in primary prevention of ARE may lead to other simple cost-effective tools like promotion of breast feeding, awareness of immunization, lesser number of pregnancies and early approach to health care system.

The etiology of the pneumonia in developed countries is predominantly viral whereas in the developing countries bacteremia is common and associated with a high case fatality rate.[24] Although immunization against measles, diphtheria and pertusis would help prevent a significant proportion of ARI associated mortality, there is a more important need to develop vaccines specific against pathogens responsible for acute LRTI in children (pneumococcus and *H. influenzae*) in developing countries.[25]

The IAP recommends the supplementation of UIP schedule with additional doses of the same vaccines and adding some newer vaccines (*H. influenzae*, MMR, hepatitis B, Typhoid). Incomplete immunization status emerged as independent risk factor for both occurrence and mortality of acute severe pneumonia. The results are comparable with findings of Cerquerio et al, Broor et al, and Shah et al.[8,20,26]

Use of biomass fuels (wood, crop-residues, animal dung), coal and other media (kerosene) are predominant contributors to indoor air pollution. Nearly half the world's households, more so in developing countries and the countryside (90%), use these fuels for cooking. These are burnt in simple stoves with very incomplete combustion generating a lot of toxic products that adversely affect specific and nonspecific local defenses of the respiratory tract.[18,19] The risk is highest for mothers and young children due to longer stay indoors and close proximity during cooking. A recent review that systematically analyzed all published studies pertaining to indoor air pollution from bio mass fuels concluded that there is a strong consistent increase in ALRTI in young children even after adjusting for confounders such as poverty. Similar results have been observed in present study.

While low socioeconomic status is associated with ARI morbidity it is important to understand the relative contribution of related factors such as large family size, poor sanitation, malnutrition, educational limitation, lack of immunization and exposure to pollution. These risk factors also predispose children to frequent and recurrent infections that impair tissue recovery and lead to more severe disease.[4] Nirmolia N et al, and Tupasi TE et al, also reported that low socioeconomic status was significant risk factor for ARI morbidity.[16,25]

Overcrowding promotes the transmission of respiratory pathogens and increases the size of infecting inoculum. Overcrowding has been implicated as a risk factor for both acquiring and dying from acute LRTI.[27-29] In the present study overcrowding emerged as independent risk factor predisposing to acute severe pneumonia. The results are comparable with the findings of Berman S et al, and Shah N et al.[4,8] Most of the URTI are caused by viral infections that are highly contagious. Also, viral URTI may predispose a child to pneumonia. The basis for susceptibility to bacterial pneumonia following influenza and influenza like infections include decrease in the function of leucocytes, macrophages, lymphocytes and monocytes, increase in the adherence of bacteria to respiratory epithelium and decrease muco-ciliary clearance History of URTI in family was an independent risk factor for severe pneumonia.[30,31]

Similar results have been observed by Broor et al, Cerqueiro et al, and O'Brien et al.[20,26,32] Authors therefore conclude that environmental factor (use of cooking-fuel other than LPG) and socio-demographic factors (low literacy status of the mother, incomplete immunization status) are modifiable risk factors for severe pneumonia. As for any disease primary prevention is generally superior and cost effective as compared to tertiary prevention and cure, appropriate preventive measures against these risk factors may help to reduce the morbidity and mortality of acute severe pneumonia.

CONCLUSION

Authors therefore conclude that environmental factor (use of cooking-fuel other than LPG) and socio-demographic factors (low literacy status of the mother, incomplete immunization status) are modifiable risk factors for severe pneumonia. As for any disease primary prevention is generally superior and cost effective as compared to tertiary prevention and cure, appropriate preventive measures against these risk factors may help to reduce the morbidity and mortality of acute severe pneumonia.

Recommendations

Low literacy status of mother, incomplete immunization status, use of fuel other than LPG, low socioeconomic status, overcrowding, and family history of URTI emerged as risk factors for occurrence of acute severe pneumonia in under five children.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. IHME. Global burden of Diseases compares University of Washington. 2013 Accessed at: http://viz.healthmetricsandevaluation.org/gbdcompare/.
2. Rudan I, Tomaskovic L, Boschi-Pinto C, Campbell H. Global estimate of the incidence of clinical pneumonia among children under five years of age. Bull World Health Organization. 2004;82:895-903.
3. Ghimire M, Bhattacharya SK, Narain JP. Pneumonia in South-East Asia region: public health perspective. Indian J Med Res. 2012;135(4):459.
4. Berman S. Epidemiology of acute respiratory infections in children of developing countries. Rev Infect Dis. 1991;13(6):S454-62.
5. Hussey GD, Apolles P. Arendse Z, Yeates J, Robertson A, Swingler. G et at. Respiratory syncytial virus infection in children hospitalized with acute lower respiratory tract infection. S Afr Med J. 2000;90:509-12.
6. Banajeh SM. Outcome for children under 5 years hospitalized with severe acute lower respiratory tract infection in Yemen: A 5-year experience. J Trop Pediatr. 1998; 44: 342-46.
7. Hamid M, Qazi SA, Khan MA. Clinical nutritional and radiological features of pneumonia. J Pak Med Assoc. 1996;46:95-9.
8. Shah N, Ramankcutty 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.
9. Suwanjuth S, Ruangkanchanasetr S, Chantarojanasiri T, Hotrakitya S. Risk factors associated with morbidity and mortality of

pneumonia in Thai children under 5 Years. Southeast Asian J Trop Med Public Health. 1994; 25:60-6.
10. Murtagh P, Cerqueiro C, Halac A, Avita M, Salomon H, Weissenbacher M. Acute lower respiratory infection in Argentanian children - A 40 month clinical and epidemiological study. Pediatr Pulmonol. 1993;16:1-8.
11. Campbell H, Armstrong JR, Byass P. Indoor air pollution in developing countries and acute respiratory infection in children. Lancet. 1989 ;333(8645):1012.
12. Collings DA, Sithole SD, Martin KS. Indoor wood smoke pollution causing lower respiratory disease in children. Trop Doctor. 1990;20:151-5.
13. Deb SK. Acute respiratory disease survey in Tripura in case of children below five years of age. J Indian Med Assoc. 1998;96:111-6.
14. Sharma S, Sethi GR, Rohtagi A, Chaudhary A, Shankar R, Bapna JS, et al. Indoor air quality and acute lower respiratory infection in Indian urban slums. Environ Health Perspect. 1998;106: 291-7.
15. Agrawal PB, Shendurnikar N, Shastri NJ. Host factors and pneumonia in hospitalized children. J Indian Med Assoc. 1995;93:271-2.
16. Nirmolia N, Mahanta TG, Boruah M, Rasaily R, Kotoky RP, Bora R. Prevalence and risk factors of pneumonia in under five children living in slums of Dibrugarh town. Clinic Epidemiol Global Health. 2018;6(1):1-4.
17. Grifly SMO, Elamin MO, Rahimtullah H, Ali AY H, Dhiblaw A, Mohamed EA et al. Risk factors of pneumonia among children under 5 years at a pediatric hospital in Sudan. Int J Med Res Health Sci. 2018,7(4):60-8.
18. Bruce N, Perez-Padilla R, Albalak R. Indoor air pollution in developing countries: a major environmental and public health challenge. Bulletin of the World Health Organization. 2000;78:1078-92.
19. Smith KR, Sarnet JM, Romieu I, Bruce N. Indoor air pollution in developing countries and acute lower respiratory infection in children. Thorax. 2000;55:518-32.
20. 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.
21. World Health Organization. Technical basis for the WHO recommendations on the management of pneumonia in children at first-level facilities. Geneva: WHO. 1991. Available at: https://www.who.int/maternal_child_adolescent/documents/ari_91_20/en/.
22. Mishra D, Singh HP. Kuppuswamy's socioeconomic status scale-a revision. Indian J Pediatr. 2003;70(3):273-4.
23. World health organization. Iron deficiency anemia. assessment, prevention, and control. A guide for programme managers. 2001:47-62.
24. Spooner V, Barker J, Tulloch S, Lehmann D, Marshall TF, Kajoi M, Alpers MP. Clinical signs and risk factors associated with pneumonia in children admitted to Goroka Hospital, Papua New Guinea. J Trop Pediatr. 1989 Dec 1;35(6):295-300.
25. Tupasi TE, Velmonte MA, Sanvictores ME, Abraham L, De Leon LE, Tan SA, et al. Determinants of morbidity and mortality due to acute respiratory infections: implications for intervention. J Infect Dis. 1988;157(4):615-23.
26. Cerqueiro MC, Murtagh P, Halac A, Avila M, Weissenbacher M. Epidemiologic risk factors for children with acute lower respiratory tract infection in Buenos Aires, Argentina: a matched case-control study. Rev Infect Dis. 1990;12(8):S1021-8.
27. Kossove D. Smoke filled rooms and lower respiratory disease in infants. S Afr Med J. 1982;61:622-4.
28. Selwyn BJ. The epidemiology of acute respiratory tract infection in young children: comparison of findings from several developing countries. Rev Infect Dis. 1990;12(8):S870-88.
29. De Francisco A, Morris J, Hall AJ, Schellenberg JA, Greenwood BM. Risk factors for mortality from acute lower respiratory tract infections in young Gambian children. Int J Epidemiol. 1993;22(6):1174-82.
30. Fainstein V, Musher DM, Cate TR. Bacterial adherence to pharyngeal cells during viral infection. J Infectious Dis. 1980;141(2):172-6.
31. Giebink GS, Wright PF. Different virulence of influenza A virus strains and susceptibility to pneumococcal otitis media in chinchillas. Infect Immunity. 1983;41(3):913-20.
32. O'brien KL, Walters MI, Sellman J, Quinlisk P, Regnery H, Schwartz B, Dowell SF. Severe pneumococcal pneumonia in previously healthy children: the role of preceding influenza infection. Clin Infect Dis. 2000;30(5):784-9.

Cite this article as: Gupta N, Bhadrala N. Risk factors for acute severe pneumonia in under five children. Int J Contemp Pediatr 2019;6:949-54.