Original Article

DETERMINANTS OF BRONCHO-PNEUMONIA IN CHILDREN

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Abstract

Bronchopneumonia is acute inflammation of the bronchioles which is characterized by multiple foci of isolated, acute consolidation that affects one or more pulmonary lobules.

Objectives: To find out the determinants of bronchopneumonia in children up to 12 years visiting Mayo hospital from February to July 2013.

Design: Population based case control study.

Place: Lahore.

Study Period: 06 months.

Subjects and Methods: Population based case-control study with 1:1 case to control ratio was conducted. A total of 100 subjects (50 cases and 50 controls) were recruited in study. Selection was made on laid down criteria after taking due consent. Interviews were conducted through a pretested questionnaire. Data was collected, compiled and analyzed through SPSS version 20.After describing the demographic characteristics using frequency tables, simple and multivariate logistic regression were used to calculate odds ratio and their 95% confidence intervals.

Results: In multivariate analysis, while controlling all other risk factors, prematurity (OR: 4.720 95% CI: 1.559 – 14.286) and poor access to health care (OR: 2.557 95% CI: 1.049 – 6.231) were found to be significantly associated with bronchopneumonia.

Key Words: Bronchopneumonia, passive smoking, overcrowding, pre-maturity.

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Introduction

Bronchopneumonia is acute inflammation of the bronchioles which is characterized by multiple foci of isolated consolidations that affects one or more pulmonary sites.[1] In bronchopneumonia, infection involves whole lung elements in the affected zone, including the bronchi, blood vessels, lymphatics and lung parenchyma. Bacterial infections (Streptococci, Staphylococci or H. Influenzae) of the lung often appear to be a primary event.[1,2] Its main determinants are age, gender, mode of birth, immunization, personal habits of mother, overcrowding, ventilation on ventilator, intubation, malnutrition, environmental factors, hospitalization, chronic lung diseases, passive smoking, genetic disorders like sickle cell anemia, feeding, health education of parents and socio-economic status.

In 1993, a study in Lahore was conducted, a cohort of 1,476 new born babies followed every 4 weeks at home, revealed that pneumonia was a major contributor to morbidity and mortality during the first two years of life in this population.[3] According to other study reports, pre-maturity is one of the leading causes of broncho-pneumonia.[4] Incidence of pneumonia is strongly and consistently associated with young age. Children between 2 – 6 months of age are reported to be highly affected.[5,6] In literature a large number of

risk factors of pneumonia have been published with evidence, including poor breastfeeding practices,[7,8] passive smoking[9,10] and low maternal education.[11,12] As far as diet is concerned, researchers indicated that there is strong association between malnutrition and pneumonia.[12] Air pollution from biomass fuels in indoors is known to elevate the risk of pneumonia by approximately 80% in children.[7] A study conducted in India suggested a strong association showing 13 – fold greater odds between pneumonia and rickets, caused by vitamin D deficiency.[13] A study revealed that low socio-economic status, poor access to health care and illness are also important causes of broncho-pneumonia.[14] Other factors considered as risk for pneumonia include male gender,[15] sickle cell anemia[16] and low immunization coverage.[17] A research was conducted in 1990 which revealed that children living in a house, that had 3 or more siblings less than 3 years of age residing with them had substantially higher rates of pneumonia than those living with no children under 3 years in a house.[18]

This study is conducted to find out the determinants of bronchopneumonia in children to give suggestions for improvement of the health of community, for the reduction of the morbidity and mortality and to eliminate the risk factors at the grass root level to prevent the disease. This can be done by considering the host factors, patient's illness and presumed causative agents so that the determinants of bronchopneumonia can be cut down and awareness of the risk factors of bronchopneumonia in the society can be increased to decrease the frequency of disease.

Subjects and Methods

A case – control study was conducted to find out determinants of bronchopneumonia in children visiting Mayo hospital from February 1st, 2013 to July 31th, 2013. Study population was divided into two groups. The study included patients of bronchopneumonia (age up to 12 years) who were not suffering from any major medical or surgical illness and were fulfilling the criteria laid down for case. The control group comprised of healthy children who did not suffer from bronchopneumonia. The study population was placed in two groups. Group 1 comprised of patients suffering from bronchopneumonia. Total number of cases were 50 (n = 50). Group 2 also comprised of 50 individuals (n = 50) who were healthy controls. While a systematic random sampling approach was used to recruit study controls from all eligible controls. Written consent was obtained from all selected study subjects. Data was collected by interviews using pretested and close ended questionnaire, while keeping all ethical and social considerations in mind. Data entry and analysis was done by statistical software SPSS version 20.

The **variables** were **defined** as below:

Overcrowding: World Health Organization refers overcrowding as a situation in which more people are living within a single dwelling as compared to space so that movement is restricted, privacy limited, hygiene is poor and disturbed sleep.[19]

Health Education of Parents: An educational program for general public that attempts to improve the health of the community.[20]

Socioeconomic Status is measured as a combination of income and occupation.[21]

Passive Smoking is the inhalation of smoke by persons other than active smoker. It occurs when tobacco smoke permeates any environment, causing its inhalation by people within that environment.[9]

Pre-maturity: The birth of a baby before the development and maturation of organs, before 37th week of gestation.[22]

Results

Among children suffering from bronchopneumonia (n = 50), majority of them were males (33) and of age group below 4 years (36). In control group (n = 50), majority belonged to female gender (28) and age group between 4 to 12 years (37). After describing the demographic characteristics using frequency tables, simple and multivariate logistic regression was applied.

Table 1: Frequency and Percentage.

Variables	Frequencies	Percentage
Age of Patient		
< 4 years	49	49

Variables	Frequencies	Percentage
4 to 12 years	51	51
Sex of Patient		
Female	45	45
Male	55	55
Religion of Respondent		
Muslim	99	99
Non-Muslim	1	1
Education of Mother		
Below primary level	45	45
Above primary level	55	55
Address of Respondent		
Rural	30	30
Urban	70	70
Monthly Income of Parents		
Less than 15000 PKR	56	56
More than 15000 PKR	44	44
Diagnosed Case of Pneumonia		
Yes	50	50
No	50	50
Prematurity		
Yes	33	33
No	67	67
Incubation of Child		
Yes	34	34
No	66	66
Low Birth Weight		
Yes	35	35
No	65	65
Respiratory Disease at Time of Birth		
Yes	8	8
No	92	92
Lack of Vaccination for Pneumonia		
Yes	55	55
No	45	45

Variables	Frequencies	Percentage
Lack of Complete Course of Vaccination		
Yes	51	51
No	49	49
Lack of Breast Feeding Practice		
Yes	25	25
No	75	75
Lack of Use of Boiled Water		
Yes	51	51
No	49	49
Recent Hospitalization for any Disease		
Yes	40	40
No	60	60
Ventilation on Ventilator for more than 2 Days		
Yes	14	14
No	86	86
History of Asthma		
Yes	15	15
No	85	85
History of Liver or Kidney Disease		
Yes	6	6
No	94	94
Passive Smoking		
Yes	50	50
No	50	50
Exposure to Cooking Smoke		
Yes	51	51
No	49	49
Overcrowding		
Yes	48	48
No	52	52
Improper Waste Disposal		
Yes	30	30
No	70	70
	44	44

Variables	Frequencies	Percentage
No	56	56
Lack of Teeth Brushing		
Yes	52	52
No	48	48
Pets in Home		
Yes	36	36
No	64	64
Carpets in House		
Yes	43	43
No	57	57
Exposure to Dust and Humidity		
Yes	45	45
No	55	55
Poor Access to Health Care		
Yes	38	38
No	62	62

Table 2: Bivariate Analysis.

Variables	Case N = 50	Control N = 50	Crude Odds Ratio	95% CI		Chi Square Value	P-value
				Lower	Upper		
Age of Patient			0.137	.056	.331	21.168	.000*
• Less than 4 years	36 (72%)	13 (26%)					
• 4 to 12 years	14 (28%)	37 (74%)					
Low Maternal Education			4.195	1.810	9.728	11.677	.001*
• Yes	36 (72%)	19 (38%)					
• No	14 (28%)	31 (62%)					
Low Socioeconomic Status			5.630	2.362	13.420	16.234	.000*
• Yes	38 (76%)	18 (36%)					
• No	12 (24%)	32 (64%)					
Pre-maturity			15.881	4.949	50.958	28.268	.000*
• Yes	29 (58%)	4 (8%)					
• No	21 (42%)	46 (92%)					
Incubation of Child			9.333	3.367	25.870	21.569	.000*
• Yes	28 (56%)	6 (12%)					

• No	22 (44%)	44 (88%)					

Variables	Case N = 50	Control N = 50	Crude Odds Ratio	95% CI		Chi Square Value	P-value
				Lower	Upper		
Low Birth Weight			10.127	3.647	28.119	23.253	.000*
• Yes	29 (58%)	6 (12%)					
• No	21 (42%)	44 (88%)					
Respiratory Disease at Time of Birth			1.741	.393	7.713	.543	.461
• Yes	5 (10%)	3 (16%)					
• No	45 (90%)	47 (94%)					
Lack of Vaccination for Pneumonia			9.333	3.720	23.415	25.253	.000*
• Yes	40 (80%)	15 (30%)					
• No	10 (20%)	35 (70%)					
Lack of Complete Course of Vaccination			11.227	4.420	28.517	29.172	.000*
• Yes	39 (78%)	12 (24%)					
• No	11(22%)	38(76%)					
Lack of Breast - Feeding Practice			1.379	.555	3.427	.480	.488
• Yes	14 (28%)	11 (22%)					
• No	36 (72%)	39 (78%)					
Lack of Use of Boiled Water			1.272	.580	2.790	.360	.548
• Yes	27 (54%)	24 (48%)					
• No	23 (46%)	26 (52%)					
History of Asthma			1.610	.527	4.920	.706	.401
• Yes	9 (18%)	6 (12%)					
• No	41 (82%)	44 (88%)					
History of Liver or Kidney Disease			5.444	0.612	48.397	2.837	.092
• Yes	5 (10%)	1 (2%)					
• No	45 (90%)	49 (98%)					
Passive Smoking			6.612	2.762	15.831	19.360	.000*
• Yes	36 (72%)	14 (28%)					
• No	14 (28%)	36 (72%)					
Exposure to Cooking Smoke			4.958	2.124	11.576	14.446	.000*
• Yes	35 (70%)	16 (32%)					
• No	15 (30%)	34 (68%)					

Pets in Home • Yes	20 (40%)	16 (32%)	1.417	.624	3.218	.694	.405
Variables	Case N = 50	Control N = 50	Crude Odds Ratio	95% CI		Chi Square Value	P-value
				Lower	Upper		
• No	30 (60%)	34 (68%)					
Improper Waste Disposal • Yes	17 (34%)	13 (26%)	1.466	.620	3.469	.762	.383
• No	33 (66%)	37 (74%)					
History of Measles • Yes	34 (68%)	10 (20%)	8.500	3.412	21.177	23.377	.000*
• No	16 (32%)	40 (80%)					
Lack of Teeth Brushing • Yes	37 (74%)	15 (30%)	6.641	2.769	15.927	19.391	.000*
• No	13 (26%)	35 (70%)					
Overcrowding • Yes	32 (64%)	16 (32%)	3.778	1.650	8.651	10.256	.001*
• No	18 (36%)	34 (68%)					
Recent Hospitalization for any Disease • Yes	28 (56%)	12 (24%)	4.030	1.712	9.488	10.667	.001*
• No	22 (44%)	38 (76%)					
Exposure to Dust and Humidity • Yes	30 (60%)	15 (30%)	3.500	1.529	8.012	9.091	.003*
• No	20 (40%)	35 (70%)					
Presence of Carpets in House • Yes	31 (62%)	12 (24%)	5.167	2.177	12.264	14.729	.000*
• No	19 (38%)	38 (76%)					
Poor Access to Health Care • Yes	31 (62%)	7 (14%)	10.023	3.754	26.757	24.448	.000*
• No	19 (38%)	43 (86%)					

*indicates p-value less than .05 which means significant result.

Table 3: Multivariate Analysis.

Variables	Case N = 50	Control N = 50	Adjusted Odds Ratio	95% CI		P-Value
				Lower	Upper	
			4.720	1.559	14.286	.006

Pre-maturity						
• Yes	29 (58.0%)	4 (8.0%)				
• No	21 (42.0%)	46 (92%)				
Variables	Case N = 50	Control N = 50	Adjusted Odds Ratio	95% CI		P-Value
				Lower	Upper	
	31 (62.0%)	7 (14.0%)				
	19 (38.0%)	43 (86.0%)				

Discussion

Bronchopneumonia in children is a common problem of our society. Factors associated with bronchopneumonia are multiple and vary from age to age and from place to place. This study is an attempt to analyze the effects of apparent risk factors on bronchopneumonia in children aged up to 12 years. We studied 25 risk factors, which were found to be associated with bronchopneumonia in the previously published studies. Our study indicated that bronchopneumonia is strongly and significantly associated with the presence of carpets in a house with 62% of the children presenting with bronchopneumonia having carpets in their houses. This was supported by the research studies of CJ Celedon[23], JW Vaughan[24] and the work by James Krieger[25] proved that the improperly cleaned carpets were sources of allergens and other contaminants that caused respiratory illnesses in children. However, in contradiction to our results, a study conducted in Africa showed no strong association between the presence of carpets in houses and the respiratory disease.[26]

In our study, age below 4 years was found to be significantly associated with bronchopneumonia with 72% of the children, in the case group belonging to the age group below 4 years. A study in Nepal by Dr. Prashant Rijal also showed that 52.0% children below two years of age presenting with lower respiratory infections had acute lower respiratory tract infections, where 68.4% had pneumonia.[27] Our result was also supported by the works of R Chanock,[28] Merci[29] and Shahzad.[30] Low maternal education is another factor that was found to be significantly associated with bronchopneumonia in children with an odds ratio (OR) of 4.195 which was supported by the work of Macedo whose study described a positive relationship between low maternal education with a high odds ratio (OR) of 12.5.[31] The work by Savitha[32] and Fatmi[33] also supported this. Our research also supported that low socio-economic status was significantly associated with bronchopneumonia in children with about 76% of the children in case group belonging to a poor family. This was also supported by the works of Fagundes – Neto[34] and Mata.[35]

Our study supported that prematurity was an important risk factor for pneumonia with an odds ratio (OR) of 8.328. This was supported by the research of H Nair, showing that prematurity was a likely risk factor with an odds ratio of 1.9 and 95% CI 1.3 to 2.8.[36] The studies in developing countries by Cerqueiro,[37] Goetghebuer[38] and Hassan[39] also supported our results. According to Barson, bronchopneumonia in children was highly associated with intubation, use of incubators and mechanical ventilation with 64% of the infected children being intubated before acquiring bronchopneumonia.[40] This was also supported by the works of Dreyfuss[41] and Soto[42] and our study also found incubation in incubators and ventilation in ventilators to be significantly associated with bronchopneumonia with 56% of the cases being incubated and 22% being ventilated previously.

Low birth weight was an important pre-disposing factor for bronchopneumonia in children with 58% of the children belonging to case group having a low birth weight. This was supported by the work of Derillien showing that in children below 3 years with a low birth weight, the chances of suffering from bronchopneumonia increased by 4 folds.[43] Eighty percent of the children suffering from bronchopneumonia lacked in pneumococcal immunization and 78% lacked in complete course of vaccination. The work by Glanz also showed that Children who were not vaccinated PCV7 were 6.5 times (OR = 6.5; 95% CI = 1.7, 24.5) more likely to be hospitalized for pneumococcal disease or lobar pneumonia than immunized children[44]. The studies by Fonseca,[45] Broor[46] and Ahmad,[47] repor-

ted that incomplete immunization causes severe ALRI. Study by M Suzuki in Vietnam showed that Children there were exposed to high ETS levels which results in 44□000 hospital admissions each year among children under 5 years of age due to pneumonia with an odds ratio of 1.55.[48]

Passive smoking also appears to be a significant risk factor in our study with an odds ratio of 6.612 with 72% of the victims being passive smokers. The study by Keskinoglu also indicated that prevalence of passive smoking in children with LRTI was 71.3% again supporting our result.[49] In our study, cooking smoke was a significant risk factor for bronchopneumonia with an odds ratio (OR) of 4.958 and with 70% of the children suffering from bronchopneumonia exposed to cooking smoke and this was supported by the work of Mahalanabis who showed that the cooking smoke from solid fuel use was associated significantly with bronchopneumonia with an odds ratio of 3.97.[50] The work by Broor also showed cooking fuel other than liquid petroleum gas to be a significant risk factor with an odds ratio of 2.5 and 95% CI: 1.51 – 4.16.[46]

Lack of measles vaccination was an important risk factor in our research with 68% of the cases having not received measles vaccination. The study by Morley in Nigeria also supported our result by showing that bronchopneumonia was the most common complication of measles and was present in 45% of admissions from measles and caused 54% of the deaths.[51] The research by Dr. Trevor Duke also supported our result by showing that Pneumonia was the most common fatal complication resulting from measles and 50% of those pneumonias occurred due to bacterial superinfection.[52] In our study, the lack of teeth brushing appeared to be a significant factor with 74% of the affected children lacking in dental hygiene. The randomized control trials by Sjogron showed that oral hygiene like brushing teeth twice daily and use of mouth wash at bed time, has a preventive effect on respiratory tract infections and pneumonia.[53]

The study by Grant showed that there was an increased risk of pneumonia hospitalization in people living in a more crowded household with an odds ratio of 2.87, and confidence interval of 1.33 – 6.41 and the study by Banerji also indicated that overcrowding significantly increased the chances of admission in hospitals due to lower respiratory tract infections with OR 2.5 and 95% CI 1.1 – 6.1.[54,55] Our study also indicated that overcrowding was a significant risk factor with 64% of the affected children living in the overcrowded houses. Our study showed that recent hospitalization for any disease increased the chances of acquiring bronchopneumonia with 56% of the cases being recently hospitalized for some disease. The study by McEachern also affirmed that recent hospitalization was a significant factor as hospital acquired pneumonia occurred at a rate of 5 – 10 cases per 1000 admissions, reporting about 13% to 18% of all nosocomial infections.[56] The studies of Fagon[57] and Hall[58] also supported our results regarding recent hospitalization. About 60% of the affected children had an exposure to dust and humidity proving it to be a significant risk factor and the researches by Cotton,[59] Yanagisawa[60] and Berner[61] regarding exposure to dust and the study by Kuhn[62] regarding dampness and poor housing facilities also supported the significance of this factor in increasing the risk for bronchopneumonia. Wonodi[63] and Williams[64] in their studies regarding Etiology of pneumonia demonstrated that a significant risk factor for bronchopneumonia was lack of access to health care which is in accordance with our results with 62% of the children suffering from bronchopneumonia having a poor access to health care centers.

However, other factors considered in our study like respiratory disease at the time of birth, lack of exclusive breastfeeding, lack of use of boiled water, history of asthma, history of renal or liver disease, pets in home and improper waste disposal were found to have no significant association with bronchopneumonia in children. However, in contradiction to our results, the works of Victoria,[65] Dharmage,[66] Cesar[67] and Weyse[13] proved a significant relationship between lack of exclusive breast feeding and bronchopneumonia with the work of Nair[36] proving that the lack of breast feeding was a definite risk factor for bronchopneumonia with an odds ratio (OR) of 2.7. The study by Mahalanbis established history of asthma as a significant risk factor with an odds ratio (OR) of 5.49 (CI = 2.37 – 12.74),[50] however, in our study it was insignificant.

Conclusion

Bronchopneumonia was found to be significantly associated with low maternal education, poor socioeconomic status, pre-maturity, incubation of child, lack of vaccination for pneumonia, lack of complete course of vaccination, use of ventilator, passive smoking, exposure to cooking smoke, history of measles, lack of dental hygiene, overcrowding, carpets in house, poor access to health care and exposure to dust and humidity.

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