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Association of Risk Factors with Severity of Acute Bronchiolitis in Admitted Patients at a Tertiary Care Centre: A Prospective Hospital Based Cross-Sectional Study

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ABSTRACT

Background: Acute bronchiolitis is a viral lower respiratory tract infection in early childhood. It's clinical course is diverse ranging from mild to severe symptoms. Several risk factors contribute to severe bronchiolitis requiring hospital admission.
Objectives: To find out the association of risk factors with severity of acute bronchiolitis in admitted patients
Methods: A cross-sectional observational study was conducted on 80 patients admitted with acute bronchiolitis after taking informed consent from parents. Demographic variables, clinical signs/ symptoms and risk factors were recorded. The severity of the disease was judged by BROSJOD scoring system.
Results: 42.5% patients were under six months with male-to-female ratio 1.6:1. Most patients belonged to upper-lower or upper-middle socioeconomic class. All patients presented with nasal symptoms and cough and 87.5% had fast breathing. Feeding difficulty was observed in 61(76.25%) children. Six had congenital heart diseases and one Down syndrome as co-morbidity. 48.75% were delivered by LSCS, 16.25% had history of NICU admission, 28.8% were LBW and 18.75% were born preterm. 56.25% children were exclusively breastfed and 70% were vaccinated till age. Passive smoking was seen in 22.5% children and 63.75% houses were infested with cockroaches. As per BROSJOD system, 11 had minor, 55 moderate and 14 had severe crises. Statistically significant association was seen between severe bronchiolitis and co-morbidity (p=0.001), H/O NICU admission (p=0.006), indoor pollution [renovation of house in last two months (OR=3.37; 95%CI=0.98-11.54; p=0.04) poor living conditions (OR=4; 95% CI=0.95-16.73; p=0.04)], and outdoor pollution (intense traffic; OR >4). Delay in seeking healthcare also led to increased severity.
Conclusion: The study found the importance of timely management of acute bronchiolitis. Severity increases with young age, malnutrition, co-morbidities and past NICU admission. Reducing exposure to environmental pollutants both indoor and outdoor may help prevent severe disease.

Keywords: *Acute bronchiolitis, Association, Risk factors, Severity.*

INTRODUCTION

Bronchiolitis is one of the common reason for hospitalization of children and frequently caused by viral infection. The guidelines given by American Academy of Pediatrics(AAP) strongly recommends that clinician should diagnose bronchiolitis and assess the severity on the basis of history and physical examination.[1] Bronchiolitis is an acute lower respiratory tract infection in early childhood caused by different viruses, with coughing, wheeze and poor nutrition as the major symptoms with a significant proportion experiencing at least one episode.[2]The American Academy of Pediatrics Clinical Practice Guideline defines bronchiolitis as "a constellation of clinical symptoms and signs including a viral upper

respiratory prodrome followed by increased respiratory effort and wheezing in children less than two years of age." Further, the guidelines of the American Academy of Pediatrics (AAP) emphasized that clinicians should diagnose bronchiolitis and assess its severity based on history and physical examination. Routine radiographic or laboratory studies are not recommended for diagnosis.[3]It is common in children under two years old and is typically caused by viral infections. Its incidence peaks during the rainy season (June) and winter months (October to February).[4,5] Bronchiolitis is characterized by inflammation and damage to small airways (<2 mm diameter), representing a spectrum of clinical and histological abnormalities across multiple respiratory conditions.[6] Currently, bronchiolitis lacks any established pharmacological treatment. Instead, supportive treatment options are available to manage symptoms, including nebulization with bronchodilators, hypertonic saline, epinephrine, and/or steroids. Notably, the routine use of these treatments in bronchiolitis management is not supported by evidence. Studies have found no conclusive benefits to warrant the routine recommendation of nebulization with bronchodilators, hypertonic saline, epinephrine, and steroids for specific treatment of bronchiolitis.[5] Hence, in view of the aforementioned details, understanding the epidemiological data, clinical presentation, and associated risk factors for acute bronchiolitis patients especially severe cases requiring admission is crucial to identify these patients early and manage them appropriately. Thus, the present study was planned and carried to analyse the clinico-epidemiological characteristics and associated risk factors for acute bronchiolitis patients especially severe cases requiring hospitalization.

MATERIALS AND METHODS:

This observational study was conducted at the Department of Pediatrics, People's College of Medical Sciences, Bhopal for the duration of 1.5 years, from June 1, 2023, to December 31, 2024. The study area comprised the Pediatric Ward and Pediatric Intensive Care Unit (PICU) of PCMS & RC, Bhopal. The sample size included all patients admitted with acute bronchiolitis during the study period. Data were collected from all admitted patients with acute bronchiolitis in the Department of Pediatrics, People's Hospital, Bhopal, serving as the primary source of information.The study was approved by the Institutional Ethics Committee of People's College of Medical Sciences, Bhopal, and informed consent was obtained from the parents/guardians of all participating children prior to enrollment.The study included admitted children aged 1 month to 24 months who were diagnosed with acute bronchiolitis. The attendant (parent or guardian) of each child had to provide informed consent to participate in the study, ensuring that all enrolled patients met these specific criteria.The study excluded children who had prior hospital admissions with acute wheezing episodes, as well as those whose parents were unwilling to provide consent to participate in the study. Furthermore, children outside the specified age range, specifically those below one month or above 2 years of age, were also excluded from the study.All patients of acute bronchiolitis admitted during study period were enrolled in the study after taking informed consent from the parents. All the demographic variables such as age, gender, socio-economic condition, parental literacy, housing condition were filled in predefined proforma. Clinical sign and symptoms like fever, cough, running nose, fast breathing, difficulty in feeding, respiratory rate, respiratory system examination and mental status were included. Risk factors like birth history and neonatal history (gestational age, NICU admission, smoking in antenatal mother etc.), history of smoking in the family members, indoor-outdoor pollution was recorded.Severity of the disease was judged as per BROSJOD scoring system. Sant Joan de Déu Hospital bronchiolitis score (BROSJOD) was designed in 1999. It aimed to objectify patient severity into degrees, in order to determine what kind of support was needed depending on the value obtained. The severity of bronchiolitis was assessed using the BROSJOD scoring system, which categorizes patients into three crisis levels based on their scores. Scores ranging from 0 to 5 indicate a minor crisis, scores between 6 and 10 signify a moderate crisis, and scores from 11 to 16 denote a severe crisis.Data was filled in excel sheet and coded. Data was analyzed using SPSS windows 21.0 software. Descriptive statistics like percentage and mean were used for analysis. Odd's ratio was calculated to find out the strength of association between risk factors causing sever bronchiolitis as against mid-moderate disease. A p-value of<0.05 was considered as significant.

OBSERVATION AND RESULTS:

Table 1: Risk factors for severe acute bronchiolitis: Demography, season & host factors (n=80)

Risk factors		Number of patients (n)	Mild-Moderate Bronchiolitis (n)	Severe Bronchiolitis(n)	OR (95% CI)	P value
Age	< 1 year	60	48	12	2.25 (0.458-11.055)	0.318
	≥1 year to < 2 years	20	18	2		
	Total	80	66	14		
Gender	Male	50	43	7	0.53 (0.16-1.71)	0.28
	Female	30	23	7		
	Total	80	66	14		
	<Median value	59	48	11	1.37 (0.34-5.50)	0.652
	≥Median value	21	18	3		

Nutritional status (Weight for length)	Total	80	66	14		
Season	Autumn & Winter	62	49	13	4.51 (0.54-37.10)	0.16
	Summer & Monsoon	18	17	1		
	Total	80	66	14		
Comorbidity	Yes	7	2	5	2.99 (2.99-105.64)	0.001*
	No	73	64	9		
	Total	80	66	14		
Vaccination status	Partially vaccinated	24	18	6	2 (0.60-6.56)	0.252
	Fully vaccinated	56	48	08		
	Total	80	66	14		
Exclusively breast feeding upto 6 months	Yes	45	37	8	2.26 (0.29-3.06)	0.94
	No	35	29	6		
	Total	80	66	14		

Odds ratio is more than 1 when child's age is less than 1 year, he/she is malnourished (weight for length ≤median), disease occurring in autumn and winter season, associated comorbidity and partial vaccination; it means the chances of developing serious crisis is more in these groups compared to second group. Though the statistically significant association is seen only in the presence of comorbidity (table 1).

Table 2: Risk factors for severe acute bronchiolitis: Antenatal/Natal/Post natal factors

Risk factors		Number of patients (n)	Mild-Moderate Bronchiolitis (n)	Severe Bronchiolitis (n)	OR (95% CI)	P value
LSCS	Yes	39	32	7	1.06 (0.33-3.36)	0.90
	No	41	34	7		
	Total	80	66	14		
Birth weight	LBW (<2.5kg)	23	17	6	2.1 (0.65-7.13)	0.20
	Normal birth weight (≥2.5kg)	57	49	8		
	Total	80	66	14		
Preterm	Yes	15	10	5	3.11 (0.86-11.23)	0.08
	No	65	56	9		
	Total	80	66	14		
NICU admission	Yes	13	7	6	6.32 (1.69-23.59)	0.006*
	No	67	59	8		
	Total	80	66	14		

In this study, patients having history of NICU admission showed statistically strong significant association with severe bronchiolitis. Chances of developing severe bronchiolitis is also more in patients having history of preterm birth and in babies born with low birth weight (OR>2) (table 2).

Table 3: Duration of symptoms at the time of presentation as risk factors for severe acute bronchiolitis

		Mean	Standard deviation	P value
Running nose/block nose/sneezing	Minor & Moderate	4.74	1.83	0.275
	Severe	5.36	1.86	
Cough	Minor & Moderate	3.88	1.33	0.194
	Severe	4.43	1.40	
Watering from eyes	Minor & Moderate	0.17	0.80	0.842
	Severe	0.21	0.80	
Fever	Minor & Moderate	2.27	1.97	0.161
	Severe	3.50	2.98	
Fast breathing	Minor & Moderate	1.17	0.67	0.02*
	Severe	1.64	0.63	
Retractions as noticed by parents	Minor & Moderate	0.89	0.53	0.011*

	Severe	1.29	0.47	
Wheezing as noticed by parents	Minor & Moderate	0.98	0.79	<.01*
	Severe	1.93	0.73	
Feeding difficulty	Minor & Moderate	1.86	1.48	0.002*
	Severe	3.50	1.56	
Reduction in normal feeding in percentage	Minor & Moderate	0.21	0.16	<0.01*
	Severe	0.46	0.12	
Vomiting	Minor & Moderate	0.44	1.22	0.015*
	Severe	1.79	1.76	
Loose stools	Minor & Moderate	0.14	0.63	0.083
	Severe	0.00	0.00	
Lethargy	Minor & Moderate	0.03	0.25	0.210
	Severe	0.64	1.74	
Irritability	Minor & Moderate	0.33	0.83	0.194
	Severe	0.79	1.19	

Table 5 shows that delay in seeking health care leads to increased severity of the disease. Higher mean duration of fast breathing, chest indrawing, audible wheeze, feeding difficulty, and vomiting all are significantly associated with severe acute bronchiolitis.

Table 4: Disease severity as per BROSJOD scoring system (n=80)

Severity	Freuency	%
Minor Crises	11	13.8
Moderate Crises	55	68.8
Severe Crises	14	17.5
Total	80	100.0

Table 5: Risk factors for severe acute bronchiolitis: Family history (n=80)

Risk factors		Number of patients (n)	Mild-Moderate Bronchiolitis (n)	Severe Bronchiolitis (n)	OR (95% CI)	P value
Socioeconomic status	Lower, Upper lower & Lower middle	51	41	10	1.52 (0.43-5.38)	0.512
	Upper middle & Upper	29	25	4		
	Total	80	66	14		
Exposure to allergen based on father's occupation	Yes	21	15	6	1.99 (0.57-6.95)	0.280
	No	59	51	8		
	Total	80	66	14		
Sibling in the family	Yes	50	40	10	1.62 (0.46-5.73)	0.44
	No	30	26	4		
	Total	80	66	14		
History of allergy in family	Yes	18	14	4	1.48 (0.40-5.45)	0.55
	No	62	52	10		
	Total	80	66	14		
History of exposure to cigarette/Bidi smoking	Yes	18	13	5	2.26 (0.64-7.9)	0.18
	No	62	53	9		
	Total	80	66	14		

Present study is showing OR>1 (more chances of developing severe bronchiolitis) in lower socioeconomic strata, patients exposed to allergens, cigarette/bidi smoking, and presence of siblings in the family (table 3). Although none was found to be statistically significant.

Table 6: Data on Outdoor/Indoor pollution in two groups (n=80)

Risk factors		Number of patients (n)	Mild-Moderate Bronchiolitis (n)	Severe Bronchiolitis (n)	OR (95% CI)	P value

Traffic pollution outside the house	Yes (Intense traffic)	7	4	3	4.22 (0.82-21.54)	0.08
	No(Little Traffic)	73	62	11		
	Total	80	66	14		
House renovation in last 2 months	Yes	18	12	6	3.37 (0.98-11.54)	0.04*
	No	62	54	8		
	Total	80	66	14		
Visible mold growth in the house	Yes	18	15	3	0.92 (0.22-3.7)	0.90
	No	62	51	11		
	Total	80	66	14		
Musty smell in the house	Yes	13	10	3	1.5 (0.36-6.46)	0.56
	No	67	56	11		
	Total	80	66	14		
Poor living conditions (loose/ damaged walls &/or ceilings of the house)	Yes	10	6	4	4 (0.95-16.73)	0.04*
	No	70	60	10		
	Total	80	66	14		
Exposure to cockroaches in house	Yes	51	40	11	2.38 (0.60-9.36)	0.20
	No	29	26	3		
	Total	80	66	14		
Use of air fresher in house	Yes	14	12	2	0.75 (0.14-3.79)	1.44
	No	66	54	12		
	Total	80	66	14		
Use of spray by parents	Yes	49	41	8	0.81 (0.25-2.61)	0.72
	No	31	25	6		
	Total	80	66	14		
Type of chulha used in house	Wood	19	17	2	0.48 (0.09-2.36)	0.36
	Gas/electric	61	49	12		
	Total	80	66	14		
Use of carpet in house	Yes	31	28	3	0.3 (0.04-1.45)	0.14
	No	49	38	11		
	Total	80	66	14		
Pet in the house	Yes	6	5	1	0.93 (0.10-8.71)	0.94
	No	74	61	13		
	Total	80	66	14		

Present study found statistically strong association between severe bronchiolitis and indoor pollution (history of renovation in the house in last 2 months and poor living conditions), outdoor pollution (intense traffic) and presence of cockroaches also had OR of >2, signifying as risk factor for severe disease (table 4). Surprisingly, use of air fresheners and sprays in the house, presence of pet in the house using wood chulha and carpet in the house found to be negatively associated with severity of the disease.

DISCUSSION:

The present study analyzed the association of risk factors with severity of acute bronchiolitis in admitted patients. These patients of bronchiolitis were admitted in PICU and paediatric ward of People's Hospital of People's College of Medical Sciences and Research Centre, Bhopal. This study observed maximum patients were in the age group less than 6 months (42.5%) followed by 32.5 % in 6-12 months age group. Similar to our results, Nguyen SN et al[3]found the majority (57%) being under 6 months of age. Robledo-Aceves M et al[6]reported the mean age of children with severe bronchiolitis was 6.6 ± 5.7 months (range, 1–24 months), Atay Ö et al[7]reported the mean age was 9±2.4 months with maximum number in 7 to 12 months [28 (27.7%)]. Bakalovic G et al[8] also revealed that the majority of patients were aged less than 6 months (87.7%).Jeswani NL et al[9]found the mean corrected age of hospitalized patients was 5.08 ± 4.70 months (range: 1-24 months);418 (71%) were under 6 months, 287 (49%) were under 3 months. We found a distinct seasonal pattern of cases and the majority of cases occurring during specific times of the year. Autumn (September, October, and November)

accounts for the highest frequency of cases 37/80 cases (46.25%), followed closely by winter (December, January, and February) with 25 cases (31.25%).This seasonal distribution suggests that environmental factors such as temperature and humidity may play a role in the development and spread of bronchiolitis. In consistent to our study, an Indian study by Hindupur A et al[10]confirmed the seasonality of RSV infection with increased positivity in September to February. Another study by Nguyen SN et al[3]found that patients with bronchiolitis were admitted in the hospital throughout the year, but there was a notable peak in admissions during in the month of March (11.1%), followed closely by January and February. Similarly, Jeswani NL et al[9] found that there was a peak in hospital admission rates during the fall season (46%), followed by winter (28%), spring (17%), and summer (9%). Another study by Bakalovic G et al[8]observed the highest number of cases during winter, peaking in the month of January 29/155 (18.7%) followed by February 24/155 (15.5%) and least in April 6/155 (3.9%). Similarly, other study by Stockman Lauren J et al[11]alleges the highest number of diseased in the winter months. Hervás Det al[12] in their study also revealed that seasonal distribution of RSV and non-RSV bronchiolitis follows different rates in different months, depending on climate and epidemiological conditions in the world. In our study, all 100 % children of bronchiolitis had nasal symptoms & cough, and their duration varied from 2 days to 10 days. 61 children developed feeding difficulty and feeding was found to be reduced upto 60% in some children. One child presented with febrile seizure too. Similarly, Nguyen SN et al[3]found that all patients of acute bronchiolitis presented with cough, tachypnea, and runny nose. Ravaglia C et al[13] observed the most common clinical signs of bronchiolitis in children were tachypnea, tachycardia, and worsening respiratory symptoms, were preceded by a 2–3 days history of rhinorrhea.We found 7 patients with comorbidity; 6 had congenital heart diseases and one had Down syndrome. In the study by Jeswani NL et al,[9] other comorbidities present were consolidation / atelectasis, acute otitis media, and urinary tract infection. Eriksson M et al[14]reported 2.8-6.4% infants having congenital heart disease. Present study also found statistically strong association between severe bronchiolitis and indoor pollution; history of renovation in the house in last 2 months (OR=3.37; 95%CI=0.98-11.54; p value=0.04) and poor living conditions (OR=4; 95% CI=0.95- 16.73; p value=0.04). Outdoor pollution (intense traffic) and presence of cockroaches in the house also had OR of >2, signifying as risk factor for severe disease. Surprisingly, the use of air fresheners, sprays in the house, presence of pet in the house, wood chulha and carpet in the house were found to be negatively associated with severity of the disease. This could be because these factors do not contribute directly to the pathogenesis of acute bronchiolitis, which is more of a viral infection rather than allergic condition. Similar to our study, Robledo-Aceves M et al[6] identified environmental factors like overcrowded living conditions, pest and cockroach infestation are associated with severe viral bronchiolitis. Similar to our study, Ruiz-Charles MG et al[15] did not found the presence of pets, pest infestation, or farm animals association with severe viral bronchiolitis. Our study found that delay in seeking health care leads to increased severity of the disease. Higher mean duration of fast breathing, chest indrawing, audible wheeze, feeding difficulty, and vomiting all are found to be significantly associated with severe acute bronchiolitis. Kneyber MCJ et al[16] reported that wheezing is a common occurrence after RSV bronchiolitis in infancy, and can persist for 5 years or more. however, no significant difference was found in the incidence of recurrent wheezing between children who had RSV bronchiolitis and those in a control group after 5 years of follow-up. Eriksson M et al[14]reported repeat hospitalization for wheezing happened in 8.4 and 4.9% of children without risk factors over and under the age of 2 months, respectively ($p < 0.001$). A study by Parker MJ et al[17]on 312 infants with wheezing and respiratory distress identified four risk factors for major medical interventions (MMI): high accessory muscle score, low oxygen saturation, high respiratory rate, and poor fluid intake. Infants with these risk factors were more likely to require MMI, while those without them were at low risk and suitable for outpatient management. Most infants without risk factors (87.8%) were discharged within 12 hours and these findings can guide hospitalization decisions for infants with bronchiolitis.

CONCLUSION:

To conclude, findings highlight the significant impact of environmental factors, such as indoor and outdoor pollution, on the severity of the disease. Specifically, the study reveals that history of renovation in the house, poor living conditions, and exposure to intense traffic are significant risk factors for severe bronchiolitis. Additionally, the study confirms that delay in seeking healthcare leads to increased severity of the disease, with higher mean duration of symptoms such as fast breathing, chest indrawing, and feeding difficulty significantly associated with severe acute bronchiolitis.The study also underscores the importance of understanding the seasonal pattern of bronchiolitis, with the majority of cases occurring during autumn and winter months.

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