



## Original Article

# Risk Factors Related to Residential Environment of Childhood Community Acquired Pneumonia

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### Abstract

**Introduction:** Community-acquired pneumonia (CAP) is a lower respiratory tract infection occurring in a child who has not resided in a hospital or health care facility in the preceding 14 days. This study was done to determine the risk factors related to the residential environment of CAP among children under five.

**Methods:** It was a case-control study conducted at the indoor and outdoor units of the Department of Pediatrics and EPI center of Rajshahi Medical College Hospital (RMCH); the study period was two years, from January 2017 to December 2018. The sampling method was purposive sampling. The sample size was 246 children aged 2-59 months, consisting of 123 cases and 123 controls.

**Result:** A significant association was found between CAP and parental smoking ( $p = 0.000$ ,  $OR = 3.33$ ), overcrowding ( $p = 0.010$ ,  $OR = 1.96$ ), indoor air pollution ( $p = 0.004$ ,  $OR = 2.33$ ), exposure to cold & humidity ( $p = 0.015$ ,  $OR = 1.95$ ). The study had identified tobacco smoking of parents, overcrowding, exposure to cold & humidity, indoor air pollution as risk factors for CAP.

**Conclusion:** CAP is an important cause of morbidity and mortality in under five children (2-59 months) in developing countries like Bangladesh. A huge amount of money is needed to treat the CAP. So, it will be a burden on family and country. However, early detection of the significant risk factors and necessary actions toward these factors help us prevent the development of CAP in under five children (2-59 months) and improve their quality of life.

**Keywords:** Environment, Community acquired pneumonia

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### Introduction

Pneumonia is a lower respiratory tract infection caused by various infectious agents, including viruses, bacteria, and fungi.<sup>1</sup> Community-acquired

pneumonia (CAP) is a lower respiratory tract infection occurring in a child who has not resided in a hospital or health care facility in the preceding 14 days.<sup>2</sup> CAP is a significant cause of respiratory morbidity and mortality in children,

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especially in developing countries. Worldwide, CAP is the leading cause of death in children younger than five years.<sup>3</sup>

Child deaths have declined globally over the last two decades from 12.6 million to 6.6 million; CAP has remained the world's leading cause of death among children under the age of five.<sup>4</sup> Bangladesh has been determined to be among the countries where 44 percent of the world's children less than five years of age live. The highest incidence rate of CAP cases for children less than five years is reported at 0.51 episodes/child-year in Bangladesh.<sup>5</sup> CAP accounted for twenty-six percent of neonatal deaths leading to high IMR in Bangladesh.<sup>6</sup> Reduction in all-cause of child mortality occurred worldwide between 2000 and 2011, including a reduction in pneumonia-related deaths; in 2011, CAP was estimated to account for more than one million child deaths, 80 % of which occurred in children under two years of age.<sup>7,8</sup> The WHO classifies the risk factors for CAP in children living in developing countries as definite, likely or possible.<sup>9</sup> A recent systematic review with meta-analysis evaluated the quality of evidence and the strength of the association between 19 risk factors and severe acute lower respiratory tract infection in children under five.<sup>10</sup> In the studies evaluated, seven risk factors were shown to be significantly associated: low birth weight, undernutrition, household air pollution, human immunodeficiency virus (HIV) infection, non-exclusive breastfeeding, household crowding, and incomplete immunization.<sup>11</sup> The residential environment plays an important role in increasing children's risk of developing pneumonia.<sup>12</sup>

Colley et al. commented that in the first year of life, exposure to cigarette smoke due to parental smoking doubled the risk for the infant of an attack of respiratory infections.<sup>13</sup> Passive smokers are at a higher risk of respiratory morbidity and mortality because cigarette pollutants act on the defense mechanisms of the respiratory mucosa, affecting mucociliary transport and alveolar macrophage activity; this induces pulmonary infections, as well as leads to an increase in the allergic response to inhaled antigens.<sup>14</sup> Studies have suggested that children whose parents are

smokers have a higher risk of having pneumonia and being hospitalized.<sup>15</sup>

Crowding is common in developing countries, contributes to the transmission of infections through respiratory droplets, and has been clearly shown to be associated with respiratory infections.<sup>16,17</sup> Children living in *kwacha* (poor) houses or poorly ventilated living rooms suffered from pneumonia significantly higher than in *pucca* and good ventilated living room<sup>18</sup>. Visible mold spots or moldy air are regarded as the result of excess dampness, promoting the rapid growth of hazardous microbes, including bacteria, fungi, or viruses<sup>19</sup> and these microbes may result in the occurrence of pneumonia.<sup>20</sup> Cooking generates substantial indoor particulate matter<sup>21,22</sup> and also emits a variety of irritating gases.<sup>23,24</sup> Strong evidence has been presented showing that pollutants from indoor solid fuel use are related to health problems.<sup>25</sup> Mahalanabis and others found that the use of any of the three commonly used solid fuels for cooking, i.e., Coal, wood, or cow dung, was associated with a 2.7, 4.8, and 5.6-fold increased risk of pneumonia.<sup>26</sup> In Bangladesh, there is very little research has been conducted on relationships between childhood community-acquired pneumonia and residential environmental factors. This study focuses on residential risk factors associated with childhood community-acquired pneumonia in Bangladesh. Indoor environmental factors, including cooking fuel, cigarette smoke exposure, dampness, and chemical emissions related to construction, are investigated.

## Materials and Methods

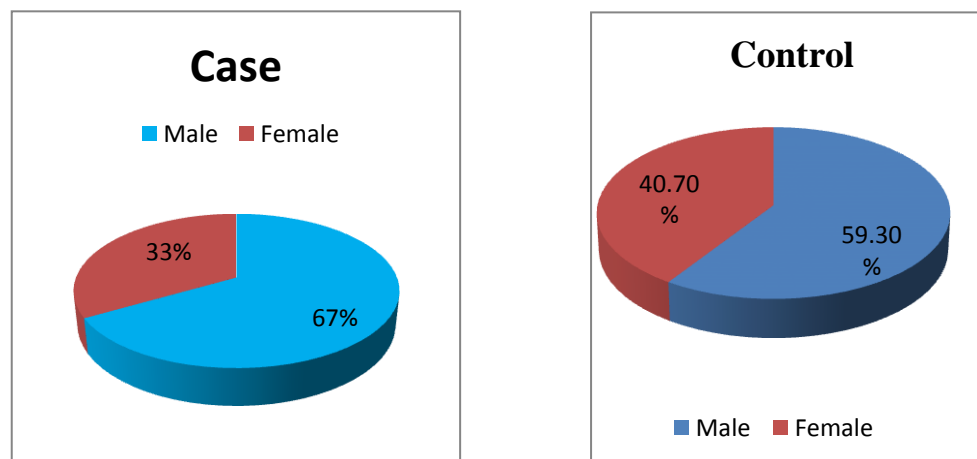
This case-control study took place from January 2017 to December 2018 indoors and outdoor in the department of Pediatrics and EPI center of Rajshahi Medical College Hospital. Under five children (2-59 months) of both sexes suffering from Community acquired pneumonia was selected from the inpatient department of Pediatrics of RMCH as cases and healthy control taken from a similar age group who are not suffering from Community acquired pneumonia was selected from Pediatrics OPD & EPI center of Rajshahi Medical College Hospital as control.

A total of 246 subjects were recruited and equally divided into two groups. Five children (2-59 months) of both sexes suffering from Community acquired pneumonia (CAP) as cases and healthy control taken from similar age groups who are not suffering from Community acquired pneumonia (CAP) were included in this study. Children who suffer from hospital-acquired pneumonia and other respiratory illness & parents unwilling to participate in this study were excluded from this study. After obtaining informed consent from the parents of the study children, data were collected through face-to-face interviews of parents, clinical and radiological

evaluation, and relevant investigations of the children were recorded on a predesigned questionnaire containing all the variables of interest. Medical history taking including age, sex, residence, cough, fever, difficult breathing, grunting, past history of recurrent chest infection, and vaccination. Clinical examination includes weight and height recording to assess the nutritional status as well as chest, cardiac and abdominal examination. CBC & X-ray chest investigations were done. In the end, data were processed and analyzed by computer using SPSS win. Program.

## Results

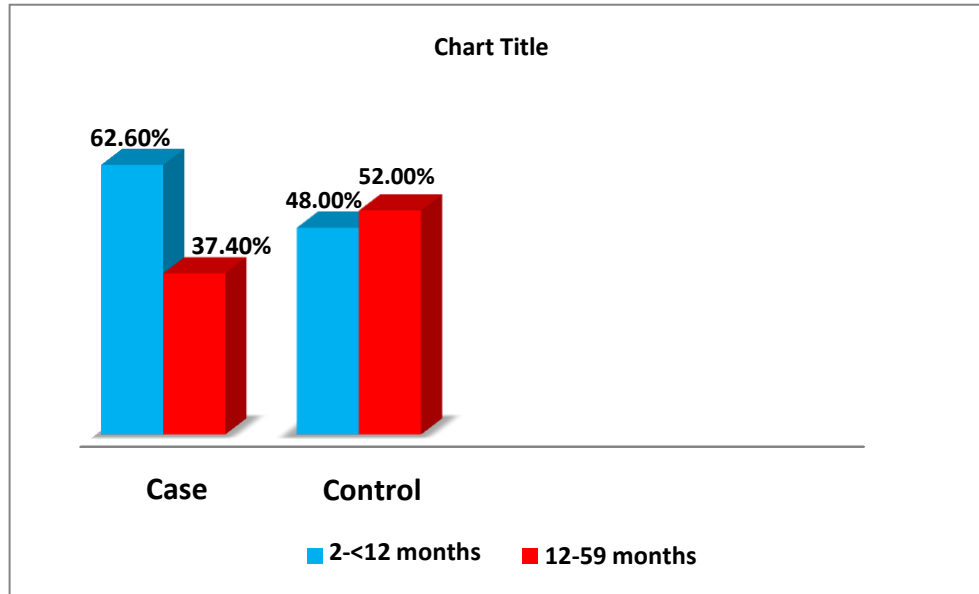
**Figure -1:** Gender distribution of the children (n= 246)



This figure shows a greater number of patients in both groups were male. Out of 123 cases, 82 (66.70%) patients were male, and 41 (33.30%) patients were female, whereas among 123 controls, 73 (59.30%) patients were male, and 50 were female (40.70%).



**Figure -2: Distribution of cases and controls according to age groups**



The figure shows cases were predominant between 2-<12 months of age (62.60%), whereas controls were predominant between 12-59 (52%) months of age.

**Table 1: Distribution of smoking habits of parents among case and control group**

Parenteral smoking	Case (%)	Control (%)	Total (%)	OR
<b>(Only father)</b>				
Yes	65(52.8%)	31(25.2%)	96(39%)	3.32
No	58(47.2%)	92(74.8%)	150(61%)	

Chi Square = 19.748, df =1, p <0.001 (0.000)

This table showing among 123 cases, 65(52.8%) fathers were a smoker, and 58(47.2%) fathers were not a smoker. The corresponding figures for control were 31(25.2%) and 92 (74.8%), respectively.

Parental smoking was significantly associated with CAP (p value <0.001).

**Table 2: Distribution of housing or living conditions among case & control group**

Overcrowding	Case (%)	Control (%)	Total (%)	OR
Yes	82(66.7%)	62(50.4%)	144(58.5%)	1.9
No	41(33.3%)	61(49.6%)	102(41.5%)	

Chi Square = 6.699, df=1, p <0.05(0.01)

This table shows the living condition of the case and control groups. 82cases (66.7%) and 62 controls (50.4%) were living in overcrowded housing, but 41cases (33.3%) and 61 controls (49.6%) were living in overcrowded housing. Overcrowding was significantly associated with CAP (p value <0.05)

**Table 3: Distribution of cases & controls according to Ventilation of Living room**

Ventilation of living room	Case (%)	Control (%)	Total (%)	OR
Bad	50 (40.7%)	32 (26%)	82 (33.3%)	1.94
Good	73 (59.3%)	91 (74%)	164 (66.7%)	

Chi Square = 5.927, df=1, p <0.05 (0.015)

This table shows about 50(40.7%) cases and 32(26%) controls lived in a badly ventilated room, while 73(59.3%) cases and 91(74%) controls lived in a well-ventilated room. Ventilation of the living room was significantly associated with CAP (p value <0.05).

**Table 4: Distribution of cases and controls according to the condition of the cooker**

Condition of cooker	Case (%)	Control (%)	Total	OR
Smoke	100 (81.3%)	80 (65%)	180(73.2%)	2.33
Smokeless	23 (18.7%)	43(35%)	66(26.8%)	

Chi-square = 8.283, df= 1, p value = < 0.001(0.004)

This table shows the condition of the cooker; 100 (81.3%) cases and 80(65%) controls lived in a home using a smoky cooker, while 23(18.7%) cases and 43(35%) controls lived in a home using a smokeless cooker. The condition of the cooker was significantly associated with CAP (p value <0.001).

## Discussion

CAP is an important cause of morbidity in developed countries and an important cause of morbidity and mortality in developing countries.<sup>27</sup> This study identified several residential risk factors that can be affected by

appropriate public health activities. Residential risk factors that were identified included tobacco smoking by parents, overcrowding, exposure to cold & humidity, and indoor air pollution. A poor house can also be directly linked to pneumonia because of dampness, lack of ventilation, and large fluctuations of day and night temperature,

all of which predispose a child to acute respiratory infections. Overcrowding, inadequate arrangements for excreta and waste disposal, poor ventilation, dampness, and numerous other housing problems remain threats to the health of low-income groups.<sup>28</sup>

Environmental tobacco smoke is another source of indoor pollution that reduces local defense mechanisms and predisposes children to respiratory illness. Most studies done in the past have implicated cigarette smoking as a risk factor for childhood pneumonia. In this study, the association between household members smoking cigarettes and CAP was statistically significant (p value <0.001, OR=3.33). In the present study, children exposed to tobacco smoke were 3.33 times more at risk of getting CAP than children who were not exposed. Di Franca et al. 2004, found strong evidence for associations between ETS exposure and risk of ARI in children. A lot of other studies by Macebo et al. 2007; Prietsch et al. 2003; Allwyne 1989, Savitha et al. 2007 (p value < 0.05) have found a strong association between the risk of pneumonia and tobacco exposure.

Overcrowding contributes to the transmission of infection through the respiratory droplet. In the present study, there was a statistically significant association between overcrowding with CAP (p value <0.05, OR =1.96). This study showed that a child with overcrowding is 1.96 times more likely to develop pneumonia as compared to a child without overcrowding. This was in agreement with a study by Cardoso et al.2004, where it was seen that overcrowding was associated with a 2.5-fold increase in the incidence of lower respiratory tract infections (p = 0.001). Study by Srivastava found overcrowding (OR = 15.30; 95% CI: 4.63-50.56; 'p' value=0.00001) had a significant positive association with pneumonia.

In this study, ventilation of the house was significantly associated (p value <0.05, OR=1.95) with CAP in children. This study is correlated with the study by Bari et al. 2007, Xiaohong et al .2013 and Nira et al. 2013 (p=0.000, OR=4.88). Lack of ventilation might

induce dampness and smell, which are risk factors for pneumonia.

In this study use of biomass for cooking was found to be a significant risk factor for CAP (p value <0.001, OR =2.33). This study showed the use of a smoky cooker increased the 2.33-fold risk of CAP in children. Biomass fuels (wood, crop residues, charcoal) and others like kerosene are important contributors to indoor air pollution. The risk is highest for the mothers and young children due to longer stay in-door and close proximity during cooking. Studies by Bruce et al. 2000; Smith et al. 2000; Dhaval et al. 2017 and Savitha et al. 2007, have shown that indoor air pollution by biomass fuels increases the risk of pneumonia. Tazinya et al. 2018 found the odds of developing an ARI after exposure to wood smoke was 2.63 compared to those who were not exposed.

## Conclusion

The present study had identified some residential risk factors for Community acquired pneumonia (CAP) in under five children (2-59 months) in our country. These factors are parental smoking, overcrowding, exposure to cold & humidity, indoor air pollution, etc. CAP is a very important cause of morbidity and mortality in under five children (2-59 months) in developing countries like Bangladesh. A huge amount of money is needed to treat the CAP. So, it will be a burden on family and country. Early detection of the major risk factors and necessary actions directed toward these factors help us to prevent the development of CAP in under five children (2-59 months) and improve their quality of life.

**Conflict of interest:** None declared

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