

# Indoor Air Pollution as a Risk Factor of Acute Lower Respiratory Tract Infection in Children

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## ABSTRACT

**Introduction:** This study was conducted to find out if indoor air pollution has any risk in occurrence of acute lower respiratory tract infection (ALRI) in children. **Materials and methods:** It was a case control study conducted on total 214 children 107 cases and 107 controls fulfilling the inclusion criteria with age and sex matched. Detailed history and physical examination was done after taking informed consent. History of upper respiratory tract infection in the family members and siblings, history of smoking by various family members, details of cooking fuel and indoor pollution was also recorded. **Results:** Those families using wood as a cooking material were associated with higher risk of ALRI ( $p=0.0001$ ). Exposure to domestic animal was significantly positively associated ( $p=0.0001$ ) and seven times higher risk to develop ALRI as compared to control group. Those children of case group who did not have separate kitchen were having nine times higher risk of ALRI ( $p=0.001$ ). Family history of smoking was associated with six times increased risk of ALRI ( $p=0.001$ ). With the use of kerosene lamps risk of ALRI was increased by 1.44 times ( $p=0.012$ ). **Conclusions:** The significant environmental risk factors for ALRI were wood as cooking material, presence of domestic animal, place for cooking, family history of smoking, absence of windows and kerosene lamp as a source of light.

**Key words:** Acute lower respiratory tract infection (ALRI), indoor air pollution.

## INTRODUCTION

World Health Organization (WHO) has defined acute respiratory tract infections on the basis of history of cough, difficulty in breathing and respiratory rate with different age groups<sup>1</sup>. Indoor air pollution is an important cause of potential health risk to exposed populations, especially in developing countries. An important source of indoor air pollution in these countries is combustion of solid fuels, including biomass and exposure to environmental tobacco smoke (ETS). About 50% of the world's population relies on biomass fuel as the primary source of domestic energy, out of which developing countries contribute to 99% of the world's biomass fuel use<sup>2,3</sup>. It is documented by WHO, exposure in indoor air pollution more than doubles the risk of this disease and is responsible for more than 900000 of the 2 million annual deaths from pneumonia and other ALRI<sup>4</sup>. Indoor air pollution is prioritized by number of articles published till date; the air pollution from household use of solid fuels, passive smoking, poor ventilation of room and source of light as kerosene lamp for lighting had been identified

as the strong modifiable risk factors for acute lower respiratory tract infections<sup>5, 6,7,8,9</sup>. An epidemiological study done in Nepal during 1980s showed a direct relation between reported hours per day spent near the stove by infants and children under 2 years and the episodes of life threatening acute lower respiratory tract infections<sup>10</sup>. After identifying the potential environmental risk factors and taking preventive measures the occurrence of ALRI may be decreased thus reducing mortality and morbidity among under five children.

## MATERIALS AND METHODS

A case control study was conducted at Nepalgunj Medical College Teaching Hospital, Kohalpur, Nepal during the period from June 2014 to November 2014 to identify indoor air pollution as a risk factor of acute lower respiratory tract infections among the children below five years. All diagnosed case of ALRI as per WHO were selected for case group, the duration of illness being less than 30 days. In the control group healthy children who were accompanied with their mother in OPD, in pediatric ward and immunization clinic without respiratory symptoms and no history of ALRI in past 2 weeks were included with age and sex matched. The convenience non probability sampling technique was undertaken and the minimum required sample size was 107 in both case and control group. Informed consent was taken from the mother of both groups and willingness was kept on consideration. All socio demographic data were collected with face to face interview from mothers by researcher himself. History of smoking by various family members and detail of cooking fuel, material use of cooking, exposure to domestic animal, indoor pollution was recorded. All data were entered in SPSS version

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19 and descriptive and analytic statistics was used for analysis of data with level of significance at p value <0.05.

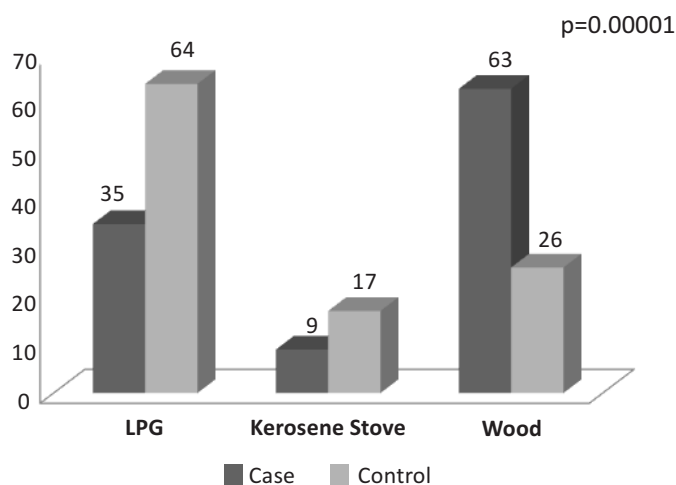
**RESULTS**

A total of 107 cases and 107 controls were taken where mean age of the case group was 11.34±10.168 (M±SD) months and control group was 11.57±10.270 (M±SD) months. Among them 70.1% (75) were below 12 month of age in case group whereas 68.3% (72) in control group. Male to female ratio was 1.6 to 1 and 1.8 to 1 in case and control group respectively. 42.1% (45) mothers were illiterate in case group whereas 6.5% (7) in control group which is statistically significant (p=0.001). 40.2% (43) fathers of case group were unskilled worker and 15% (16) in control group which was also statistically significant (p=0.03). Majority of families (84.1%) were residing in rural areas in case group and 66.1% in control group (p=0.001). 28% mothers of case group were teenager while they were only 13.1% in control group. Children of teenage mothers were 1.5 times higher chance of getting ALRI than controls (p=0.005).

**Environmental variables**

Figure 1 shows relationship of material used for cooking with ALRI cases and controls where 58.8% (63) families cooked their food by using wood in case group and 24.2% (26) in control group. It was shown that those families using wood as a cooking material were associated with higher risk of ALRI (p=0.0001).

Table I shows 60.7% (65) children were exposed to domestic animal in case group while only 16.8% (18) of control group and seven times higher risk to develop ALRI as compared to control group (p=0.0001). 15.9% (17) cooked their food in the bed room as compared to 1.9% (2) of control group and they had nine times higher risk of ALRI (p=0.001). Similarly 26.2% (28) of ALRI cases of case group lack window in their houses as compared to 12.2% (13) in control group but adequate number



**Figure 1: Association of Material used for cooking with ALRI**

of families from case and control group had window in their houses (73.8% vs 87.8% in cases & controls respectively). This was statistically significant (p=0.009). 24.3% (26) of families from case group used kerosene lamps as the lighting source while only 12.1% of controls and they had 1.44 times higher chance of getting ALRI as compare to controls (p=0.012). Positive family history of smoking was observed in 64.5% (69) of case group and 23.4% (25) in control group and six times increased risk of ALRI in children with positive history (p=0.001). 70.09% (75) of cases had either mud or cow dung flooring in their houses as compared to 63.5% (68) of controls, which was not statistically significant (p=0.437).

**DISCUSSION**

The study was aimed to find out indoor air pollution as a risk factor of acute lower respiratory tract infections (ALRI) among under five year children. A total number of 107 cases and 107 controls (age and sex matched) were selected in our study

Variables	ALRI		Total (%)	Odd Ratio (95% CI)	p value
	Cases (%)	Control (%)			
<b>Domestic Animal</b>					
Yes	65 (60.7)	18 (16.8)	83 (38.7)	7.566 (3.996-14.327)	0.0001
No	42 (39.3)	88 (83.2)	130 (61.3)		
<b>Place for cooking</b>					
Separate	90 (84.1)	105 (98.1)	195 (91.1)	9.917 (2.231-44.088)	0.001
In the bed room	17 (15.9)	2 (1.9)	19 (8.9)		
<b>Windows</b>					
Present	79 (73.8)	94 (87.8)	173 (61.7)	0.390 (0.18 – 0.80)	0.009
Absent	28 (26.2)	13 (12.2)	41(38.3)		
<b>Lighting</b>					
Kerosine lamps	26 (24.3)	13 (12.1)	39 (36.4)	1.44 (1.09 - 1.89)	0.012
Electricity	94 (87.9)	81 (73.7)	175 (63.6)		

**Table I: Association of environmental variables with ALRI**

population, where majority of children from cases and controls were infants 70.1% and 68.3% respectively. This finding goes in accordance to other studies reporting 62.5% vs 74.04%<sup>11</sup>, 62.2% vs 66.9%<sup>12</sup> and 70.7% vs 67%<sup>13</sup> in cases and controls respectively. It is explained by the fact that various anatomical and physiological risk factors in infants such as they are obligate nose breathers, tongue relatively large, airway narrow, increase metabolic demand and less elasticity of alveoli; associated with incomplete establishment of immunity<sup>14</sup>. Male preponderance was found in both case and control groups (61.7% vs 64.5%) with male to female ratio 1.6:1, 1.8:1. Similar results were found in different studies conducted in different countries<sup>6,10&11</sup>. The possibility of gender bias in seeking medical care may be the cause it.

In our present study 58.8% of ALRI cases and 24.2% of control group used biomass fuel like wood for cooking. Firewood users were significantly associated with occurrence of ALRI in case group ( $p=0.003$ ). Similar finding was also observed from the studies conducted in various countries; India<sup>5,6</sup>, Middle East Country<sup>7</sup> and Kenya<sup>12</sup>. Wood is burnt with very incomplete combustion generating a lot of toxic products that adversely affect specific and nonspecific local defences of the respiratory tract<sup>6,14</sup>.

Majority of under five children, being young spend most of their time with their mothers who is doing household cooking, thus getting more exposed to biomass fuel pollution. Added on this, in about 15.9% cases and 1.9% of controls, cooking was done in the bed room. These children had ten times higher risk of ALRI when cooking was done in the living room ( $p=0.001$ ). Similar was the finding of study conducted in India which showed 14.2% vs 0%<sup>4</sup> ( $p=0.0001$ ) but higher percentage (69.8%) observed in study of Kenya<sup>14</sup>. This can be explained by the fact that when cooking was done in bed room, it led bulk of emissions of toxic products into the living place thereby leading to persistent adverse affect for longer duration and ultimately increasing the risk of ALRI in under five children.

Another significant risk factor in our study was lighting source used in houses where 24.3% of cases and 12.1% of controls were using kerosene lamps as lightening source and it was significantly associated with ALRI ( $p=0.012$ ). These are potential source of emission of harmful particulate matter (<2.5mm in size) like polycyclic aromatic hydrocarbons, aliphatic hydrocarbon, nitrated hydrocarbon etc which as they are small, are inhaled deep into lung, leading to greater severity of illness<sup>15</sup>.

Added on this, 26.2% of case group and 12.2% of control group houses were not well ventilated (windows not present) and they were significantly associated with occurrence of ALRI in the children of these families ( $p=0.009$ ). Similar was the observation in the study conducted in India with significant

association (32.4% vs 4.8%) ( $p<0.001$ )<sup>5</sup>. Numbers of windows are directly proportional to ventilation of room and it ultimately determines indoor air pollution. If the room is not having enough windows, less fresh air circulates and it becomes damp and moist which favors growth of organism, mainly responsible for ALRI.

## CONCLUSIONS

The significant environmental risk factors for ALRI in children were wood as cooking material, presence of domestic animal, place for cooking, family history of smoking, absence of windows and kerosene lamp as a source of light.

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