Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.4, No.2, 2014 

# Indoor Air Pollution and Prevalence of Acute Respiratory Infection among Children in Rural Area of Bangladesh

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**Abstract**
This study was undertaken in the village Shalchura under Nalitabari Thana in Sherpur district where total of 145 study populations (Children) were selected by systematic random sampling. Prevalence of acute respiratory infection (ARI) was seen in 76.6% of study children during last one year most of whom were found to be in the age group 0-5 years. The difference in the prevalence of acute respiratory infection (ARI) in 0-5 years group compared to prevalence of 6-18 years group were found to be statistically significant. Having a poor or lower medium class socio-economic background, majority of the family used mixture of biomass fuel like wood, crop-residue, cow-dung, saw dust, leaves etc. for cooking purpose. Association with disease symptoms to poor ventilation condition of the house and kitchen were also found to be significant. Another important factor for acute respiratory infection (ARI) symptoms was exposure to biomass fuel at daily cooking time. The disease symptoms tend to increase in 0-5 years group and the children who spent more time in cooking were more exposed to indoor air pollution as they have been showed more incidences of acute respiratory infection (ARI). It was revealed that due to smoking habit of family members and did that inside the living room, increased the occurrence of acute respiratory infection (ARI) among children. It was also found that use of mosquito's coils and poor living space increased the incidences of acute respiratory infection (ARI) among children. It was revealed that among the children with exposed (ARI) 41(28.8%) were liberated gases enter into their living room during cooking compared to 8 (23.5%) children in the unexposed (non ARI) group.
**Keywords:** Indoor Air Pollution**,** Acute respiratory infection, Children, Sherpur, Bangladesh

## INTRODUCTION

Indoor air pollution is usually associated with occupational situation particularly through combustion of biomass fuels. The greatest threat of indoor pollution exists where the people continue to rely on traditional fuels for cooking and heating. Biomass is the energy source of the poor. It is also the major source of indoor air pollution. Millions of poor households in developing countries like Bangladesh which rely on traditional biomass fuels for cooking and domestic heating suffer a disproportional high burden of ill-health from exposure to indoor smoke.

According to the World Health Report, 2002 indoor air pollution (IAP) is responsible for 2.7% of the global burden of disease and nearly 2.5 million people die due to air pollution, mainly (65%) because of indoor air pollution. Biomass fuel is the major source of indoor air pollution (IAP) and it is burned for cooking, heating and lighting homes. Globally, almost three billion people rely on biomass (wood, charcoal, crop residues, and dung) and coal as their primary source of domestic energy. Biomass accounts for more than half of national energy and as much as 95% of domestic energy in many lower-income developing countries like Bangladesh.

Traditional biomass fuels account for about 80 percent of Bangladesh's domestic energy consumption. When these fuels burn in simple cook stoves during meal-preparation, air inside homes gets heavily polluted with smoke that contains large amounts of toxic pollutants such as carbon monoxide, oxides of nitrogen, sulfur dioxide, aldehydes, dioxin, polycyclic aromatic hydrocarbons and respirable participate matter. The resulting human exposures exceed recommended World Health Organization levels by factors of 10, 20 or more.

In rural areas, indoor air pollution is responsible for much greater mortality than ambient air pollution. Epidemiological studies have linked exposure to indoor air pollution from dirty fuels with at least four major categories of illness such as acute respiratory infections (ARI) in children, chronic obstructive pulmonary disease (COPD), lung cancer and pregnancy related problems.

Bangladesh has made a remarkable improvement in health indicators over last few decades. The infant mortality rate (IMR) has come down from 117 deaths per 1000 live births in the mid-1980s to 65 in 2004 according to the Bangladesh Demographic & Health Survey, along with a neonatal mortality rate of 42 and an under-five mortality rate of 88 per 1000 live births. Main causes of death in children fewer than five years for acute respiratory infection (ARI) and possible acute respiratory infection (ARI) are 27% of total child death in Bangladesh. Most of the rural area of Bangladesh has not natural gas for burning and cooking. The people of rural Bangladesh use biomass fuel for their cooking and other necessary activities which causes acute respiratory infection mostly.

 

## JUSTIFICATION OF THE STUDY

The indoor air pollution is one of the top health related problems next to safe water and sanitation in our rural area of Bangladesh. Maternal exposure to pollutants results in low birth weight and infant ill health. The major categories of health problems related to indoor air pollution are acute respiratory infections in children, chronic lung disease, heart disease and lung cancer, till today acute respiratory infections (ARI) is one of the leading causes of high infant mortality rate in Bangladesh. The exposure to indoor air pollution caused acute respiratory infections (ARI) among the children. Many researches had been done the study on indoor air pollution for acute respiratory infections (ARI) in rural area of Bangladesh, but in Sherpur district the study on the exposure of indoor air pollution and extent of acute respiratory infections (ARI) and among the children had not been sufficiently done. So this study aims to assess the extent of acute respiratory infections (ARI) among the children exposed to indoor air pollution in a rural area of Sherpur district.

The findings of this study would have important environmental health implication. It would also assist the planner, policy makers, implementer and stakeholders towards adopting more effective strategy for prevention and control the impact indoor air polluting among children of rural area of Bangladesh.

## OBJECTIVES OF THE STUDY

### General Objectives

To assess the prevalence of acute respiratory infection (ARI) among children exposed to indoor air pollution in a selected rural area of Sherpur district, Bangladesh.

### Specific objectives

- To find out socio-economic and demographic condition of the family.
- To find out the housing condition of the children (0-18).
- To find out the ventilation condition of the kitchen of the household.
- To find out the sources of indoor air pollution.
- To find out the duration of exposure to indoor air pollution of the children.
- To find out the episode of acute respiratory infection (ARI) among the children during last one year.

## MATERIALS AND METHODS

### Study Area

This study was conducted in the village of Shalchura under Nalitabari Thana in Sherpur district. Shalchura is approximately 5 Km. from Sherpur sadar. There is no industry in the surrounding area and as such the area is devoid of industrial pollution. The place purposely chosen, as there is non-availability of pipeline gas or LP gas. The community is generally poor and is dependent on biomass fuel for cooking and heating process.

### Study Period

The study was conducted from 3 February 2011 to 15 August 2011 period included all the study protocols.

### Study Population

Only the children of 0-18 years of each family were the study population. But the respondents were almost their mother and other housewives as the children of minor age were unable to respond to data collection.

### Sample Size

The sample size was determined purposively as 150 children of 0-18 years. Because if the sample size was determined by ideal procedure, it could not be attained within the stipulated time.

### Sampling Technique

Sample was collected by systematic random sampling. We know that 3-4 children can be getting in each family in our rural community, as the growth rate is 4.47. The Upazilla Family Planning Department has the family register and from the register child name and age was quoted and was made a sampling frame. There are 600 households in the village and 2400 children were present in the village. So the total number of children was divided by total number of estimated sample size and 16 were got as the sampling interval. First child was detected by simple random sampling and then every $16^{th}$ child was detected as a sample child. In those way 150 children was selected.

### Pre test

Necessary pre-testing was conducted using the draft data collection instrument and then the data collection instrument was modified based on the observations appeared during the pre testing exercise.

### Data collection

Data were collected on questionnaire and on checklist. Probable answer of maximum questions was listed against the respective question and few were of numeric answer. The probable condition for observation checklist was listed against each question of the checklist. The answers mentioned by the respondents were ticked by the researcher himself. The data were collected in 15 days including the holiday. Time for interview was agreed upon so that the respondents could spend sufficient time. Accordingly the interview was conducted

 

by the researcher in the different houses of the respondent.

**Data Analysis**

Data were collected, checked, edited and entered in the computer sofware 'Statistical Package of Social Science (SPSS)' version 11.5. Analysis was carried out keeping in pace with the objectives and the data was thereafter presented in tabulated form and also in the form of figures. Both descriptive and inferential statistics have been used in the process of data analysis.

## RESULT

**Age distribution of children**

The mean age of the study population (Children) was found to be 6.99 years with standard deviation of ± 4.21. Further analysis stated the mean age of the children in the unexposed (non ARI) group to be 10.12 years with SD or ±2.63 and that in exposed (ARI) group was found to be 6.03 years with SD of ± 4.15. It was found that among the children with exposed (ARI) 72(64.9%) was in the age group 0-5 years compared to 39(35.1%) children in the age group 6-18 years and the difference was highly significant (P=0.00).

**Table 1:** Age distribution of the study children

| Age of the Children (years) | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| 0 – 5 years | 2 | 5.9 | 72 | 64.9 | 74 | 51.0 |
| 6- 18 years | 32 | 94.1 | 39 | 35.1 | 71 | 49.0 |
| Mean± SD | 10.12± 2.63 | | 6.03± 4.15 | | 6.99± 4.21 | |

**Sex distribution of children**

Table-2 shows that in the unexposed (non-ARI) group male was 21 (61.8%) and female was 13 (38.2%). Among the exposed (ARI) group, male was 45(40.5%), and female was 66(59.5%). Significant difference was observed with male and female (P<0.05) indicates that exposed (ARI) was higher among female children.

**Table 2:** Sex distribution of study children

| Sex of children | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Male | 21 | 61.8 | 45 | 40.5 | 66 | 51.0 |
| Female | 13 | 38.2 | 66 | 59.5 | 79 | 49.0 |
| Total | 34 | 100 | 111 | 100 | 145 | 100 |

**Distribution of the Family size of children**

The mean family size was found 5.47 with standard deviation (SD) of ±0.96 in Non-ARI group and 5.14 with standard deviation of ±0.97 in exposed (ARI) group and also 5.21 with standard deviation of ±0.97 in the whole study population. It was found that among the children with exposed (ARI) 23(20.7%) was in the 1-4 family members compared to 88(79.3%) children in the more than 4 family members and the difference was significant (P=0.04).

**Table 3:** Distribution of the Family size of study children

| Family size of children | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| 1-4 members | 2 | 5.9 | 23 | 20.7 | 25 | 17.2 |
| More than 4 members | 32 | 94.1 | 88 | 79.3 | 120 | 82.8 |
| Mean± SD | 5.47± 0.96 | | 5.14± 0.97 | | 5.21± 0.97 | |

**Distribution of the number of children of the household**

The average children per family was found 3.47 with standard deviation (SD) of ± 0.96 in unexposed (non ARI) group and 3.13 with standard deviation(SD) of ± 0.97 in exposed (ARI) group and also 3.21 with standard deviation(SD) of ± 0.97 in the whole study population.

It was found that among the children with exposed (ARI) 23(20.7%) was in the 1-2 children compared to 88(79.3%) children in the more than 2 children family and the difference was significant (P=0.04).

 

**Table 4:** Distribution of the number of children of the household

| Number of children | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| 1-2 child | 2 | 5.9 | 23 | 20.7 | 25 | 17.2 |
| More than 2 children | 32 | 94.1 | 88 | 79.3 | 120 | 82.8 |
| Mean± SD | 3.47± 0.96 | | 3.13± 0.97 | | 3.21± 0.97 | |

**Annual Family income of the respondent**

The mean annual family income was found 75.823.53 taka with standard deviation of ± 63.957.12. further analysis revealed that the mean annual family income in the non exposed (non ARI) to be 59,315.32 taka with standard deviation of ±45,795.99 and in exposed (ARI) was found to be 63,186.21 years with standard deviation of ± 50879.76.

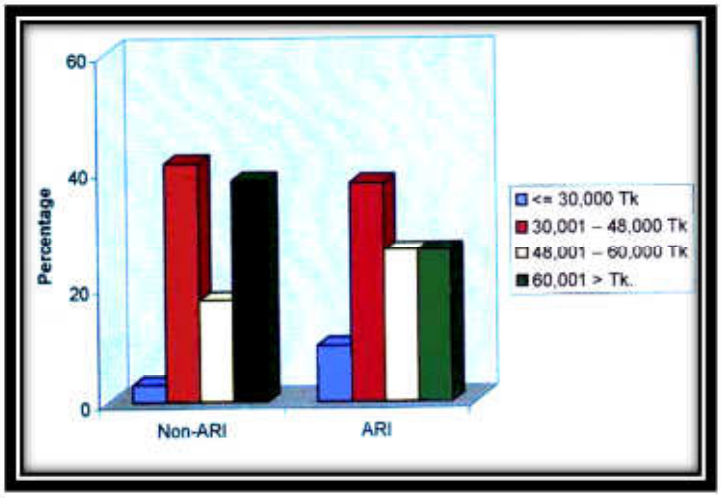


**Figure 1:** Featuring the annual family income of the respondent

**Type of house of the respondent**

It was found that among the children with exposed (ARI) 47(90.4%) was in thatched house compared to 64 (68.8%) children in the tin-roof/Pucca house and the difference was highly significant (p=0.003).

**Table 5:** Distribution of the type of house of the respondent

| Type of House | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Thatched | 5 | 9.6 | 47 | 90.4 | 52 | 100 |
| Tin roof/ Pucca | 29 | 31.2 | 64 | 68.8 | 93 | 100 |
| P= 0.0003 (Significant) | | | | | | |

**Symptoms with common/cold among the exposed children**

The analysis revealed the other associated symptoms with exposed (ARI) children were fever associated with cough 109(98.2%), fast breathing present with cough 48(43.2%), wheeze/stridor present 41(36.9%), chest indrawning present 11(9.9%) and sore throat during last one year 2(1.8%).

 

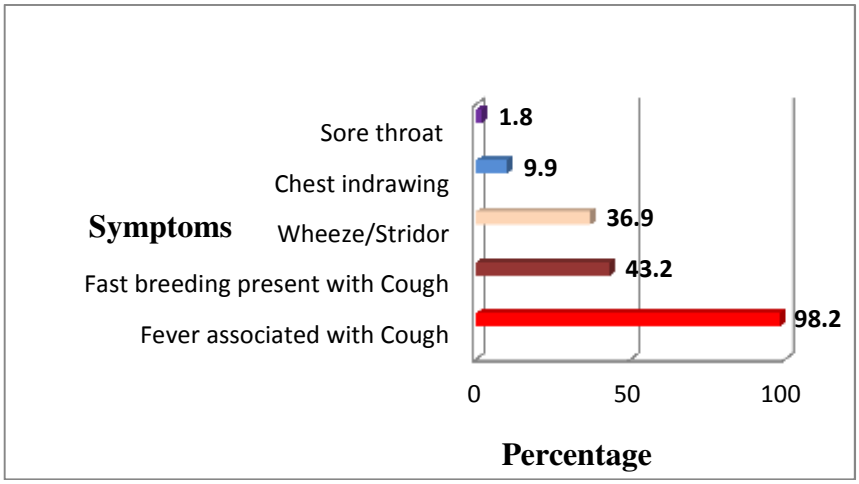


**Figure 2:** Associated symptoms with common/cold among the exposed children

**Distribution of the children taken treatment**

It was found that among the children with exposed (ARI) 107(96.47%) taken treatment from Upozilla Health complex or registered doctor and among exposed (ARI) group 4(3.6%) children did not taken treatment.

**Table 6:** Distribution of the children taken treatment

| Treatment | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Not taken | 34 | 100 | 4 | 3.6 | 38 | 26.2 |
| Taken Treatment | 0 | 0 | 107 | 96.4 | 107 | 73.8 |
| Total | 34 | 100 | 111 | 100 | 145 | 100 |

**Type of fuel used for cooking**

It was found that among children with exposed (ARI), wood was 6 (5.4%), and mixture was 105 (94.6%) used as fuel for cooking in the household. On the other hand among the unexposed (non ARI) children, wood was 5 (14.7%) and mixture was 29 (85.3%)

**Table 7:** Distribution of type of fuel used for cooking

| Type of fuel used for cooking | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Wood | 5 | 14.7 | 6 | 5.4 | 11 | 7.6 |
| Mixture | 29 | 85.3 | 105 | 94.6 | 135 | 92.4 |

**Stove used inside the house for Cooking**

It was revealed that 91% household of exposed (ARI) children used the stove inside the house for cooking but house hold of unexposed children (non ARI) was only 9%

 

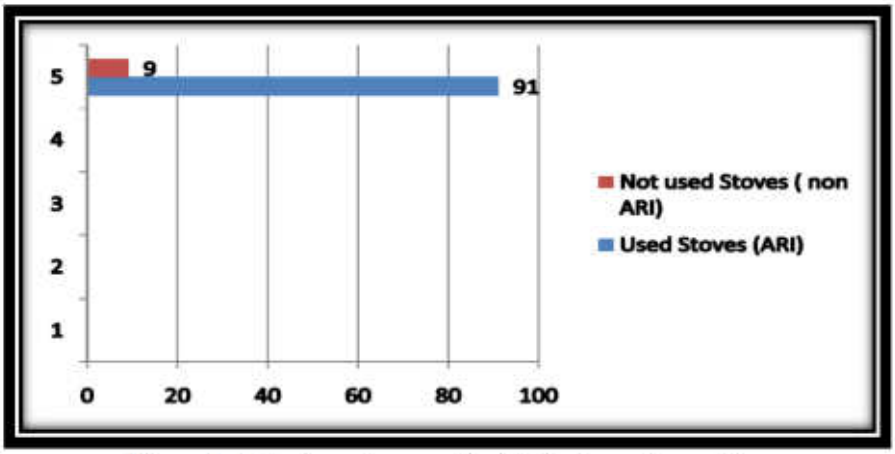


**Figure 3:** Featuring stove used inside the house for cooking

**Hour spent for cooking of household**

It was found that among the children of exposed (ARI), 6 or more hours spent by the mother were 84 (75.7%) and less than 6 hours was 28 (82.4%). On the other hand among the non exposed (non ARI), 6 or more hours spent by the mother was 29 (85.3%) and less than 6 hours was 5 (14.7%)

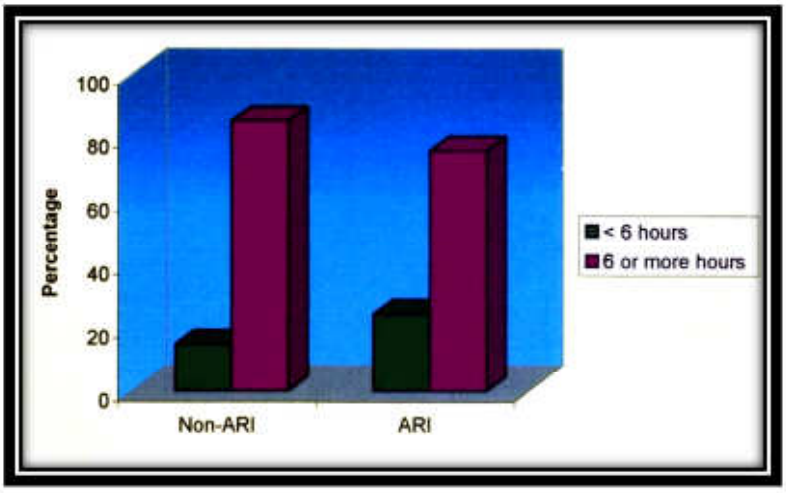


**Figure 4:** Featuring hour spent for cooking of household

**Children stay status in the kitchen while cooking**

The mean hours stay in the kitchen in the study population (Children) was found to be 2.02 hours with standard deviation of ±2.47. Further analysis revealed the mean hours stay by the in the children in the kitchen in exposed (non ARI) group to be 2.57 hours with SD of ±2.52 and that in exposed (ARI) group was found to be 0.24 hours with SD of ± 1.08. It was found that among the children with exposed (ARI) 65(58.6%) was stay in the kitchen while cooking their mother compared to 2(5.9%) children in the exposed (non ARI) group and the difference was highly significant (P=0.00).

**Table 8:** Distribution of Children stay status in the kitchen while cooking

| Children stay in kitchen | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Don't stay | 32 | 94.1 | 46 | 41.4 | 78 | 53.8 |
| Stay | 2 | 5.9 | 65 | 58.6 | 67 | 46.2 |
| Mean± SD | 0.24± 1.08 | | 2.57± 2.52 | | 2.02± 2.47 | |

 

**Age of children stay in kitchen during cooking**

It was found that among the children of exposed (ARI) 50 (76.9%) was in the age group 0-5 years compared to 15 (23.1%) children in the age group 6-18 years.

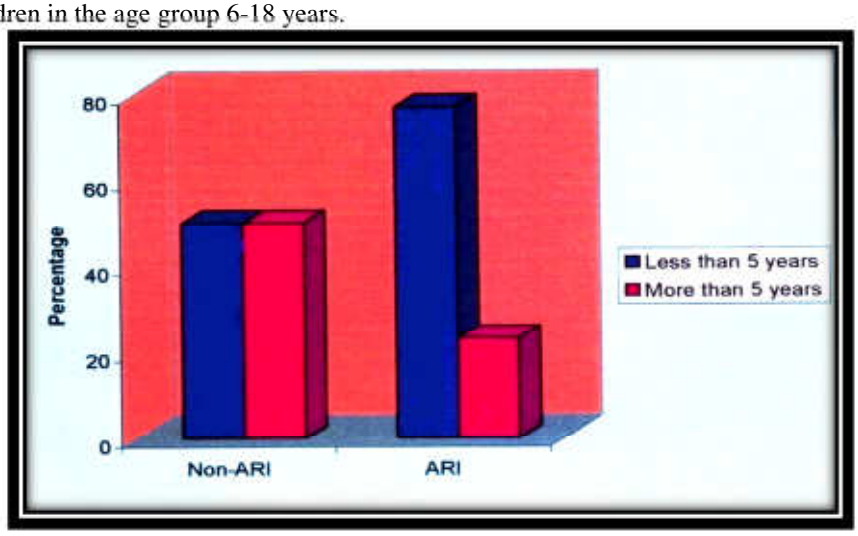


**Figure 5:** Featuring age of children stay in kitchen during cooking

**Hours given by the children in kitchen during cooking**

It was found that among the children with exposed (ARI) 17 (26.2%) gave 0-2 hours in the kitchen and 48(73.8%) children gave more than 2 hours than 2 hours in the kitchen.

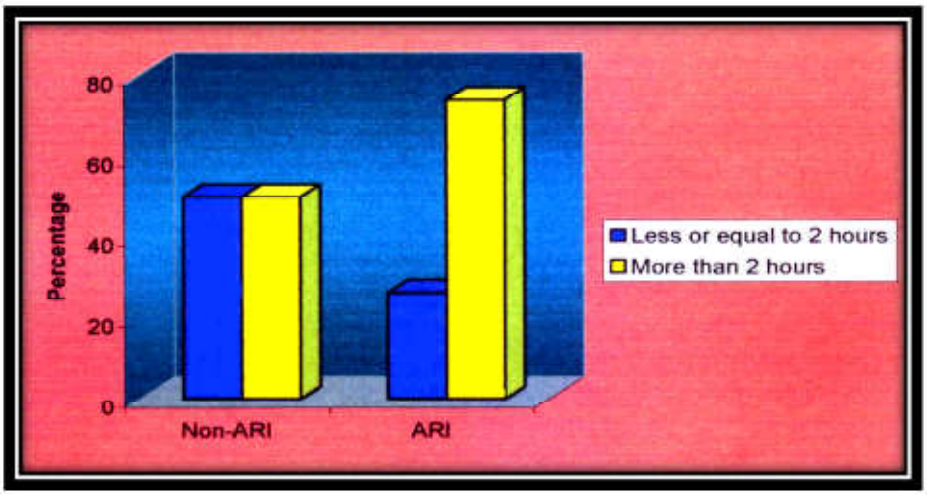


**Figure 6:** Featuring hours given by the children in kitchen during cooking

**Use of mosquito coils inside the house**

It was found that 86(59.3%) of the household of the exposed (ARI) children used mosquito coils and the household of the unexposed (non ARI) was 59(40.7%)

 

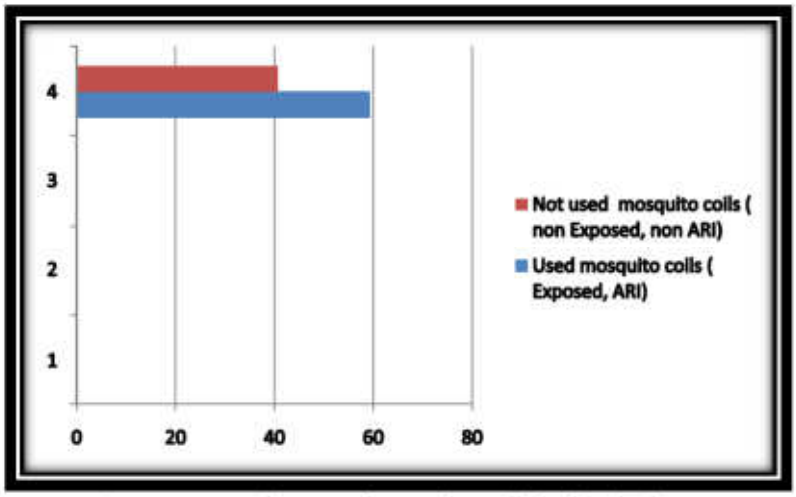


**Figure 7:** Featuring use of mosquito coils inside the house

**Smoking status of the household member**

It was found that among the children with exposed (ARI) 56 (50.5%) smoker in the family and 15 (44.1%) were in the unexposed (non ARI) group.

**Table 9:** Distribution of Smoking status of the household member

| Smoker in the family | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| No | 19 | 55.9 | 55 | 49.5 | 74 | 51.0 |
| Yes | 15 | 44.1 | 56 | 50.5 | 71 | 49.0 |
| Total | 34 | 100 | 111 | 100 | 145 | 100 |

**Smoking habit of the family members inside the living room**

It was found that among the children with exposed (ARI) 52 (92.9%) smoked inside the living room 15(100.0%) were in the unexposed (non ARI) group.

**Table 10:** Distribution of smoking habit of the family members inside the living room

| Smoking habit inside the living room | Unexposed ( non ARI) (n=15) | | Exposed (ARI) (n=56) | | Total (n=71) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| No | 0 | 0 | 4 | 7.1 | 4 | 5.6 |
| Yes | 15 | 100 | 52 | 92.9 | 67 | 94.4 |
| Total | 15 | 100 | 56 | 100 | 71 | 100 |

**Ventilation condition of the house**

It was found that among the children with exposed (ARI) 47(42.3%) was no ventilation in the house compared to 26 (76.5%) had ventilated house in the unexposed (non ARI) children and the difference was significant (P=0.04).

**Table 11:** Distribution of ventilation condition of the house

| Ventilation condition | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| No | 8 | 23.5 | 47 | 42.3 | 55 | 37.9 |
| Yes | 26 | 76.5 | 64 | 57.7 | 90 | 62.1 |
| Total | 34 | 100 | 111 | 100 | 145 | 100 |

 

**Status of the living space of the house**

It was found that among the children with exposed (ARI) 107 (96.4%) had adequate space in the living room computed to 33 (97. l %) in the unexposed (non ARI) children.

**Table 12:** Distribution of status of the living space of the house

| Adequate space in living room | Unexposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| No | 1 | 2.9 | 4 | 3.6 | 5 | 3.4 |
| Yes | 33 | 97.1 | 107 | 96.4 | 140 | 96.6 |
| Total | 34 | 100 | 111 | 100 | 145 | 100 |

**Type of the kitchen of the family**

It was found that among the children with exposed (ARI) 57 (51.4%) was in ventilated kitchen in the family compared to 26 (76.5%) children in the unexposed (non ARI) group and the difference was highly significant (P=0.00).

**Table 13:** Distribution of type of the kitchen of the family

| Type of the kitchen | Non Exposed ( non ARI) (n=34) | | Exposed (ARI) (n=111) | | Total (n=145) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Well ventilated | 26 | 76.5 | 57 | 51.4 | 83 | 57.2 |
| Poor ventilated | 8 | 23.5 | 54 | 48.6 | 62 | 42.8 |
| Total | 34 | 100 | 111 | 100 | 145 | 100 |

**Status of distance between living room and kitchen**

It was found that children with exposed (ARI) 41(36.9%) was less or equal 5 feet distance between the living room and kitchen compared to 7 (20.6%) children in the unexposed group.

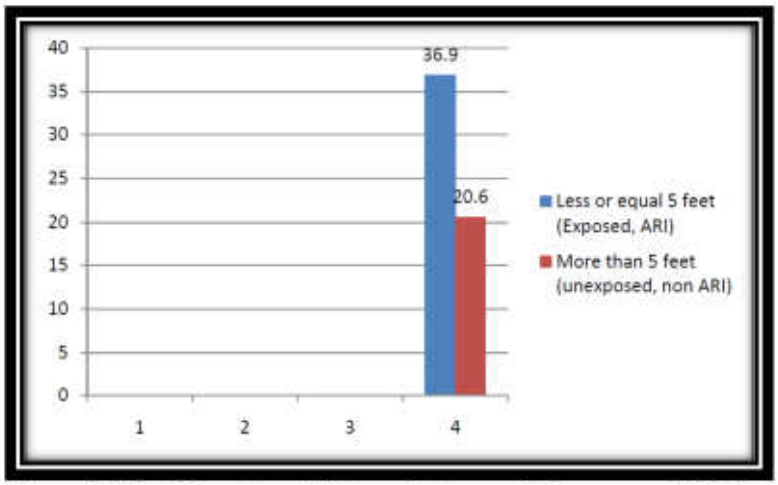


**Figure 8:** Featuring status of distance between living room and kitchen

**Status of the liberated gases enter into the living room during cooking**

It was found that among the children with exposed (ARI) 41(28.8%) were liberated gases enter into the living room during cooking compared to 8 (23.5%) children in the unexposed (non ARI) group.

 

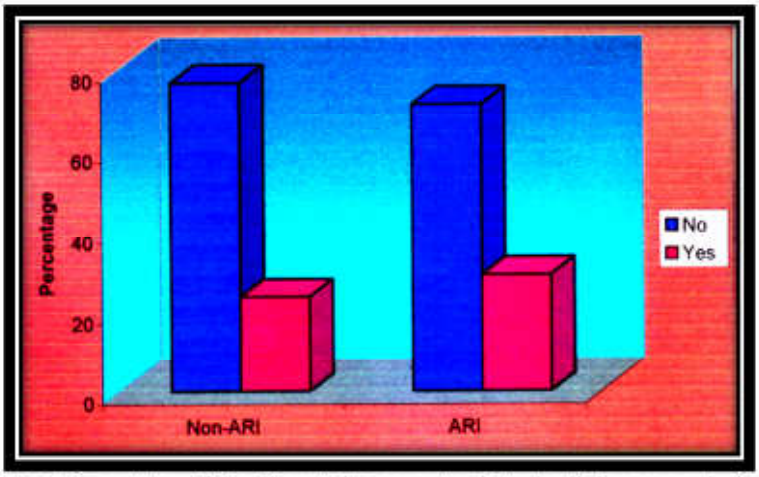


**Figure 9:** Featuring status of the liberated gases enter into the living room during cooking

## DISCUSSION

Surveys on effects of indoor pollution from various pollutants like biomass fuel such as wood, crop-residues, cow-dung, indoor stoves, mosquito coils, insecticides, cigarette smoking etc. as per available information are not sufficiently surveyed in Bangladesh.

Use of biomass fuel is common in rural Bangladesh and this is mostly due to poverty, ignorance and tendency to stick to aged old tradition of using such fuel. The persons most frequently affected are females who traditionally do the cooking for household and the children who remain in the kitchen with their mother in rural Bangladesh. They suffer from impaired health due to prolonged and repeated contact with these pollutants. Mortality and morbidity from Acute Respiratory Infection (ARI) are high among the children. The role of indoor air pollution in the development of disease has been examined in various studies.

The study was carried out in the village Shalchura under Nalitabari Thana in Sherpur district. The area of the study was purposively chosen, as it was 5 km. away from Sherpur town. The village has no industries in its vicinity and is thus devoid of industrial pollution.

Among the 145 study population, 74 (51%) belonged to the age of 0 - 5 years and others age group 6-18 years was 71 (49%). It was found that among the children with Acute Respiratory Infection (ARI) 72(64.9%) was in the age group 0-5 years compared to 39(35.1%) children in the age group 6-18 years and the difference was highly significant (p=0.00). As the children of 0-5 years stayed more times inside the house with their mothers and were more exposed to indoor air pollution, the episode of Acute Respiratory Infection (ARI) was more in this age group.

The mean family size was found to be 5.21. This roughly corresponds to 4.8% per household as stated in Population Data 2001. Study showed that about 35.9% respondents had thatched lodgings, followed by 64.1% living in tin roof houses or Puccu houses. It was found that among the children with Acute Respiratory Infection (ARI) 47(90.4%) was in thatched house compared to 64(68.8%) children in the tin roof/Pucca house and the difference was highly significant (P=0.003).

In the present study, it was found that among the total study population 76.6% suffered from at least one episode of common cold/cough during last one year. Among the children suffering from common cold/cough, fever was associated in 98.2%, fast breathing was present in 43.2%, wheeze/stridor was present in 36.9%, Chest indrawning was present in 9.9% and sore throat was present only in 1.8%.

The present study conducted in a poor area of Sherpur district where the family members did not didn't know the effect of indoor air pollution on child health, thus the attack rate of ARI was a little bit high probably due to the fact that 62.1% houses and 57.2% kitchens were found to be ventilated. The study revealed that among the Acute Respiratory Infection (ARI) attacked children 96.4% taken treatment from Upazilla Health Complex or from a registered doctor, which indicates well awareness of the parents of study population towards treatment seeking from qualified doctors.

Study revealed that household used different types of biomass fuels on the basis of availability and affordability. 92.4% used mixture crops residue, dry leaves, cow dung and wood etc and only 7.6% could afford to use wood throughout the year.

The study shows among the Acute Respiratory Infection (ARI) attacked group 58.6% stayed in the kitchen during cooking and 41.4% didn't stay in the kitchen during cooking. Analysis revealed the difference in the mean hours stay in the kitchen by ARI and Non-ARI children was significant. In the study smoking habit didn't show any significant difference with the development of acute respiratory infection (ARI).

 

Ventilation condition of the house and type of the kitchen had direct impact on disease symptom of ARI as 42.3% was observed in poor-ventilated houses and 48.6% Acute Respiratory Infection (ARI) was observed in poor-ventilated kitchen. The findings were statistically significant in case of Acute Respiratory Infection. ($P<0.05$). It was also found that among the children with exposed (ARI) 41(28.8%) were liberated gases enter into the living room during cooking compared to 8 (23.5%) children in the unexposed (non ARI) group. So it can be said that family who use biomass for various purposes exposed to more indoor air pollution which causes more acute respiratory infection among children exposed than non exposed to who use less biomass.

## RECOMMENDATION

Based on the findings, the study leads towards the following recommendations

1. Biomass fuel users having poor-ventilated type of kitchen should be encouraged to use well-ventilated type of kitchen to prevent indoor air pollution.
2. Biomass fuel users should use improved version of cooking stoves to minimize their exposure to the noxious smoke. "There are numbers of cooking stove models called improved stoves which is compatible for the rural populations of Bangladesh. These stoves prevent direct exposure to the smoke through improvised exhaust system.
3. Biomass fuel users should be made aware of the effects of indoor air pollution on their children health through different means and media such as television, radio, newspaper and also by arranging group discussions, door to door campaign, leaflets etc.
4. Children should be kept away from exposure when cooking using biomass fuel. The family should develop their ventilation condition. Use of mosquito's coils and insecticides should be used cautiously.
5. The smokers among the family members should not smoke inside the house.
6. Physicians and field health workers should play an important role in dissemination of information regarding the affect of indoor air pollution on the health of children and others.
7. The subjects need more research to analyze the accurate situation and appropriate intervention is required.

## CONCLUSION

Indoor air pollution is one of the burning issues in Bangladesh. Indoor air pollution due to biomass fuel and other pollutants in rural Bangladesh has escaped the notice of the researchers. The issue is of vital importance because approximately 75% of the population lives in rural areas and about 25% of that population are children who have direct or indirect exposure to the biomass fuel. The study is to assess and compare its results. It must be pointed out that biomass fuel is used by lowest portion of population with very poor economic status. Clear fuel such as LP gas and electricity are far more expensive and can be only afforded by more solvent society. The similar group having equal socio demographic status using LP gas or other forms of clean fuels is hard to find. Findings of this study revealed that a fair among of acute respiratory infection (ARI) prevalent among the indoor air pollution exposed children even most of them use well ventilated kitchen. Age and Sex plays an important role in the morbidity on the child health duo to use of biomass fuel. The lower age group and children were found to have more acute respiratory infection (ARI) than higher age group.

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