

## Knowledge of Health Hazards and Perception of Prevention Amongst Females Exposed to Biomass Fuel and Gas/Electricity Fuel in A District of Bangladesh

\*MA Alim<sup>1</sup>, ASM Nurunnabi<sup>2</sup>, S Ahmad<sup>3</sup>, MA Khan<sup>4</sup>, SA Ahmad<sup>5</sup>

<sup>1</sup>*Dr. Md. Abdul Alim, Institute of Public Health Nutrition (IPHN), Dhaka*

<sup>2</sup>*Dr. Abu Sadat Mohammad Nurunnabi, Bangladesh Medical Research Council, Dhaka*

<sup>3</sup>*Dr. Salahuddin Ahmad, Upazila Health Complex, Bhaluka, Mymensingh*

<sup>4</sup>*Dr. Mohammad Adnan Khan, Upazila Health Complex, Sharishabari, Jamalpur*

<sup>5</sup>*Prof. Dr. Sk. Akhter Ahmad, Department of Occupational & Environmental Health, National Institute of Preventive and Social Medicine (NIPSOM), Dhaka*

\*Corresponding author

### ABSTRACT

Indoor air pollution from biomass smoke is now regarded as public health hazard in the developing world, where more than two billion people still rely on the use of solid biomass fuels such as, dung, wood, crop residue and coal for cooking daily meals and heating homes. A cross-sectional study was designed and conducted from March to June 2007, in Madla, a rural area, and in Thanthania, an urban area, under Bogra District of Bangladesh, to see and compare the prevalence of respiratory disease among female biomass fuel users and gas/electricity fuel users. A total of 103 females from the rural households meeting the defined enrollment criteria for biomass fuel group were selected purposively as cases, while 101 females from the urban households meeting the defined eligibility criteria for controls were included in gas/electricity fuel group. The participants were interviewed on a semi-structured questionnaire. Nearly 70% of the biomass fuel users used wood for the daily cooking and heating purposes, 64% leaves, 31.1% cow dung, crop residue 30.1% and 7.8% saw-dust. The biomass group exhibited a significantly higher frequency of respiratory problem (16.5%) compared to their gas/electricity counterpart (5%). The findings revealed that, 67.5% of the biomass group complained of eye problem followed by cold 36.1%, headache 33.8%, cough 13.9% and difficulty in breathing 11.1%. The respondents of gas/electricity group also complained about same health hazards but they were less aware of the problems. Both the group had fairly comparable level of perception of prevention of hazards of biomass fuel ( $p > 0.05$ ), except that a significantly higher proportion of biomass group (12.2%) told that the problem could be avoided by using kerosene stove compared to the gas/electricity group (1.2%).

**Key words:** Health hazards, biomass fuel, gas/electricity fuel

### Introduction

Indoor air pollution from biomass smoke is now regarded as public health hazard in the developing world, where more than two billion people still rely on the use of solid biomass fuels such as, dung, wood, crop residue and coal for cooking daily meals and heating homes. About half of the world's households still use unprocessed solid fuels, ranging near zero in developed countries to more than 80% in the

regions such as China, Indian sub-continent and Sub-Saharan Africa<sup>1</sup>. In rural areas of Bangladesh, a vast majority of rural households use biomass fuel for daily cooking and heating purposes (particularly in winter season) and are at risk of developing diseases associated with unprocessed fuels. However, excepting a few small scale studies, no national level study has yet been conducted in Bangladesh to ascertain the

risk associated with exposure to biomass smoke and development of diseases particularly respiratory illness<sup>2</sup>. The researchers, donors and policy makers have failed to comprehend the significance of relationship of exposure to indoor air pollution and increased risk of acute respiratory tract infection in childhood, and chronic obstructive pulmonary diseases in adults. Hence, their adverse effects on health have been somewhat neglected<sup>3,4</sup>. Bangladesh is a poor, developing country, situated in the tropical zone with monsoon and high humidity which plays a vital role to keep the population indoor. Almost two-thirds of the population of Bangladesh is in rural areas and almost half of them are female. Most of them have poor living conditions and almost all of them use poorly ventilated kitchens or cooking space. They do not have access to cleaner forms of fuel such as Natural Gas/LPG or electricity and only few can afford to have kerosene for cooking and heating purpose; instead they stick to their age old tradition of using biomass fuel for cooking and heating purposes as such biomass fuel has become the part and parcel of their lives. There are reports from a number of studies in India<sup>5,6,7</sup> and Nepal<sup>8,9</sup> stating representative levels of air pollution in rural households and the physical and social factors that lead to these exposures in their countries. By far there are only few data from rural areas of Bangladesh which relate smoke exposure from biomass fuel combustion to the prevalence of respiratory diseases. Therefore, the present study was aimed to see and compare the prevalence of respiratory disease and knowledge of the health hazards and perception of prevention of hazards among female biomass fuel users and gas/electricity fuel users in a Bangladeshi population.

### Methods

The present study was a cross-sectional comparative study, conducted from March to June 2007, in Madla, a rural area under Bogra District, which is approximately 5 km far from Bogra city and in Thanthania, an urban area having good communication facilities. There were no industries in the surrounding area and as such the areas were devoid of industrial pollution. The study population was divided into two groups:

**Biomass fuel group:** Adult female household members residing in rural area, associated with daily cooking using biomass fuel at least for the last 3 years were included in biomass group.

**Gas/electricity fuel group:** Adult female household members residing in urban areas, associated with daily cooking using either gas or electricity at least for the last 3 years were assigned to gas/electricity group. A total of 103 females from the rural households meeting the defined enrollment criteria for biomass fuel group were selected purposively as cases, while 101 females from the urban households meeting the defined eligibility criteria for controls were included in gas/electricity fuel group.

All respondents of both groups were selected purposively. A structured questionnaire addressing all the variables of interest was developed. The questionnaire was pre-tested and modified and finalized according to the feedbacks received from field-testing. Collected data were checked and compiled and statistical analyses were done by using SPSS version 11.0. Both descriptive and inferential statistics were used in the process of data analysis. Chi-square (2) test was done and the level of significance was set at 0.05.

### Results

Of the 204 female respondents, the age categories were almost identically distributed between gas/electricity and biomass fuel groups with 25-30 years category occupying over one-quarter (25%) of the total in each group. Majority (87.1%) of the gas electricity group and 60.2% of the biomass group were Muslims ( $p < 0.001$ ). The groups did not differ in terms of number of family members, although, frequency 2-4 membered families were a bit higher in the biomass group (70.9%) compared to that in the gas/electricity group ( $p = 0.063$ ) (Table-I). A significantly higher proportion of the respondents in the biomass group (43.7%) was found to be illiterate, where as secondary and higher secondary educated formed the main bulk in Gas/electricity group (76.2%) ( $p < 0.001$ ). Distribution of occupation shows that respondents were predominantly housewife in

both groups. However, service-holders were much higher (15.8%) in the gas/electricity group than that in the biomass group (1.9%) ( $p=0.001$ ). Agriculture work was the prime occupation of the respondents' husbands in the biomass group (43.1%), while service was the main job in the gas/electricity group (49%) ( $p<0.001$ ). Majority of the gas/electricity group (97%) had a monthly income 5-10 thousand Bangladeshi Taka compared to 52.4% of the biomass group ( $p<0.001$ ). In terms of housing too the groups were found to differ with 83.3% of the former group occupying a pacca house compared to only 8.9% of the latter group ( $p<0.001$ ) (Table-I). Nearly 70% of the biomass fuel users used wood for the daily cooking and heating purposes, 64% leaves, 31.1% cow dung, crop residue 30.1% and 7.8% saw-dust (Fig. 1). The biomass group exhibited a significantly higher frequency of respiratory problem (16.5%) compared to their gas/electricity counterpart (5%) ( $p=0.008$ ) (Fig. 2).

When asked about the health hazards of biomass fuel, 71.8% of the respondents of biomass group opined that it was injurious to health, where as 53.1% of the gas/electricity group held the same view. Further asking about the health consequences of biomass fuel, 67.5% of the biomass group complained of eye problem followed by cold 36.1%, headache 33.8%, cough 13.9% and difficulty in breathing 11.1%. The respondents of gas/electricity group also complained about same health hazards but they were less aware of the problems in comparison to the biomass group (Table-II). Besides, both the group had fairly comparable level of knowledge about prevention health hazards of biomass fuel ( $p>0.05$ ), except that a significantly higher proportion of biomass group (12.2%) told that the problem could be avoided by using kerosene stove compared to the gas/electricity group (1.2%) ( $p=0.001$ ) (Table-III).

**Table-I:** Socio-demographic characteristics of the respondents

Sociodemographic variables	Group		p-value
	Gas/Electricity (n = 101)	Biomass (n = 103)	
Age (yrs)			
<25	13(12.9)	25(24.3)	0.178
25-30	24(23.8)	27(26.2)	
30-35	20(19.8)	12(11.7)	
35-40	18(17.8)	15(14.6)	
≥ 40	26(25.7)	24(23.3)	
Religion			
Muslim	88(87.1)	62(60.2)	<0.001
Hindu	13(12.9)	41(39.8)	
Education			
Illiterate	3(3.0)	45(43.7)	<0.001
Primary	7(6.9)	23(22.3)	
Secondary & higher	77(76.2)	33(32.0)	
Graduate/post graduate	14(13.9)	2(1.9)	
Respondent's occupation			
House wife	85(84.2)	95(92.2)	0.001
Small business	00	4(3.9)	
Farming	00	2(1.9)	
Service	16(15.8)	2(1.9)	
Husband's occupation			
Agriculture work	4(4.0)	44(43.1)	0.001
Service	49(49.0)	18(17.6)	
Small business	42(42.0)	33(32.4)	
Others	5(5.0)	7(6.9)	
Family income (BD)			
<5000	3(3.0)	49(47.6)	<0.001
5000-10000	98(97.0)	54(52.4)	
Housing condition			
Pacca	84(83.2)	9(8.9)	<0.001
Semi pacca	16(15.8)	42(41.6)	
Thatch	1(1.0)	50(49.5)	

Data was analyzed using Chi-square (2) test; figures in the parentheses denote percentage.

**Table-II:** Comparison of knowledge about health hazards of biomass fuel

Knowledge about hazards	Group		p-value
	Gas/Electricity (n = 98)	Biomass (n = 98)	
Injurious to health	51(53.1)	74(71.8)	0.006
Cold	19(37.3)	26(36.1)	0.897
Cough	7(13.7)	10(13.9)	0.979
Difficulty of breathing	6(11.8)	8(11.1)	0.910
Headache	23(31.9)	25(33.8)	0.056
Eye problem	27(51.9)	50(67.5)	0.036

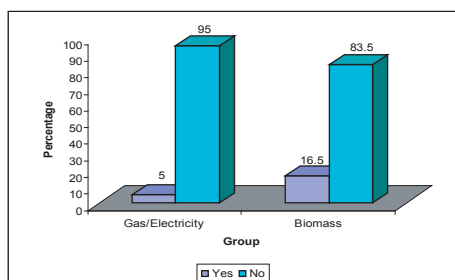
Data was analyzed using Chi-square (2) test; figure in the parentheses denoted corresponding percentage.

**Table-III:** Perception of prevention of health hazards

Perception of prevention	Group		p-value
	Gas/Electricity (n = 98)	Biomass (n = 98)	
By electricity	13(27.7)	11(19.6)	0.338
By gas	22(46.8)	36(63.2)	0.095
By Kerosene cooker/stove	1(1.2)	10(12.2)	0.001
By coal	1(2.1)	1(1.8)	0.890
By healthful kitchen	17(36.2)	19(32.8)	0.714

Data was analyzed using Chi-square  $\chi^2$  test; figure in the parentheses denoted corresponding percentage

**Fig. 1:** Type of biomass fuel used by study participants



**Fig. 2:** Comparison of respiratory problems between groups

**Discussion**

To the best of our knowledge, the effect of air pollution by different kinds of fuel such as wood, crop residue, cow-dung and gas etc. is yet to be surveyed in Bangladesh by any agency/institution. Use of the biomass fuel is common and over 95% of the rural households in this country are using such fuel. Due to poverty as well as lack of knowledge people are compelled to use such low quality fuel, which is causing ill health effects especially respiratory problems. In this country, as women are exposed to such situation, they are the worst sufferer. Kim et al.<sup>10</sup> reported that the users of biomass fuels used them on the basis of availability and affordability. Crop residues were most randomly used (71.3%) followed by leaves (52%), wood (34.7%) cow-dung (17.3%) bearing consistency with findings of the present study.

Pandey<sup>8</sup> reported that prevalence of chronic bronchitis in female increased with duration of time spent per day for cooking which corresponds' with the present finding showing 47.1% of asthma-like symptoms and 23.5% of bronchitis-like symptoms among the respondents who had spent more than 6 hours in cooking daily. Similarly 42.9% had asthma-like symptoms and 25% had bronchitis-like symptoms amongst the group of respondents who had 5-6 hours of daily exposure. The above disease symptoms tend to reduce with shorter daily cooking time.

Balakrishnan<sup>7</sup> et al. measured respirable particulate matters in four districts of Tamil Nadu, a coastal state in Southern India. During the survey period temperature varied from 24°C to 36°C and agriculture was the main occupation. The socio-economic background and dietary habits were very much similar. The study result showed that 90% of household used biomass fuel. Firewood was the most common fuel used. 36% of the biomass fuel users had indoor kitchens without partition while 30% had separate kitchens. Respirable dust was measured and the 24-hour exposure for women cooks using biomass fuel was significantly higher than for those using clean fuels and non-cooks.

Perez-Padilla et al.<sup>11</sup> investigated the relationship between older females (more than 40 yrs) with chronic bronchitis and chronic airway obstruction (CAO) and exposure to biomass fuels. They reported causal role of domestic wood smoke exposure for chronic bronchitis and CAO.

Shrestha<sup>9</sup> demonstrated that Nepalese household kitchens using biomass fuels in traditional clay stoves for cooking were highly polluted with smoke. The mean smoke level (PM10) in kitchens was about three times higher than that in those using cleaner fuels (kerosene, LPG and biogas). Biomass fuel caused significantly more respiratory disorders than did cleaner fuels. The prevalence of respiratory illness and symptoms were considerably higher in those living in mud and brick houses compared with concrete houses which is not consistent with the findings of the present study as expected (p = 0.305).

Albalak et al.<sup>12</sup> studied in two Bolivian villages and the result of the study suggests an association between chronic bronchitis and

exposure to domestic biomass fuel combustion. Mishra<sup>6</sup> stated that women living in household using biomass fuel have significantly higher prevalence of asthma than do those living in households using cleaner fuels. Uzun et al.<sup>13</sup> investigated whether biomass fuel was a potential risk for chronic bronchitis and asthma among the females in five villages of Van, East Turkey. It was found that mean age of biomass fuel was 41 years and that of non-biomass fuel users were 33 years. Thirty three percent of biomass fuel users were smokers and twenty nine percent of non biomass fuel users smoked. Over 60% of the biomass fuel users had asthmatic symptoms compared to only 12.9% of non-biomass fuel users. Biomass fuel users reported more cough symptoms than their counterparts.

The biomass fuels are composed of complex organic matter- vegetable proteins and carbohydrates - incorporating carbon, nitrogen, oxygen, hydrogen, and certain other elements in trace amounts. Their combustion often produces substances harmful to human health, such as a range of polycyclic hydrocarbons not found in the fuels themselves<sup>10,14,15</sup>. Biomass fuel emissions present a health hazard effects of which vary in type and severity depending on the local situation, the type of fuel used, and the populations at risk<sup>3,4,14</sup> in our country, biomass fuels are used mostly by women in cooking stoves with open combustion without any combustion chamber. Hence, women seem to be the principal sufferers from such smoke in our country because of their role as the family cook as is the usual practice in most of the other countries. Long term and excessive exposure to biomass smoke cause significant health problem in the same degree as those who are exposed to cigarette smoke and active cigarette smokers<sup>10,14,15</sup>.

### Conclusion

It was found that smoke generated from biomass fuel combustion was a significant risk factor for respiratory problems among the female household members who, by tradition, are associated with cooking activities and are not able to quit due to poverty, unavailability of facilities and partly out of ignorance. More public health awareness campaigns need to be designed by the health and other concerned authorities to inform people about the risks of exposure to cooking smoke.

### References

1. Smith KR. Indoor air pollution in developing countries recommendations for research. *Indoor Air* 2002; 12: 198-207.
2. World Health Organization. The health effects of indoor air pollution exposure in developing countries. *Protection of the Human Environment*. Geneva, Switzerland: 2002.
3. Bruce N, Perez-Padilla R, Albalak R. Indoor air pollution in developing countries: a major environmental and public health challenge. *Bull World Health Organ* 2000; 78(9): 1078-92.
4. Brown LR. Assessing the planet's condition. *Epa J* 1990; 16(4): 2-6.
5. Behera D, Jindal SK. Respiratory symptoms in Indian women using domestic cooking fuels. *Chest* 1991; 100(2): 385-8.
6. Mishra V. Effect of indoor air pollution from biomass combustion on prevalence of asthma in the elderly. *Environ Health Perspect* 2003; 111(1): 71-8.
7. Balakrishnan K, Parikh J, Shankar S, et al. Daily average exposure of respirable particulate matter from combustion of biomass fuels in rural households of Southern India. *Environ Health Perspect* 2002; 110(11): 1069-75.
8. Pandey MR. Domestic smoke pollution and chronic bronchitis in rural community of the hill region of Nepal. *Thorax* 1984; 39(5): 337-9.
9. Shrestha IL, Shrestha SL. Indoor air pollution from biomass fuels and respiratory health of the exposed population in Nepalese households. *Int J Occup Environ Health* 2005; 11(2): 150-60.
10. Kim K-H, Jahan SA, Kabir E. A review of disease associated with household air pollution due to the use of biomass fuels. *J Hazard Mater* 2011; 192(2): 425-31.
11. Perez-Padilla JR, Regalado-Pineda J, Moran-Mendoza AO. The domestic inhalation of the smoke from firewood and of other biological materials: a risk for the development of respiratory diseases. *Gac Med Mex* 1999; 135(1): 19-29.
12. Albalak R, Frisancho AR, Keeler GJ. Domestic biomass fuel combustion and chronic bronchitis in two rural Bolivian Villages. *Thorax* 1999; 54(11): 1004-8.
13. Uzun K, Ozbay B, Ceylan JE, et al. Prevalence of chronic bronchitis-asthma symptoms in biomass fuel exposed females. *Environ Health Prev Med* 2003; 8(1): 13-7.
14. de Koning HW, Smith KR, Last JM. Biomass fuel combustion and health. *Bull World Health Organ* 1985; 63(1): 11-26.
15. Smith KR. Biomass fuels, air pollution and health: a global review. New York: Plenum Press; 1987.