Prevalence of Biomass Use and its Effect on the Respiratory Health of Women Residing in Eastern Terai Region of Nepal

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ABSTRACT

Introduction: Nearly one-third of the world's population and three-quarters of rural households in developing countries still rely on unprocessed biomass fuel such as wood, cow-dung, and crop residues for cooking and heating. According to the World Health Organization, Indoor Air Pollution (IAP) from burning of biomass fuel has emerged as one of the top ten global threats to public health, as it accounts for 2.7 % of the global burden of disease. This study aimed to find out the prevalence of biomass use in the study area and the respiratory health problems associated with it in women.

Methods: A descriptive cross-sectional study was conducted among women (18+ age) in a rural population (n = 415), exposed to biomass smoke. A semi-structured questionnaire was used along with an observation checklist. Data was entered in MS Excel and analysis was done using SPSS 11.5.

Results: The prevalence of biomass use was 98.8%. The most common respiratory problems were cough (14.7 %) followed by phlegm (9.9%). Respiratory problems were significantly higher in people using leaves/straws as biomass fuel (p=0.034).

Conclusion: Prevalence of respiratory symptoms is definitely higher among women using biomass smoke. There was no outlet for smoke in the kitchen among the rural women in our study thus provision for smoke vents is recommended.

Keywords : Biomass; Cough; Indoor air pollution; Phlegm; Respiratory problems.

INTRODUCTION

Almost half of the world populations rely on biomass fuels (BMF) for cooking, heating and lightning purpose. Household air pollution (HAP) from incomplete combustion of BMF is now understood to be a major risk factor for adverse health outcomes.[1] According to the 2016 Global Burden of Disease Study (GBD), HAP is ranked as the single most significant environmental health risk factor globally. It accounted for 2.6 million deaths and 77.2 million disability-adjusted life years (DALYs) in year 2016[2], with greater than 99% of death occurring in low- and middle-income countries.[3] The health effect ranges from cardiovascular, respiratory, neurocognitive and reproductive health effect. The most important one is cardiovascular and respiratory health effect.[4, 5, 6] Recent estimates are that 3 billion people rely on biomass fuels for domestic purposes.[7] There are many reasons why biomass fuels are used. In developing countries where poverty is prevalent, burning biomass fuels is a cheaper alternative compared to liquefied petroleum gas or electricity. Also, biomass fuels are more accessible, especially for people living in rural places.[8,9] In Nepal, by 2011, the share of solid-fuel users had barely declined and about two-thirds of the country's population were still primarily reliant on firewood for cooking. Total of 74% of households were still the primary users of solid fuels overall and this fraction rose to 86% in rural areas.[12] The housing structure is very vulnerable for Indoor Air Pollution (IAP) because 70% households have wooden and mud bonded house with poor ventilation.[13] In developing countries women and children have the

highest biomass smoke exposure due to cultural practices such as indoor cooking in housing with very poor air ventilation.[10,11] According to WHO, women exposed to high level of indoor smoke are 2.3 times more likely to suffer from respiratory disease like COPD than those who use cleaner fuel.[14] In Nepal the studies related to use of biomass fuel and Indoor Air Pollution (IAP) are very less and its prevalence has not been clearly found out. Identification of the problems and magnitude of IAP is very important to minimize the burden of health and environmental issues. Therefore, the study aims to find out prevalence of the biomass use and assess the respiratory health problems among women.

METHODS

A Descriptive cross-sectional study was conducted with a women of age group >18 years and who were involved in cooking and were selected from Babiya, & Jalpapur VDC. There are 1,545 households in Babiya VDC with a total population of 8,526 of which 4,306 are females. There are 1,066 households in Jalpapur VDC with a total population of 6,633 of which 3,386 are females. Within these VDC's two wards with more than 400 households were selected randomly. Unit of study was the household which was selected using systematic random sampling method. Every second house was selected as a sample unit. Women of age group >18 years and involved in cooking for at least 5 years & living in study area for at least 1 year were included. An interviewer-administered semi-structured questionnaire was used to collect data on biomass smoke exposure, smoking, socio-economic status, literacy, history of fuel use, and respiratory symptoms. The questionnaire was based on the British Medical Research Council pattern. Tuberculosis being a major disease in our community, was added in the questionnaire. Written informed consent was obtained from all study participants. The sample size was calculated according to prevalence of respiratory problem which was reported to be 30% according to a study done by SEAM-N (Strengthening of Environment Administration and Management at local level in Nepal). Considering 95% Confidence Interval and 85% Power, the estimated sample size came out to be 415. Data was entered in MS Excel and analysis was done using SPSS 11.5. For Descriptive Variables, data was analyzed by calculating percentage, mean with standard deviation and median.

RESULTS

Socio-Demographic Profile

A total of 415 females were interviewed. The mean age of study population was 30.50 years with SD ±9.86 with a 32.5 % literacy rate. 94.9%of women were married. More than half of the women were Muslims (56.4%) and lived in nuclear family (60%). Regarding occupation of the respondents 91.4% of the total women were housewife, 2.4% were farmers, 1.9% were unemployed, 1% were involved in business, 1.2% were laborers 0.5% were working in office (Table 1).

Table 1: Socio-demographic Data

Characteristic	Category	No. of Respondents	Percentage (%)
Age	Below 20	55	13.3
	21 – 30	212	51.1
	31 – 40	108	26.0
	41 – 50	24	5.8
	51 – 60	10	2.4
	61 – 70	6	1.4
Ethnicity	Brahmin/ Chettri	43	10.4
	Terai/Madhesi	112	27.0
	Dalits	26	6.3
	Muslim	234	56.4
Marital Status	Single	14	3.4
	Married	394	94.9
Employment	Self-employed	6	1.4
	Housewife	379	91.3
	Unemployed	8	1.9
	Farmer	10	2.4
	labour	5	1.2
Educational status	Illiterate	280	67.5
	Primary school	62	14.9
	Secondary school	59	14.2
	High school	12	2.9
Type of Family	Nuclear	249	60.0
	Joint	123	29.6
	Three generation	43	10.4

Specific Biomass Exposure Data

about 49% participants use traditional mud stove with 79% using firewood, 91.6% using cow dung, 57.1% using leaves and straw biomass fuel. Among them, there were few people who uses improve smokeless type of stove for cooking purpose. None of participant used blowing pipe and did not have exhaust fan/smoke vent in the kitchen. 87% of the women spent 2-5hrs cooking each day. On being interviewed 79.28% responded that, they use traditional mud stove instead of smokeless as it is

cheap and more convenient to use. They also said that it was too costly or did not know how to use LPG stove. The women who were uneducated and who were below poverty line were significantly more liable to use biomass fuel (Table2).

Table 2: Specific Biomass Exposure Data

Characteristic	Category	No. of Respondents	Percentage (%)
Kitchen Fuel	Firewood	328	79.0
	Cow dungs	380	91.6
	LPG	43	10.4
	Leaves and Straws	237	57.1
Cause of Fuel	Non-Availability of other fuel	3	0.72
	Being cheap and convenient	329	79.28
	Not able to afford modern fuel	86	20.72
	Others	71	17.11
Type of Stove	Three stone	0	0
	Traditional mud	410	98.8
	Improved smokeless	23	5.5
Cooking Hours	<2	5	1.2
	2-5	361	87.0
	>/= 5	49	11.8

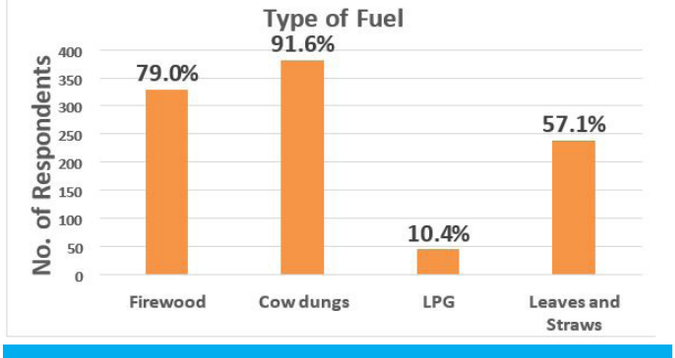

Figure 1: Types of Kitchen Fuel

Among all types of the kitchen fuel, the major kitchern fuel was found to be the cow dung (91.6%) followed by the firewood (79%), leaves and straws (57.1%) and lastly LPG (10.4%). The result shows thet the number of the respondents comes in contact with all those fuel that can create the respiratory problems.

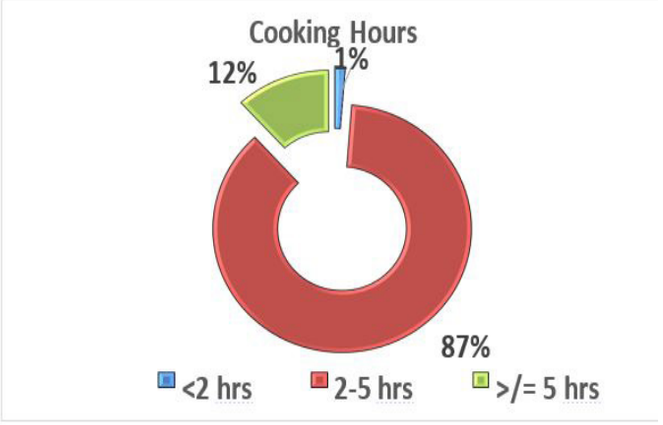

Figure 2: Time spent cooking per day

Majority of the respondents total time spend whille cooking was 2-5 hours per day where as 12% of the respondents spend more than or approximately five hours in the kitchen for coooking and only one percent respondents cook less then two hours a day.

Association between Kitchen fuel and Respiratory Symptoms

Out of 415 women in study, 88 women (21.2%) had respiratory problem where 328 women use firewood as the source of fule at their homes. Among the 415 women who uses LPG as the source of fuel has been having less respiratory problems. Respondents use firewood, cow dung, LPG, leaves/stem as kitchen fuel. Out of various kind of kitchen fuel used respiratory problem were significantly higher in women using leaves/straw (P=0.034). However, there was no association between respiratory symptom and use of other fuel (cow dung, firewood and LPG) (Table 3).

Association between usage of different kinds of kitchen fuels and respiratory health problems

Among all the respiratory problems Cough, Phlegm, Wheeze, Breathlessness and Chest illness was seen as the major problem. Only the association that were seen in this study where the leaves and straws with cough which shows 61 women had cough symptoms while cooking (p=0.010) and with firewood, cowdung, LPG, leaves/steams with p-value (p-=0.001). Moving towards the Phlegm the association was ssen with the leaves and straws where 41 women has phlegm with the p-value (p=0.012). Among all the 415 respondents the association with leaves and straws was seen with the wheeze where 389 respondents doesnot have any problems where 26 of the respondents has the wheeze(p=0.012) (Table 4).

Table 3: Overall Respiratory Symptoms

Characteristics	Category	Respiratory Problems			P-Value
		Yes	No	Total	
Firewood	Yes	70(21.34)	258(78.66)	328	0.895
	No	18(20.70)	69(79.30)	87	
Cow dung	Yes	82(21.58)	298(78.42)	380	0.539
	No	6(17.14)	29(82.86)	35	
LPG	Yes	12(27.90)	31(72.10)	43	0.256
	No	76(20.43)	296(79.57)	372	
Leaves and Straws	Yes	59(24.90)	178(75.10)	237	0.034*
	No	29(16.29)	149(83.71)	178	

Table 4: Association between usage of different kinds of kitchen fuels and respiratory health problems

Characteristics	Category	Cough			P-Value
		Yes (n=61)	No (n=354)	Total	
Leaves and Straws	Yes	44(18.56)	193(81.44)	237	0.010*
	No	17(9.55)	161(90.45)	178	
Firewood, cow-dung, LPG and leaves/stem	Yes	7(50)	7(50)	14	0.001*
	No	54(13.46)	347(86.54)	401	
Leaves and Straws		**Phlegm**			0.012*
		Yes (n=41)	No(n=374)	Total	
	Yes	31 (13.08)	206 (86.92)	237	
	No	10 (5.6)	168 (94.38)	178	
Leaves and Straws		**Wheeze**			0.012*
		Yes (n=26)	No(n=389)	Total	
		21(8.9)	216(91.1)	237	
		5(2.8)	173(97.2)	178	

DISCUSSION

Use of biomass for cooking purposes is calculated by adding up the proportion of households that reports the use of firewood, cow dung, leaves and straws as cooking fuel which is also significantly high in our study. It is seen that 82.6% of rural people use biomass which was shown by study done by[15] and similarly this study also has 98.8% prevalence of use of biomass fuel.

A study done by Babalik A et. al.[16] reported, wood (92%), animal dung (30%), charcoal (23%), and dry plant (23%) used as biomass fuel. This study also showed that cow dung (91.6%), firewood (79%), leaves and straws (56.1%) were used as biomass fuel. A study done by Deepak et. al.[17] reported that 89.5% used traditional mud. Similarly, our study also showed 98.8% of the women using traditional mud.

The major source of cooking is found to be biomass fuel among family that fall under poverty line and people with low literacy rate especially in rural setting. According to various studies biomass use has been proven to be used more by people who are illiterate and of low socio economic status. A study done by Ranabhat et. al. showed that (81.5%) biomass was a major source for fuel among households who were under poverty level.[18] Similarly, our study also shows that biomass fuel use was high among people who were illiterate (67.5%) and were below poverty line (78.6%). One of the reasons for increased use of 27 biomass fuel was that it is cheap and more convenient for 79.28% participants in the study.According to a study done by Ranabhat et. al. showed 87.3% use biomass as a cooking fuel, Difficulty in breathing, cough and

phlegm had significant association with the use of biomass smoke.[18] Similarly, in the study the use of biomass has a proportional effect in respiratory problem. As there is increase in the use of biomass it is directly proportional with increase of respiratory problem. Ranabhat et al. reported prevalence of cough with phlegm 19.7%, difficulty in breathing 27.3% and asthma 8.9 in a study done in Terai and Hills of Nepal.[18] This study also shows similar kind of prevalence of cough 14.7%, phlegm 9.9%, cough and phlegm 3.9%, breathlessness 2.7%, wheeze 6.3% and chest illness 6% among cooking women of family who were involved for more than 5 years in kitchen. The variation with result of breathlessness could be due to high number of sample used in study done by Ranabhat et al. Behena and Jindal reported that different respiratory symptoms is present according to type of fuel use.[19] Similarly this study also shows high incidence of respiratory problems like cough, phlegm, wheeze, breathlessness among women who use leaves and straws rather than other kind of biomass fuel which are firewood, cow dung, LPG, which might be because wet leaves and straws emit thick smoke to hamper respiratory health. Respiratory problem was found to be increased among women who smoked more than five pack years of cigarette. This could be because of the synergistic effect of biomass and tobacco on respiratory health.

CONCLUSION

Biomass smoke is a major source of indoor air pollution. In our society, due to customary involvement of women in cooking, they are more exposed to it which results in respiratory problems. From this study we found that majority of the respondents were housewives of the age group between 21-30 years. Majority (98.8%) of the participants were exposed to biomass smoke. Traditional mud type of stove was most commonly used for cooking purposes with cow dung being the major kitchen fuel. Illiteracy and poor economic status were the main cause of using biomass fuels. Most common respiratory symptoms seen was cough (14.7%) followed by phlegm (9.9%). A positive association between respiratory symptoms and usage of leaves/stems as kitchen fuel was found. However significant association with other biomass fuels was not found. The current study, attempted to know the prevalence of biomass exposure among the respondents. Prevalence of respiratory symptoms is definitely higher among women using biomass smoke. There was no outlet for smoke in the kitchen among the rural women in our study thus provision for smoke vents is recommended. For reduce the exposure to biomass smoke proper home ventilation, home design and if possible change of biomass to cleaner fules is recommended.

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