

# A Cross-Sectional Study on Households fuel Consumption and its Health Effects among the Women in Rural area under RHTC, Annaram

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## ABSTRACT

**Background:** Bio-mass fuel usages is responsible for causing several adverse health effects on the population and associated with an increase morbidity and all-cause mortality both in adults and children. Hence the objective of present study is to evaluate the prevalence and usage of household fuel consumption and its associated health effects among women exposed to smoke.

**Materials and Methods:** A cross sectional study was conducted during october 2017 to March 2018 among women residing in rural field practice area. A semi-structured questionnaire consisting of socio-demographic characteristics, questions related to housing and kitchen characteristics, type of fuel use and associated morbidities was administered to 494 women of study area.

**Results:** Among study participants, majority 236 (47.8%) were using exclusively biomass fuels as the primary source of cooking fuel, while about 184 (37.2%) were exclusively using non- biomass fuel and 74(15%) were using mixed fuels. Out of 494 respondents, about 124 (25.1%) respondents experienced the various morbidity symptoms during the cooking process.

**Conclusion:** It was observed that still there was widespread use of biomass fuel and the major morbidities were reported among the bio-mass users compared to the non -biomass users in study area. Rural residents have limited knowledge about indoor air pollution and its related health effects and the government can disseminate information on the source of indoor air pollution through health education and hygiene education, adoption of cleaner sources of energy and reducing household air pollution exposure by improving ventilation particularly in rural areas.

**Keywords:** House hold fuels, health effects, women, rural

## INTRODUCTION

Household air pollution is an important and poverty-related global health problem. The Global burden of Disease study suggests that every year about 3.5 million people die as a consequence of house hold air pollution. Recent analysis estimates that globally almost 2.8 million people use solid fuel as their main source of fuel for cooking. Bio-mass fuel are the largest sources of house hold air pollution worldwide; solid fuels are used extensively for cooking and home heating in developing countries, especially in rural areas.<sup>[1]</sup>

Cooking in a household involve the use of solid fuel and

nonsolid fuel.<sup>[2]</sup> The solid fuel consists of coal which is a fossil fuel and biomass fuel (BMF), the fuel that has come from any recently living plant or animal based material including charcoal, cow dung, wood and crop residues. Globally, more than three billion people depend on solid fuels, including biomass (wood, dung and agricultural residues) and coal, to meet their most basic energy needs: cooking, boiling water and heating, while the nonsolid fuel consists of kerosene, liquefied petroleum gas (LPG) and electricity.<sup>[2,3]</sup>

In India, out of 0.2 billion people using fuel for cooking; 49% use firewood; 8.9% cow dung cake; 1.5% coal, lignite, or charcoal; 2.9% kerosene; 28.6% liquefied petroleum gas

(LPG); 0.1% electricity; 0.4% biogas; and 0.5% any other means. [4]

Smoke from burning of some solid fuels has been associated with indoor pollution and unsafe levels of toxic emission. [5] In addition, these BMF usages is responsible for causing several adverse health effects on the population and associated with an increase morbidity and all-cause mortality both in adults and children. [6] Combustion of Bio-mass fuel in the household through the cooking and heating process which often takes place in poorly designed and ill maintained stoves with no chimney for removing emissions and with poor ventilation leading to release of high levels of noxious chemicals.

Exposure to these substances leads to increased risk of a variety of diseases including acute respiratory infections (ARI), chronic obstructive pulmonary disease (COPD), asthma, diseases of the eye such as cataract and blindness, low birth weight and other associated neonatal conditions. It was recognized that there was an inverse relationship between the cost and efficiency of different types of fuel, such that the most efficient fuel type, electricity, is the most expensive whereas the least efficient fuel types (firewood, crop residues and animal dung) are the cheapest and most easily available to the low income households.

In the developing world, the association between household air pollution and COPD is an important part of the emerging epidemic of non-communicable diseases. [7] The economic burden of managing a chronic respiratory condition resulting from exposure to household pollution in a poor resource setting is huge therefore, it's important to target on the preventive measures.

For an effective prevention and intervention against indoor pollution from household fuel, there is a need to identify the pattern of household cooking fuel and the various factors that influence the choice of household cooking fuel. Despite this, there are limited studies describing the choice and pattern of biomass fuel use and a very few studies are available examining the impact of household air pollution on health effects of population, So therefore further studies on assessing the various risk factors are needed to plan preventive strategies for non-communicable diseases.

The importance of this study therefore is that, it will provide base line information, which will enable us to address household air pollution – associated communicable and non-communicable diseases more effectively.

Hence the objective of the present study is to evaluate the prevalence and usage of household fuel consumption and its associated health effects among women exposed

to domestic smoke in the study area.

## MATERIALS AND METHODS

A community based cross-sectional study was conducted during October 2017 to March 2018 among the women residing in rural field practice areas of the Department of Community Medicine. The Rural Health Training Centre (RHTC) is located at Annaram and the serving area includes five villages (Golepally, Lalithapur, Ellampally, Sadasivapally and Srinivas nagar) of total population 5064. As per village health survey, conducted by RHTC a list of all women 1109 in the area was prepared. One who was involved in the daily cooking process for each household (877 in total women) agreed to participate in our study. Among them, 494 women who met the inclusion criteria were included.

A semi-structured questionnaire was used to gather data. The study protocol was approved by the Institutional Ethics Committee of the Institution. The purpose of the study was explained and written and signed informed consent was obtained. Before proceeding to the main study a pilot study was conducted among 100 women and then necessary correction were made in the proforma. Data was analyzed by using Microsoft excel and statistical measures obtained were numbers and percentages.

### *Inclusion criteria*

1. Women aged 15 years and above having regular or daily cooking practice for at least 3 years.
2. Residents in the study area for at least one year.
3. Those were willing to participate in the study and able to give informed consent.

### *Exclusion Criteria*

1. Women not available at the time of data collection after frequent visits.
2. Unwilling to participate in the study.

## RESULTS

The socio-demographic characteristics of the respondents are depicted in table 1. The mean age of the respondents was  $40.93 \pm 15.24$  years and majority 139 (28.1%) was between the age group of 25-35 years. Most of them were 307 (62.1%) illiterate, while 67 (12.3%) had primary education. As per Modified B.G. Prasad socio-economic status scale, majority 205 (41.4%) were belonging to upper lower class. Among the study participant, about 469 (94.9%) were married.

Majority 202 (40.9%) of the study participants were home maker, hence exposure is particularly high among those women and young children, who spend most of their time near the domestic stove. About 124 (25.1%) of respondents

were aware of the adverse effects of the house-hold fuel exposure.

Table-2 represents the housing standards and kitchen characteristics of the respondents. The maximum 238 (48.2%) of respondents were residing in pucca houses and only a few 65 (13.2%) were having kuccha houses. Most of the participants 262 (53.0%) were residing in houses with 1-2 rooms. About 224 (45.3%) of the participants have an indoor kitchen without partition in the house and only a few 20 (4.1%) were having an outdoor kitchen.

Our study findings also found that different types of stoves were used by the respondents, most commonly used was traditional stove 100 (20.3%), improved stove with chimney 136 (27.5%) followed by Kerosene stove 54 (10.9%). Around 204 (41.3%) of respondents were LPG stoves in the study area. About 184 (37.2%) respondent's were found to have no proper ventilation. Regarding the duration of exposure to smoke about 194 (39.3%) were exposed to smoke more than 10 years, while around 46(9.3%) were exposed for less than 5 years of duration. A maximum 203(41.1%) were exposed to smoke for more than three hour per day.

Table-3 shows the type of fuel consumption among the respondents. Among study participants, majority 236 (47.8%) were using exclusively biomass fuels as the primary source of cooking fuel, while about 184 (37.2%) were exclusively using non- biomass fuel and 74 (15%) were using mixed fuels. Among bio-mass users, majority were using wood 252 (81.3%) followed by cow dung 44 (14.2%) and crop residues 14 (4.5%), whereas the LPG 204 (79.1%) was dominant fuel among the non-biomass users. None of the participants were utilizing the electricity for domestic purpose in the study area.

Table-4 presents the reasons given by the participants for using the specific types of fuel consumption for household purposes. The majority of the respondents in the study have given multiple responses and among the bio-mass users the easily availability of fuel 164 (52.9%) was considered as the most common cause by followed by the low fuel price 84 (27.1%) whereas able to afford the clean fuels 126 (48.8%) followed by availability of subsidy by government to BPL families 72 (27.9%) were the most common reasons reported by non-biomass fuel users. It was observed that depending upon the need and financial situation; most of the respondents are alternating their fuels.

Figure-1 represents the pie-chart distribution of morbidity profile of the respondents. Out of 494 respondents, about 124 (25.1%) respondents experienced the various morbidity symptoms during their cooking process.

Table-5 shows the comparisons of symptoms/morbidities

in different fuel users. The majority of the respondents in the study have given multiple responses. It was observed that the prevalence of non-respiratory morbid conditions was found to be more common than the respiratory symptoms among the study participants.

Furthermore, the prevalence of morbid conditions was found to be more among biomass users when compared with those who used a non-BMF, more often reported symptoms of eye irritation (17.7% vs. 9.7%), Body aches (20.9% vs. 1.6%), watering of eyes (14.5% vs. 4.0%), Dry cough (14.5% vs. 3.2%), and breathlessness (6.4% vs. 3.2%).

## DISCUSSION

A total of 494 women respondents residing in rural areas were recruited for the study who met the inclusion criteria. The present study evaluated the effect of household smoke on health of rural women exposed to different types of cooking fuels. The mean age of the respondents was  $40.93 \pm 15.24$  years and majority 139 (28.1%) was between the age group of 25-35 years.

A study conducted by Olufemi Olumuyiwa Desalu et al showed that the mean age of the participating women was  $55 \pm 10$  years and 63.6% of respondents were in the age group of 55 to 64 years.<sup>[8]</sup> In the present study, 307 (62.1%) of the respondents were illiterate and 205 (41.4%) of the studied participant's belonged to upper lower socio – economic class. While in a study conducted by Olufemi Olumuyiwa Desalu et al which revealed that (89.6%) had a low level of education and 94.1% belonged to lower socio-economic class.<sup>[8]</sup>

It was evident from the studies that biomass was the major energy source for households as compared to conventional energy sources. The main findings of the present study was that the utilization of biomass fuel 236 (47.8%) was slightly high in the study area than the non-bio-mass fuel 184 (37.2%).

The current study revealed that the majority were using wood 252 (81.3%) followed by LPG 204 (79.1%) as their source of fuel consumption for domestic purpose. None of the participant was used electricity in our study. About 74 (15.0%) of study participants, they prefer to use a combination of fuels rather than a single one based on their feasibility and availability of fuels.

A study conducted by Neeelam et al, it was observed that the, out of 760 women studied, 252 (33.2%) were using exclusively biomass fuels for cooking; 73 (9.6%) were using exclusively kerosene stove; 192 (25.3%) were using exclusively LPG and 243 (31.9%) were using mixed fuel (combination of two or more)<sup>[9]</sup> where as in a study conducted by Komala HP. et al showed the mean values

Table-1: Baseline characteristics of the respondents

Variables		Number	Percentage
Age	15-25	87	17.6
	25-35	139	28.1
	35-45	120	24.3
	45-55	53	10.7
	55-65	56	11.3
	65-75	31	6.3
	75-85	7	1.4
	85-95	1	0.2
Marital status	Married	469	94.9
	Single	25	5.1
Family type	Nuclear	416	84.2
	Joint	68	13.8
	Extended	10	2.0
Literacy	Illiterate	307	62.1
	Primary	61	12.4
	Secondary	88	17.8
	Graduate	38	7.7
Occupation	Unemployed	202	40.9
	Unskilled	198	40.1
	Semi-skilled	84	17.0
	Professional	10	2.0
Socio-economic status	Upper	79	16.0
	Middle	136	27.5
	Upper lower	205	41.5
Aware of adverse effect of household fuel exposure	Lower	74	15.0
	Yes	124	25.1
	No	370	74.9
Total		494	100

of types of fuel consumption are firewood (98.6%), animal residues (63.6%), kerosene (15.2 %) and LPG (34.4%) respectively. <sup>[10]</sup> However we can assume that economic factors played the greatest role in our study sample, since the majority of the participating respondents had a low level of education (94.4%) and were of low socioeconomic status (93.8%). The role of socioeconomic status as a determinant of the type of cooking fuel used in the household has been described in other studies in developing countries.

Regarding housing characteristics and cooking pattern it was found to be different among the households in the study area. Majority of the respondents were residing in the pucca houses 238(48.2%) while only a few were residing in the kuccha houses 65(13.1%).

In a study conducted by Vipin Bihari, the author observed

that type of houses of study subject groups were Kuccha (20.83%), Pucca (35.2%) and mixed 43.75%. <sup>[11]</sup> It was found that the most of the respondents were having an indoor kitchen without partition 224 (45.3%) for cooking while 20 (4.1%) were having outdoor kitchen. It was found that about 184 (37.2%) of houses are having poor ventilation. In a study conducted by Komala et al, observed that the majority of households cook at separate kitchen while others cook in living room and outside the house. <sup>[10]</sup>

The ventilation and chimney are most important characteristics which help in reduction of indoor air pollutants. In rural areas many households use different stoves in different times and situations and our study findings revealed that traditional stove 100 (20.3%) and improved stove with chimneys 136 (27.5%) followed by LPG stove 204 (41.3%) were the most commonly used

**Table 2: Distribution of Housing and Kitchen characteristics of respondents**

Variables		Number	Percentage
Type of house	Pucca	238	48.2
	Semi- pucca	191	38.7
	Kuccha	65	13.1
No. of rooms	1-2	262	53.0
	3-4	198	40.1
	>4	34	6.9
Kitchen Type	Indoor Kitchen with partition	198	40.1
	Indoor kitchen without partition	224	45.3
	Separate indoor kitchen outside house	52	10.5
	Outdoor / Open kitchen	20	4.1
Stove type	Stove with three stones plastered with mud/ provided with chimneys	100	20.3
	Improved stove with chimney	136	27.5
	Keroscene stove	54	10.9
	LPG stove	204	41.3
Proper ventilation	Yes	310	62.8
	No	184	37.2
Duration of exposure to smoke	< 5 years	46	9.3
	5-10 years	254	51.4
	>10 years	194	39.3
Average duration of exposure to smoke /day	<1 hour	84	17.0
	2-3 hours	207	41.9
	>3 hours	203	41.1
History of exposure to passive smoke in house	Yes	197	39.9
	No	297	60.1
History of occupational Exposure to smoke	Yes	42	8.5
	No	452	91.5
Total		494	100

**Table 3: Type of fuel consumption for domestic purpose by the respondents**

Variables		Number	Percentage
Type of fuel do you used for domestic purpose	Bio-mass	236	47.8
	Non-bio-mass	184	37.2
	Both	74	15.0
Total		494	100
If, Bio-mass (310)	Wood	252	81.3
	Crop residues	14	4.5
	Cow dung	44	14.2
If, Non bio-mass (258)	Keroscene	54	20.9
	LPG	204	79.1

Multiple responses

stoves by the respondents.

Our study findings were consistent with the study conducted by Jingwen Wu showed that traditional stove is widely used in rural areas, accounting for 79%, and second commonly used stove LPG accounting for 68%, 74% use electric stoves and 15 % inferior coal stove and

11% advanced coal stove.<sup>[12]</sup> Further there was a need for the improvement of stoves which helps in reduction of need of fire wood and also reduces the duration of exposure to smoke.

In the present study a maximum 254(51.4%) number of respondents had higher duration of exposure (5-10 years)



**Table 4: Reasons for using Type of fuel by respondents**

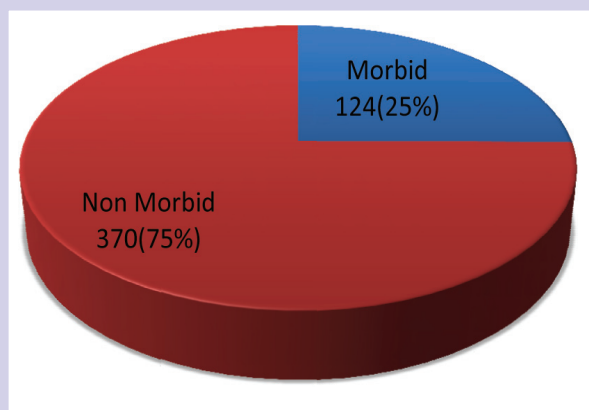
Variables		Number	Percentage
Bio-mass (Total-310)	Easily available	164	52.9
	Less cost/Not affordable to use high price fuel	84	27.1
	As alternate fuel	63	20.3
	Food tastes good/ better flavour	24	7.7
	Not aware of clean fuels	5	16.1
Non-Biomass (Total-258)	Can affordable	126	48.8
	Less harmful to health	44	17.1
	Subsidy by govt to BPL family is available	72	27.9
	More comfortable ( less health problems)	28	10.9
	As alternate fuel	46	17.8

Multiple responses

**Table 5: Distribution of symptoms reported by respondents according to type of fuel**

Symptoms (n=124)		Bio-mass fuel	Non- bio mass fuel	Total
Respiratory symptoms	Dry cough	18(14.5)	4(3.2)	22(17.7)
	Breathlessness	8(6.4)	4(3.2)	12(9.7)
	Wheezing	3(2.4)	0	3(6.5)
	Chest pain / chest discomfort	2(1.6)	0	2(1.6)
	Chronic bronchitis	1(0.8)	0	1(1.6)
	Aggravated Bronchial asthma	3 (6.5)	1(0.8)	4(4.8)
Non- respiratory symptoms	Eye irritation	22(17.7)	12(9.7)	34(67.7)
	Watering of eyes	18(14.5)	5(4.0)	23(27.4)
	Diminution of vision	12(9.7)	2(1.6)	14(20.9)
	Cataract	11(11.3)	0	11(11.3)
	Headache	14(11.3)	6(4.8)	20(34.7)
	Giddiness	2(1.6)	0	2(6.4)
	Body aches	26(20.9)	2(1.6)	28(53.2)
	Nasal symptoms	3(2.4)	1(0.8)	4(36.3)
Burns	3 (2.4)	2(1.6)	5(19.4)	

Multiple responses



**Figure 1: Pie - chart Distribution of morbidity conditions on exposure to household smoke reported by respondents**

to smoke and majority 207(41.9%) of them were exposed to smoke for more than 2-3 hours/day.

Nowadays, fuel accessibility has greatly increased in rural areas in recent years, but still solid fuels are still widely used in rural areas. Though the clean fuels are available even in rural areas, the use of biomass still comprises a large proportion which influenced by various factors like easily availability of fuel, fuel price, socio-economic status, education level, age, cooking with bio-mass provide better flavour and not aware of indoor air pollution and their related health effects.

The present study revealed that major reasons for using bio-mass fuel was the easily availability of bio-mass fuel 164 (52.9%) and low fuel price 84 (27.1%) whereas non-biomass fuel was able to afford the non-biomass fuel 126 (48.8%) and availability of subsidy provided by government to BPL families was 72(27.9%).

In our study we inquired about the morbidity conditions experienced by the women during their exposure to

domestic smoke and found that the about 124 (25.1%) of women experienced various symptoms during cooking process. Our study results also show that respiratory symptoms like Dry cough (14.5% v/s. 3.2%), Chest pain (1.6%v/s.0%), Breathlessness (6.4%v/s.3.2%), Nasal symptoms (2.4%v/s0.8%) and Chronic bronchitis (0.8%v/s.0%) were more common in women using BMFs than in those using non-BMFs.

Our findings are consistent with study conducted by the Olufemi Olumuyiwa Desalu showed that the women who used BMFs, when compared with those who used a non-BMF, more often reported symptoms of cough (13.7% vs. 3.7%), wheezing (8.7% vs. 2.8%), chest pain (7.5% vs. 1.9%), breathlessness (11.8% vs. 6.5%), and nasal symptoms (9.3% vs. 4.6%).<sup>[8]</sup>

Another study conducted in North India on 3701 women using different types of cooking fuels found that women using mixed fuel experienced more respiratory symptoms (16.7%), followed by biomass (12.6%), stove (11.4%), and LPG (9.9%) users.<sup>[13]</sup> Though LPG fuel was a clean fuel, but users suffered from respiratory infections probably due to the inhalation of oil and fats vapour generated during cooking.

It was observed that the prevalence of non-respiratory symptoms like eye irritation (17.7%v/s.9.7%), body aches (20.9%v/s.1.6%), watering of eyes (14.5%v/s.4.0%) and headache (11.3%v/s.4.8%) were found to be more common among the Bio-mass fuel users than non-biomass users and these findings were consistent with the study conducted by the Neelam D Sukhsohale.<sup>[14]</sup>

## CONCLUSION

In the present study, it was observed that there is still widespread use of biomass fuel for cooking and lighting purpose in the study area. Most of the study participants, they prefer to use a combination of fuels rather than a single one. It was found that the fuel accessibility of commercial energy has improved greatly in rural areas through the fuel subsidy offered by the government to the below poverty line households, but fuel affordability is still fragile, and still bio-mass fuel is mainly used by low income households. In the present study, the major morbidities were reported among the bio-mass users compared to non-biomass users. Rural residents have limited knowledge about indoor air pollution and its related health effects, and the government can disseminate information on the source of indoor air pollution through health education and hygiene education, adoption of cleaner sources of energy and reducing household air pollution exposure by improving ventilation particularly in rural areas and improving lung health. Further rural poverty alleviation programmes are required for improving the overall health status of the

rural population.

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## CONFLICT OF INTEREST :

The authors declared no conflict of interest.

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