

Original article:

A Study on extent of Solid biomass fuel use and factors associated with it among households in rural Coimbatore

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ABSTRACT

Background: Indoor air pollution from solid biomass fuel smoke is a major concern in developing world. India is one of the developing countries with high traditional fuel use in rural areas.

Aim: To find out the extent of solid biomass fuel use in rural area of Coimbatore and the factors associated with it among households.

Materials and Methods: A Cross-sectional study was conducted in the field practice area of Rural Health training centre, Vedapatti, Community medicine department, PSGIMSAR, Coimbatore from September to November 2015 among 125 households selected from two villages using two stage sampling method.

Results: Out of 125 households, the proportion of households using solid biomass fuel was about 37.6% (CI 28.94-46.26). In univariate analysis, there was a significant association between solid biomass fuel use and the variables such as age of head of household, scheduled caste, illiteracy, low socio-economic status, female headed household, family size, kutcha house, and kitchen without partition. On doing Logistic regression analysis, only factors such as underprivileged caste, low socio-economic status and smaller family size were found to be statistically significant.

Conclusion: Study reveals that one third of rural households were using solid biomass fuels. Underprivileged caste, low socio-economic status and smaller family size were found to be associated with higher usage of solid biomass fuels. There is a need to increase the awareness among underprivileged households to use cleaner fuels like LPG. It should be ensured, that subsidized cleaner fuels reaches the underprivileged households.

Keywords: Solid biomass fuel, LPG, Indoor air pollution, Energy ladder

Introduction:

More than one third of global disease burden is attributable to ten leading risk factors and Indoor smoke from solid fuels is one among them.¹ The widespread use of solid fuels to meet basic energy needs represents a major public health concern with important implications for MDGs 4 and 5.² On a global basis, most indoor air pollution results from the burning of solid fuels for household cooking and heating.^{3,4} Solid Fuel use is defined as the household combustion of biomass (such as dung, charcoal, wood, or crop residues), or coal.⁵ Worldwide, approximately around 50% of people and 90% of rural households, rely on solid biomass in the form of wood, dung and crop residues for cooking or heating.^{6,7} These materials are typically burnt in simple stoves with very incomplete combustion.^{6,7} In simple stoves, biomass fuels emit substantial amounts of health-damaging pollutants, including respirable particulates,

carbon monoxide, nitrogen oxides, benzene, formaldehyde, 1,3 butadiene, and polyaromatic compounds such as benzo(α)pyrene.^{8,9} Exposure to indoor air pollution is a significant public health hazard predominantly affecting poor rural communities in developing countries.¹⁰

A common model to describe household fuel choices in developing countries is the “energy ladder” which ascribes differences in energy-use patterns between households to variations in economic status.^{11,12,13} Fuel use patterns in households are the result of complex interactions between economic, social and cultural factors.¹¹ Understanding household fuel choice is of vital importance in search for policies to support the transition process in energy ladder.¹¹ More research of factors associated with solid biomass fuel use were required to determine household fuel choice and energy consumption pattern, specifically in rural area.

Objectives of the study

- To find out the extent of solid biomass fuel use among households in rural area of Coimbatore
- To find out the factors associated with solid biomass fuel use among households in rural area of Coimbatore.

Materials and methods:

In the field practice area of RHTC, Vedapatti, PSGIMS&R, there were 14 villages having 6697 households, a community based- cross sectional study on extent of solid biomass fuel use and factors associated with its use was conducted over a period of three months (September 2015-November 2015). The sample size required was calculated based on reported proportion of households using solid biomass fuel as 50% with precision- 20% and non-responders as 20%, Sample size 125 Households estimated. Study participants were selected by two stage sampling method. In first stage two villages was selected from total of 14 villages by Lottery method and in the second stage all the households (684 Households) in the two villages Kempanoor and Dhaliyur were listed and 125 households were selected by SPSS generated Random numbers. All permanent residents of these two villages were included in the study. Those houses that were locked and participants who were not available at the time of study (Minimum 3 visits) and those residents who are not willing to participate in the study were excluded. The study was started after getting approval from the Institutional Human Ethics Committee (IHEC). Brief explanation about the study was given to the participants and informed consent was obtained and data was collected by interview using semi-structured questionnaire.

Use of Solid biomass fuel as primary cooking fuel was considered as dependent variable. Independent Variables were Socio-demographic characteristics such as sex, age(years), education, occupation, religion, caste, type of family, head of family, Family size, Socioeconomic status (Modified Prasad classification), type of housing and type of kitchen.

Statistical Analysis: The obtained data was tabulated and analysed using the statistical package SPSS 19.0 version for windows. Findings were described using percentages and Proportion of Solid biomass fuel use was estimated with 95% CI. Univariate analysis was done to find out the association of Solid biomass fuel use and factors associated with it. The strength of association was estimated by the calculation of odds ratios (OR) and 95% confidence intervals (CI) and p value of < 0.05 as statistically significant. Those variables which were statistically significant were subjected to multivariate logistic regression analysis.

Results:

Current study was conducted among 125 households by two stage sampling method in the rural area in two villages and their socio-demographic characteristics were given below.

Table 1: Socio- Demographic characteristics of sampled households (N=125 Households)

S.No	Characteristics		Frequency	Percentage
1	Age in years (Head of Household)	<30	8	6.4
		31-45	44	35.2
		46-60	41	32.8
		>60	32	25.6
2	Head of Family	Male	115	92
		Female	10	8
3	Education of Head of house hold	Illiterate	39	31.2
		Primary	29	23.2
		Middle	14	11.2
		High School	31	24.8
		Higher Secondary	8	6.4
		Graduate	4	3.2
4	Occupation of Head of house hold	unskilled	33	26.4
		semiskilled	29	23.2
		skilled	29	23.2
		Agriculturist	14	11.2
		Semiprofessionals	3	2.4
		Professionals	1	0.8
		Pensioners	16	12.8
5	Religion	Hindu	121	96.8
		Christian	4	3.2
6	Caste	BC	53	42.4
		MBC	22	17.6
		SC	50	40
7	Type of Family	Nuclear	91	72.8
		Joint	34	27.2
8	Number of Family member	1-2	28	22.4
		3 & above	97	77.6
9	Socioeconomic status (Modified Prasad	Class I	6	4.8
		Class II	22	17.6

	Classification)	Class III	25	20
		Class IV	46	36.8
		Class V	26	20.8

Table 1 shows the Socio- demographic characteristics of sampled households with majority belongs to Hindus (96.8%) and male headed households(92%)

Table 2: Housing, and Kitchen Characteristics of sampled Households (n=125)

S.No	Variable		Frequency	Percentage
1	Type of House	Kutchha	18	14.4
		Semi-pucca	80	64.0
		Pucca	27	21.6
2	Type of Kitchen	Indoor with Partition	67	53.6
		Indoor without Partition	44	35.2
		Open air Kitchen outside house	10	8.0
		Separate Kitchen outside house	4	3.2
3	Type of Cooking Fuel Used	LPG	59	47.2
		Kerosene	19	15.2
		Firewood, Crops, Residues, Coconut shell/Groundnut shells	47	37.6

Table 2 shows the housing and kitchen characteristics of sampled households. Solid Biomass fuel was used among 37.6% (CI 28.94-46.26) households. LPG was used among 47.2% and Kerosene in 15.2% Households.

Table 3: Solid biomass fuel use among sampled households and factors associated with it upon Univariate analysis

Factors	Category	Solid biomass fuel use		Unadjusted odds ratio (95% Confidence Interval)	p value
		Yes	No		
		Numbers (%)	Numbers (%)		
Age in years (Head of Household)	>60	19(59.4)	13(40.6)	3.39(1.47-7.8)	<0.05
	≤60	28(30.1)	65(69.9)	1	
Head of Household	Female	7(70)	3(30)	4.7(1.07-17.84)	<0.05
	Male	40(34.8)	75(65.2)	1	
Education of Head of house hold	Illiterate	28(71.8)	11(28.2)	8.9(3.78-21.2)	<0.001
	Others	19(22.1)	67(77.9)	1	
Occupation	Unskilled, Semiskilled, skilled workers, Agriculturist	39(37.1)	66(62.9)	0.88(0.33-2.35)	0.80
	Semi-professionals, Professionals & Pensioners	8(40)	12(60)	1	
Religion	Hindu	45(37.2)	76(62.8)	0.59(0.08-4.35)	0.63
	Non Hindus	2(50)	2(50)	1	
Caste	SC	31(62)	19(38)	6.01(2.71-13.3)	<0.001
	Others	16(21.3)	59(78.7)	1	
Type of Family	Nuclear	36(39.6)	55(60.4)	1.36(0.59-3.14)	0.53
	Joint	11(32.4)	23(67.6)	1	
Family size	1-2	21(75)	7(25)	8.19(3.11-21.5)	<0.001
	3 & above	26(26.8)	71(73.2)	1	
Socio-economic status (Modified Prasad's classification)	Class IV,V	41(56.9)	31(43.1)	10.36(3.9-27.3)	<0.001
	Class I,II,III	6(11.3)	47(88.7)	1	
Type of House	Kutchha	42(42.9)	56(57.1)	3.3(1.15-9.43)	<0.05
	Others	5(18.5)	22(81.5)	1	
	Without Partition	33(61.1)	21(38.9)	6.39(2.87-14.2)	<0.001

Type of Kitchen	With Partition	14(19.7)	57(80.3)	1	
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Table 3 shows the Solid biomass fuel use among sampled households and factors associated with it by Univariate analysis. It was observed that factors such as age of head of household, scheduled caste, illiteracy, low socio-economic status, female headed household, family size, kutcha house and kitchen without partition were significantly associated with solid biomass fuel use.

Table 4. Solid biomass fuel use among sampled households and factors associated with it upon Multivariate logistic Regression analysis

Variable	Category	Adjusted OR	Confidence Interval	P value
Age(years)	>60	2.34	0.54-10.10	0.25
	≤60	1		
Education of Head of house hold	Illiterate	1.26	0.38-4.14	0.70
	Others	1		
Caste	SC	3.48	1.15-10.46	<0.05*
	Others	1		
Family size	1-2	7.12	1.4-35.09	<0.05*
	3 & above	1		
Head of Household	Female	5.8	0.7-43.11	0.08
	Male	1		
Socio-economic status (Modified Prasad's classification)	Class IV,V	8.2	1.97-34.17	<0.05*
	Class I,II,III	1		
Type of House	Kutcha	2.49	0.55-11.17	0.23
	Others	1		
Type of Kitchen	Without Partition	2.70	0.92-7.86	0.06
	With Partition	1		

* Statistically Significant

Table 4 shows the results of logistic regression analysis. It was observed that Scheduled caste [Adjusted OR = 3.48, (CI- 1.15-10.46)], Socio-economic status [Adjusted OR = 8.2, (CI- 1.97-34.17)], and Family size with 1-2 members [OR = 7.12, CI – 1.4-35.09] were significantly associated with solid biomass fuel use, whereas of head of household, illiteracy, , female headed household, kutcha house and kitchen without partition were not significantly associated with solid biomass fuel use

Discussion:

The current study found that the extent of solid biomass fuel use was about 37.6%. Balakrishnan K et al¹ study conducted at rural districts of Andhra Pradesh by in 2004 showed that solid biomass fuel use was around 81% and a study conducted at Bagalkot district, Karnataka by Parajuli in 2004¹⁵, showed all of the rural houses were dependent on traditional fuels. National family health survey-3 (2005-06)² data had shown that above 75% in rural households used solid biomass fuels. According to National family health survey-4 (2016)¹⁴ data estimates, the overall traditional fuel use in rural areas was about 42%. In the NFHS-4 data, there was a decline in trend of using Solid biomass fuel compared to NFHS-3. Current study finding was closer to the recent NFHS-4 findings.

In the current study, Scheduled caste people had 3.4 times more likely to use the solid biomass fuel than the other caste people, which was similar to the finding from the study conducted by Joon et al in Haryana(2009)¹⁶ and a systematic review conducted by Lewis JJ et al.¹⁸

In the current study, the family size with 1-2 members, seven times more likely the use of solid biomass fuel. Deshmukh et al in Maharashtra (2014)¹⁷ reported that the households with higher family size are 0.71 times more likely to use cleaner fuels. According to the systematic review using 32 studies conducted by Lewis JJ et al¹⁸ had shown household size as inconclusive factor to influence the choice of cooking fuels.

In the current study, the poor socio-economic status people were eight times more likely to use solid biomass fuel. This was similar to the finding from Deshmukh et al (2004)¹⁷ in Maharashtra, and Joon V et al in Haryana (2009)¹⁶. According to the systematic review conducted by Lewis JJ et al¹⁸ had also shown that higher the income, more shift towards the cleaner fuel use. Our study has certain limitations. Study being a cross sectional study, the existence of a cause-effect relationship cannot be made. Fuel cost expenditure and opportunity cost was not addressed in the current study.

Conclusion:

Study reveals that one third of rural households were using solid biomass fuels. Underprivileged caste, low socio-economic status and smaller family size were found to be associated with higher usage of solid biomass fuels. There is a need to increase the awareness among underprivileged households to use cleaner fuels like LPG. It should be ensured, that subsidized cleaner fuels reaches the underprivileged households.

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