

## Original Research Article

# Housing conditions, knowledge and perceived health effects of indoor air pollution in tribal women of rural Maharashtra

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## ABSTRACT

**Background:** Dependence on using biomass fuels for cooking and heating leads to Indoor Air Pollution (IAP) which can lead to adverse health outcomes. Aim of this study was to observe the housing and kitchen conditions in households of tribal areas, assess the knowledge of women regarding the IAP and perceived health effects due to it.

**Methods:** Cross-sectional community-based study conducted in 100 women above the age of 18 years in a tribal village. A semi-structured questionnaire was used and spot observations were made. Chi-Square was used to calculate the association between type of stove, housing conditions and health effects of IAP. Logistic regression was used to identify determinants of the health effects of IAP.

**Results:** The mean age of women was 29 years; all houses had a separate kitchen; 34% used mud stove with wood. Easy availability and economic reasons were cited for using wood. 47% of women thought IAP present in their homes and the most common source was cooking. Symptoms like asthma, sweating, burns/rash, and headache had a significantly higher association in women using mud stove ( $P < 0.05$ ) than LPG stove. A strong association was found between cooking hours and health effects due to IAP ( $P < 0.004$ ).

**Conclusions:** IAP due to cooking and unfavorable housing conditions are associated with health problems in women. Knowledge regarding IAP is poor. Reasons for reliance on using mud stove needs to be addressed.

**Keywords:** Indoor air pollution, Solid fuel, Tribal women

## INTRODUCTION

Indoor Air Pollution (IAP) has emerged as a 'silent killer' for the women and children of the developing nations including India. With more than 80% rural population there is dependence on using biomass fuels which causes IAP.<sup>1,2</sup> A pollutant released indoors is 1000 times more likely to reach people's lungs than a pollutant released outdoors.<sup>3</sup> Exposure to IAP can lead to acute and chronic respiratory illnesses, cardiovascular illnesses and adverse perinatal health outcomes.<sup>2,4</sup> Despite the launch of Pradhan Mantri Ujjwala Yojana in 2016 providing free Liquefied Petroleum Gas (LPG) connections to the poor households, the uptake is less. Therefore, this study was

undertaken to observe the housing and kitchen conditions in households of tribal areas, assess the knowledge of women regarding the IAP and perceived health effects due to it.

## METHODS

This cross-sectional community-based study was conducted from September to December 2018 in a tribal village, Palghar district Maharashtra. The unit for sampling was a household along with a woman in that household who was mainly responsible for cooking. Using the formula,  $n = z^2 P(1-P)/d^2$  with  $P=0.50$  and absolute precision(d) of 10 percentage points at 95%

confidence interval, sample size comes up to 96 households. It was rounded off to 100. Thus, 100 women above the age of 18 years were interviewed from these households. Simple random sampling was done. Ethical clearance (EC/OA-14) was obtained and written informed consent was taken from all women. A pre-validated, semi-structured questionnaire was used and spot observations were made. Data analysis was done in SPSS version 22.0 (IBM).

## RESULTS

### *Socio-demographic profile (SDP)*

The mean age of women is 29 years (Range 18-60 years). All of them were married; 46% were illiterate; 37% were educated up to primary school (I to IV standard), and 17% were educated up to middle school (V to VII standard). The husbands of these women were educated up to middle school in 47%, primary school (30%) and 23% were illiterate. All the women were housewives and helped in farm work rarely. According to modified BG Prasad Classification, 6% belonged to the lower-class, 42% belonged to the lower-middle-class, 29% to the middle-class, 11% to upper-middle-class and 12% to the upper-class. The average family size is 5-6.

### *Housing*

The average number of rooms in houses was 2.3. Rooftop was commonly made of asbestos (95%) and thatch (5%); floor was made of earth (92%) followed by cement/concrete (8%); exterior wall was made of tin sheets and cement blocks (36% each) followed by mud bricks (15%) and wood/bamboo (13%). Around 63% of women had access to flush toilets and the rest did it in the open air. Tube well was the source of domestic water in all the houses. Natural lighting during the day was inadequate in 61% of houses. Any kind of ventilation was absent in 74% houses, 16% had partial ventilation and adequate cross ventilation was present in only 10%. There was no dampness or evidence of mold found in any of the houses. None of the women reported flooding of the house during monsoons. There was no evidence of excessive dust in any of the houses. None of the houses had carpets.

### *Kitchen*

All the houses had a separate kitchen. Mud stove (Figure 1) was used by 34% women and rest 66% used Liquid Petroleum Gas (LPG) stove. The cost of the LPG cookstove is 1200 INR whereas no cost is involved in mud type stove. The stove was placed indoor in all houses using LPG stove i.e. 66% and those using mud stove placed it outside the house in a separate enclosed area. Fuel in all houses using mud stove was wood. Matchstick was used to light both the types of the cookstove. Ventilation was very poor in the kitchen of all the houses. A window of around 100 centimeters square

was present in 60% of houses. There was no seasonal variation observed in the cooking pattern.

### *Exposure*

None of the women were smokers but, 12% of them gave history of smoking by a family member. Most women (76%) cooked thrice daily followed by 23% who cooked four times daily and 1% who cooked more than four times daily. On average, 60% of women spent four or more hours cooking, followed by 23% who spent one to two hours and the rest 17% spent three to four hours cooking. About 9% women reported having slept or have been sleeping in the kitchen.



**Figure 1: A woman cooking food in fire mud stove with wood as fuel (original).**

The majority of women (33%) swept the house four times a day followed by 29% who swept three times and rest of them swept five or more times daily. Frequent accumulation of dust was the main reason for sweeping. In addition to this, 70% of women reported having dusted the house at least once daily. Mopping was done by 76% of women at least once daily.

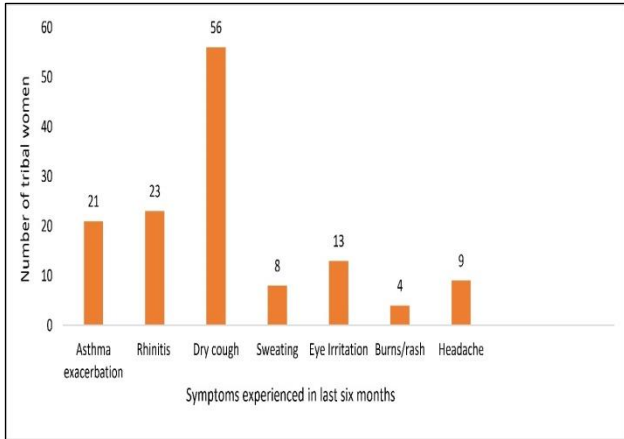
The women using traditional cookstoves (open-air type) stated that it was cheap and familiar to use. The women not using traditional cookstove stated that smoke generation and breathing discomfort was the main reason for changing to LPG stove. Pets were present in 49% houses. Around 96% women reported burning of incense sticks at home and 69% reported burning of mosquito repellents.

### *Knowledge about IAP and perceived health effects from it*

Around 47% of the women said that they feel IAP is present at their home, 2% felt there is no IAP and 51% did not know if it is present or not.

There was a significant difference in the presence of IAP and the type of cookstove used ( $\chi^2$  statistic- 13.621, d.f-2,  $p=0.001$ ). Burning of wood and waste was cited as the

most common source of IAP (47%), followed by cooking (28%) and smoking (25%). Out of fuel and stove, 51% of women thought fuel is an important cause for IAP and rest believed it was the stove. About 38% of the women think that burning incense sticks can cause IAP and rest 62% do not know if they can cause IAP or not.



**Figure 2: Symptoms experienced by the tribal women in the last six months (n=100).**

**Table 1: Association of symptoms experienced by tribal women with stove type used (n=100).**

Symptoms	Stove type		Chi <sup>2</sup> statistic (d.f=1)	p-value	
	Mud stove	LPG stove			
Asthma	Yes	12	9	6.345	0.012
	No	22	57		
Rhinitis	Yes	9	14	0.350	0.554
	No	25	52		
Dry cough	Yes	22	34	1.585	0.208
	No	12	32		
Sweating	Yes	7	1	11.091	0.001
	No	27	65		
Eye irritation	Yes	7	6	2.623	0.105
	No	27	60		
Burns/rash	Yes	4	0	8.088	0.004
	No	30	66		
Headache	Yes	8	1	13.278	0.001
	No	26	65		
Tuberculosis	Yes	6	5	2.325	0.127
	No	28	61		

\*p<0.05 is significant

**Table 2: Significant characteristics associated with the health effects due to IAP.**

Characteristics	Health effects due to IAP (n=100)		Chi <sup>2</sup> statistic	Degree of freedom	p-value
	Yes	No			
Number of rooms	1	4	14.297	2	0.001
	2	37			
	≥3	27			
Exterior wall material	Mud bricks	7	15.147	3	0.002
	Cement	21			
	Wood /bamboo	7			
	Tin sheets	33			
Access to toilet	Yes	35	12.118	1	0.000
	No	33			
Cooking hours	1-2	5	41.490	2	0.000
	3-4	8			
	>4	55			
Frequency of sweeping	3	24	12.101	2	0.002
	4	26			
	≥ 5	18			
Frequency of dusting	1	43	4.631	1	0.031
	≥2	25			
Presence of pets	Yes	30	4.028	1	0.045
	No	38			
Burning of mosquito repellent	Yes	42	5.201	1	0.023
	No	26			
Burning of incense stick	Yes	0	8.854	1	0.003
	No	68			

About 21% of women reported that the child is located inside the kitchen or nearby while cooking, 23% reported that the child is outside in another room while cooking and 56% reported that the child is sometimes in the kitchen and sometimes outside. 61% women knew that IAP is harmful to health.

All the women believed that they were the most vulnerable to the harmful effects of IAP followed by children and other family members. All the women could name at least one illness due to IAP.

The symptoms/illnesses experienced by the women in the last six months are given in Figure 2. Symptoms like asthma, sweating, burns/rash, and headache had a significantly higher association in women using mud stove (all  $P < 0.05$ ) than LPG stove. None of the women experienced any allergy (physician confirmed). Dry cough was the most common symptom experienced on most of the days in all seasons. Those who experienced eye irritation and rhinitis experienced it almost every day during and after cooking. On applying independent sample t-test we found that there was a significant difference in frequency of eye irritation among users of mud stove and LPG gas stove ( $p = 0.002$ ). The frequency of other symptoms was not statistically significant in mud stove and LPG stove users. None of them were diabetic or hypertensive. Past history of tuberculosis was present in 11% of them.

None of them could suggest any measure to prevent IAP in their house.

On applying the chi-square test we found that certain characteristics were significantly associated with the health effects due to IAP. (Table 2) Logistic regression was performed to identify predictors of health effects due to IAP (Hosmer-Lemeshow:  $p > 0.05$ , predictive accuracy rate-93%, Nagelkerke  $R^2 = 0.740$ ). We found a strong association between cooking hours and health effects due to IAP (OR 14.8, CI 2.40-91.09,  $p = 0.004$ ). We also found a strong association between the frequency of dusting and health effects due to IAP (OR 19.8, CI 1.09-360.07,  $p = 0.044$ ). We also found that the frequency of sweeping was negatively associated with health effects due to IAP (OR 0.050, CI 0.006-0.418,  $p$ -value 0.006).

## DISCUSSION

This study was conducted on 100 women in a tribal village. Most of them have poor education status and socio-economic background. This typical SDP of rural India and its relationship with IAP has been previously studied by authors in India.<sup>5-7</sup> Women are more predisposed to the health effects of IAP influenced by factors like younger age, low per capita income and joint family or large average family size.<sup>5-7</sup> However, authors found no statistically significant association between SDP and health effects due to IAP.

Household and kitchen characteristics have significant contribution towards IAP and its health effects. Most of the houses in our study comprised of two to three rooms, with asbestos roof, mud floor, exterior wall made up of tin, cement, mud or wood with inadequate natural lighting and ventilation. There was no dampness, evidence of mold or dust and carpet use in any of the houses. Similar to our findings, Rumchev et al, report that most households had one or two rooms, 43% had mud flooring and rest had cement floor and no houses had carpets.<sup>5</sup> Maharana et al, reported inadequate ventilation in 65% houses, poor ventilation in 72.5%, dampness, and humidity in 40 %, and leaky roofs in 12.5% houses.<sup>7</sup>

In our study, all the houses had a separate kitchen. Mud stove with wood was used in 34% houses and rest had LPG stove. Ventilation was very poor in all kitchens. Windows were present in 60% kitchens. Similar to our study Dey et al, report that all households in their study had single cookstoves placed inside an enclosed space near the main home or at some distance from it.<sup>6</sup> Even Rumchev et al report that 70% of houses stove were placed indoors. However, they also report different findings where 74% of the houses used biomass for cooking and rest used LPG or kerosene. They also report no windows in 47% of kitchens.<sup>5</sup>

Biomass is more commonly used in rural areas though some percentage of urban population may also use it.<sup>5,8,9</sup> Major fuels apart from biomass are gas and kerosene.<sup>7,10</sup> Since biomass is available in abundance and for free in rural areas, there is no impetus to use clean and costly fuels. On the other hand, ease of use, fuel efficiency, perceived reduction in smoke and improved health are some incentives to use cleaner fuels.<sup>11</sup>

Many other factors also contribute to IAP. As in our study, smoking by family member, cooking hours, sleeping in kitchen, dust accumulation, frequency of sweeping and dusting, presence of pets, burning of incense sticks and mosquito repellents have all been documented in the past as potential sources of IAP leading to morbidity due to it.<sup>5,7,12-14</sup> Both level of pollution and the time of exposure determine the health-effects of IAP.<sup>15</sup> We found strong association between cooking hours, frequency of dusting and health effects of IAP. The frequency of sweeping was negatively associated with health effects due to IAP. This could be possible because sweeping decreases dust accumulation in the house.

Authors found that nearly half of the women felt the presence of IAP at their home similar to previous studies.<sup>6,7</sup> There was significant difference in presence of IAP and type of cook-stove. This finding was also reported by Hugo et al.<sup>13</sup> Burning of wood and waste was cited as most common source of IAP followed by cooking and smoking. More than half of the women knew that IAP is harmful to health and believed they were most vulnerable to effects of IAP followed by children and

other family members. Similar findings are reported by Dey et al. except that cooking was most commonly cited source of IAP and majority of the women attributed this to the fuel rather than stove.<sup>6</sup>

Women in this study experienced a variety of symptoms like asthma, rhinitis, dry cough, sweating, eye irritation, burns/rash and headache in the last six months. Of these, asthma, sweating, burns/rash, headache and frequency of eye irritation had significantly higher association in women using mud stove than LPG. Many studies have found increased respiratory illnesses, eye irritation, and headache among women using cheaper and polluting fuels.<sup>5,10,14,16,7</sup>

## CONCLUSION

IAP due to cooking and unfavorable housing conditions are associated with health problems in women. Knowledge regarding IAP is poor. Reasons for reliance on using mud stove needs to be addressed. Practical demonstration and economic support for change to LPG stove need to be promoted. Awareness sessions regarding health effects of IAP and measures to minimize risk needs to be conducted in the community.

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