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A Study on Indoor Air Pollution Among Rural Masses

J. Sathya* and J. Gayathri**
*Department of Economics, Sri Sarada College for Women (Autonomous), Salem-636 016, Tamil Nadu, India
**Department of Commerce and Financial Studies, Bharathidasan University, Tiruchirapalli- 620 024, Tamil Nadu, India

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ABSTRACT

People in rural areas were found to be largely exposed to indoor air pollution by their usage of dirty fuels and biomass in kitchens. The other household conditions prevailing among rural poor masses such as lack of ventilation facilities, indoor kitchen without separation, smoking habits at home, cattle rearing at home etc. make them vulnerable to indoor air pollution. At this outset, this paper aimed to analyse the impact of indoor air pollution in Veeranam village of Salem District, Tamil Nadu. A sample of 150 households has been selected using simple random sampling. A significant association was found between (<0.001) types of kitchen facilities, ventilation facilities, smoking habits at home and respiratory illnesses. A statistically significant difference was found in medical expenses incurred by households in different types of kitchens (P<0.001). The paper suggests the implementation of proper guidelines to rural masses to switch over to clean fuels.

INTRODUCTION

People usually felt that they were safe and free from pollution in indoors. But their indoor environment is more polluted than their outdoor ambiance. Thus, the risks of life posed by indoor air pollution were huge nowadays due to our changing lifestyles. Rural masses are more vulnerable to indoor air pollution due their smoky traditional way of cooking. Dirty fuels such as wood, charcoal, coal, dung and crop wastes used by rural households were found to be the largest source of indoor air pollution in rural India. The significant impact of traditional fuels such as crop residue, wood fuel and dung cakes on the respiratory health was highlighted in several past studies (Gupta et al. 1997). The emission of indoor pollutants from dung cakes and crop residues was found to be two to three times higher than fuel wood (Veena et al. 2005).

In no way, urban people were less vulnerable when compared to rural masses. Their modern lifestyle in apartments tends to cause indoor air pollution sourced from furnishings, wet or damp carpets, household chemical products, air conditioners, dehumidifiers and outdoor sources such as radon and pesticides.

According to WHO, 4.3 million people a year die from the exposure to household air pollution. Indoor air pollution is responsible for 2.7% of the global burden of disease and has been ranked among top 10 risk factors. Approximately 2.0 million deaths and 39 million disability adjusted life years (DALYS) (mainly of women and children) a year are due to unvented burning of biomass for cooking and heating; and about half million of total deaths in India itself (WHO 2012). In the year 2016, 1,00,411 children in India were found to be dead caused by household air pollution. Respiratory infection was found to be the major health ailment among children and adult in India sourced from indoor air pollution.

Our daily household activities such as cleaning, cooking, heating, smoking, painting and spraying contribute to indoor air pollutants. The lack of ventilation facilities, smoking habits at home, pets at home, asbestos roofing and kitchens without separation were the factors which add fuel to the problem of indoor air pollution. Those who spend more time in indoor atmosphere such as women, elders and children were more vulnerable to health problems associated with indoor air pollution.

At this outset the present study intends to focus on a few aspects of indoor air pollution in rural atmosphere, such as:

- To study the socio-demographic profile of the households in the study area.
- To identify the sources of indoor air pollution in the study area.
- To find out the impact of indoor air pollution on the human health.

HYPOTHESES

1. There is no significant association between types of kitchens and respiratory illnesses.
2. There is no significant association between ventilation facilities at home and respiratory illnesses.

3. There is no significant association between smoking habits at home and respiratory illnesses.
4. There is no significant difference between types of kitchen and medical expenditure incurred.

METHODOLOGY

Veeranam village in Ayothiapattinam block of Salem District has been chosen as the study area. The study block consisted of 32 panchayat villages. A sample of 150 households has been chosen for the study. The sample forms 5 percent of the total number of households in the village which is around 3000 households (collected from village panchayat). Sample has been identified by using simple random sampling method. Descriptive and inferential statistics have been used for the analysis of primary data. The present study is based on both primary and secondary data. Interview schedule method is used to collect data from respondents. The collected data were properly checked and administered in SPSS 20 for the analysis.

LIMITATIONS

The main limitation of the study is that it is limited only to one Block of Salem District of Tamil Nadu. The researchers have selected only one village for the study. They have encountered lot of problems in eliciting information from respondents pertaining to their health issues relating to indoor air pollution. After having imparted the knowledge regarding the significance of the study the researchers could gather a little information about their health.

PRIMARY DATA ANALYSIS

Since indoor air pollution is recognized as a significant source of potential health rises to exposed population, the main objective of this paper is to assess the health impact of exposure to indoor air pollution on the households in the study area.

Of the 150 total sample respondents, 90 are male and 60 are female. The majority of the sample households, which is 40%, belong to the age group 25-50. Self employed workers form the large portion of the sample which is 60 in numbers out of 150. The prevalence of households living under below poverty line is 64 percent. It was found by the support of Suresh Tendulkar panel's recommendations (2011-12), which say that the new poverty line worked out to monthly per capita consumption expenditure of Rs. 972 in rural areas and Rs. 1,407 in urban areas. For a family of five, this translates into a monthly consumption expenditure of Rs. 4,860 in rural areas and Rs. 7,035 in urban areas.

Table 2 shows that the majority of the kitchens were indoor kitchens with partition, which accounted for 48% of the households. Indoor kitchens without partition accounted for 23.3% of the households. There were only 5 open air kitchens outside the house.

Table 3 reveals the fact that 78 sample respondents were affected by any one of the respiratory illnesses viz. asthma, breathing troubles, allergic rhinitis (AR), chronic obstructive pulmonary disease (COPD) and rhinosinusitis.

From the Table 4, it is inferred that respiratory illness is huge among the respondents living in the house with kitchen inside without partition and with partition. None of the households having kitchen outside the house and open air kitchen were affected by respiratory illness. It was further proved by the Chi square test showing the significant association between types of kitchens and respiratory illnesses with the P value < 0.001. Since the P value is less than the level of significance (0.05), the null hypothesis has been rejected. Further the strong association between the two categorical nominal variables was proved by the contingency co-efficient test with its value more than 0.7.

Majority of the sample respondents make use of LPG stove (Table 5). The issue of LPG stove by the government on a subsidised price has enabled the majority of households to make use of LPG stoves. About 36 of the sample respondents make use of kerosene stove. Biomass source of cooking is adopted by 22 respondents. The prevalence of large use of biomass is characterised by the rural setup. The prevalence of respiratory symptoms like cough and shortness of breath (dyspnoea) in women using traditional fuels and LPG is high. Unvented kerosene stoves release carbon monoxide and nitrogen dioxide, which tends to cause ailments like headache, dizziness, nausea and the respiratory infections. Since the majority of the rural households belong to low income category, they often use kerosene and traditional fuels such as crop residue, dung cakes and wood fuel.

Majority of the sample respondents use refined oil for cooking (Table 6). Others use mustard, groundnut, sesame and palm oil for cooking. Whatever is the type of oil used, whenever overheated it tends to emit VOCs like acrolein and formaldehyde. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. Formaldehyde is mainly emitted by materials used in home construction and furniture, such as particle board, panelling and foam insulation. Formaldehyde is a lung irritant that can trigger asthma attacks and may cause cancer. Acrolein in the home is primarily from cooking (especially from oils). It is a strong irritant for the skin, eyes and nasal passages. Cooking is a major source of indoor air pollutants.

Majority of the sample respondents, i.e. 90 in numbers did not have proper ventilation and chimney facilities

Table 1: Socio-demographic characteristics of sample respondents.

	Characteristics	Number of respondents	Percentage
Sex	Male	90	60%
	Female	60	40%
Age (in years)	20-25	42	28%
	25-50	60	40%
	50 above	48	32%
	Total	150	100%
Occupation	Government	30	20%
	Self- Employed	60	40%
	Non-Government	42	28%
	Others	18	12%
	Total	150	100%
Literacy		Can Read or Write	Nil
		105 (70%)	45 (30%)
Socio Economic Status	Poverty line	Above Poverty Line 54 (36%)	Below Poverty Line96 (64)

Table 2: Types of kitchen amomg the respondents.

Types of kitchen	Number of Respondents	Percentage
Indoor kitchen without partition	35	23.3
Indoor kitchen with partition	72	48.1
Open air kitchen outside the house	5	3.3
Separate kitchen outside the house	38	25.3
Total	150	100

Table 3: Details of respondents affected by respiratory illnesses.

Respiratory Illnesses	Number of respondents
Suffered	78
Not Suffered	72
Total	150

(Table 7). Radon is a gas that is emitted naturally by the soil, which is due to modern houses having poor ventilation. It is confined inside the house causing harm to the dwellers. Due to the improper ventilation, pollutants like carbon monoxide, nitrogen dioxide and particles released from kerosene, wood and gas stove, find no way to emit outside the house. This tends to cause huge amount of indoor air pollution. The associated diseases with such pollutants include headache, dizziness, nausea, eye and nose irritation, etc. It tends to cause severe respiratory diseases to foetuses, infants and elderly people. In the poorly ventilated houses, indoor smoke can exceed permissible level. And its exposure is particularly high in women and children. The health risks posed by poor ventilated conditions have been highlighted in many studies (Smith 1994, WHO 1997, Mishra et al. 1999).

From the Table 8, it is inferred that respiratory illness is massive among the respondents living in the house without proper ventilation. It was further proved by the Chi square test showing the significant association between ventilation facilities at home and respiratory illnesses with the P value < 0.001. Since the P value is less than the level of significance (0.05), the null hypothesis has been rejected. Further the strong association between the two categorical nominal variables was proved by the Phi-Cramer's test with the value more than 0.5.

Of the 150 sample respondents, 87 are using sprays at home at different forms (Table 9). And 63 of the respondents are not using any sprays at home. The pest sprays, cleaners and disinfectants are the major types of sprays almost used by the majority of the sample respondents. Volatile organic compounds originate mainly from solvents and chemicals. The main indoor sources for volatile organic compounds are perfumes, hair sprays, furniture polish, glues, air fresheners, moth repellents, wood preservatives, and many other products used in the house. Sprays used at home release organic gases, which tend to cause ailments like eye, nose, throat irritation, headache and nausea. At higher concentration, organic gases suspect to cause failure of kidney and some forms of cancer.

Only 48 of the sample respondents have asbestos roofing at home (Table 10). Asbestos has given concern, which is suspected to cause cancer. Asbestos roofing at a deteriorating, damaged and disturbed condition has failed to cause

Table 4: Cross tabulation between types of kitchen and respiratory illnesses.

Types of Kitchen	Details of respondents affected by respiratory illnesses		Total
	Suffered	Not Suffered	
Indoor Kitchen without Partition	30	5	35
Indoor Kitchen with Partition	48	24	72
Open air Kitchen outside the House	0	5	5
Separate Kitchen Outside the House	0	38	38
Total	78	72	150
Pearson's Chi square	68.727		
P - Value	0.000		
Contingency Co-efficient	0.71		

H_0 = There is no significant association between types of kitchens and respiratory illnesses.

Table 5: Mode of cooking.

Mode of cooking	No. of respondents	Percentage
LPG stove	133	88.7
Kerosene stove	36	24
Biomass	22	14.7
Others	10	6.7

Table 6: Types of cooking oil used.

Types of cooking oil used	No. of respondents	Percentage
Mustard Oil	02	1.3
Refined Oil	130	86.7
Olive Oil	-	-
Ghee	-	-
Others	18	12
Total	150	100

Table 7: Details of ventilation facilities.

Ventilation Facilities	No .of respondents	Percentage
Yes	90	60
No	60	40
Total	150	100

Table 9: Types of sprays used at home.

Types of sprays used at home	No. of respondents	Percentage
Aerosol sprays	-	-
Cleaners and disinfectants	43	28.7
Pest sprays	21	14
Air fresheners	23	15.3
Not using	63	42
Total	150	100

Table 10: Asbestos roofing at home.

Asbestos roofing at home	No. of respondents	Percentage
Yes	48	32
No	102	68
Total	150	100

Table 11: Smoking habit at home.

Smoking habit at home	No. of respondents	Percentage
Yes	53	35.4
No	97	64.6
Total	150	100

Table 8: Cross tabulation between ventilation facilities and respiratory illnesses.

Details of ventilation facilities at home	Details of respondents affected by respiratory illnesses		Total
	Suffered	Not Suffered	
Yes	7	53	35
No	71	19	72
Total	78	72	150
Pearson's Chi square	65.175		
P - Value	0.000		
Phi-Cramer's V	0.51		

H_0 = There is no significant association between ventilation facilities at home and respiratory illnesses.

Table 12: Cross tabulation between smoking habits and respiratory illnesses.

Smoking Habits at Home	Details of respondents affected by respiratory illnesses		Total
	Suffered	Not Suffered	
Yes	56	4	60
No	22	68	90
Total	78	72	150
Pearson Chi-Square			68.447
P - Value			0.000
Phi-Cramer's V			6.76

H_0 = There is no significant association between smoking habits at home and respiratory illnesses.

Table 13: Cattle and pets at home.

Pets at Home	No. of respondents	Percentage
Yes	96	64
No	54	36
Total	150	100

Table 14: Unpleasant odours at home.

Unpleasant odors	No. of respondents	Percentage
Yes	33	22
No	117	78
Total	150	100

Table 15: Details of respondents affected by lung cancer.

Lung Cancer	No. of respondents	Percentage
Yes	-	-
No	150	100
Total	150	100

Table 16: Average inpatient expenditure incurred.

Inpatient expenditure (Rs.)	No. of households
<1000	96
1001-5000	18
5001-10000	29
10001-20000	5
>20000	2
Total	150
Mean	3393.33
Std. Deviation	6952.52

any immediate effect. But in long term it tends to cause severe diseases like chest, abdominal, cancer and lung diseases.

Only 53 of the respondents have smoking habit and 138 are non-smokers (Table 11). Tobacco smoke has both short term and long term effect. It not only affects the person who is smoking, but its harmful effect is extended to all in the home. It is known as passive smoking. Short term effects of tobacco smoke include allergies in eyes, nose and throat. Long term effects are as serious as to cause lung cancer and heart disease. Homes with one or more smokers may have particle levels several times higher than the outdoor levels.

Table 17: Average outpatient expenditure incurred.

Outpatient expenditure (Rs.)	No. of households
<100	42
101-500	40
501-1000	52
1001-2000	14
>2000	2
Total	150
Mean	526.46
Std. Deviation	521.07

From the Table 12, it is inferred that respiratory illness is immense among the respondents living in the home having any one smoking inside the home. It was further proved by the Chi square test showing the significant association between ventilation facilities at home and respiratory illnesses with the P value < 0.001. Since the P value is less than the level of significance (0.05), the null hypothesis has been rejected. Further the strong association between the two categorical nominal variables was proved by the Phi-Cramer's test with its value more than 0.6.

Ninty six of the sample respondents are having cattle and pets at home (Table 13). And 54 of the respondents are not having pets at home. The hair, fungi, parasites, and some bacteria from pets are allergens and can cause asthma, hay fever, and other allergic diseases. Dogs and cats are the major types of pets grown by the sample households. The cattle include goats, cows and pigs.

The sources of odours of the sample households include humans, chemicals, building materials, animals, dirt, smoke, sewage, mould, etc. (Table 14). Health effects from odours will vary depending on the frequency, duration and the con-

Table 18: MANOVA test between types of kitchen and average inpatient expenditure incurred and average outpatient expenditure incurred

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	0.260	25.439[b]	2.000	145.000	0.000	0.260
	Wilks' Lambda	0.740	25.439[b]	2.000	145.000	0.000	0.260
	Hotelling's Trace	0.351	25.439[b]	2.000	145.000	0.000	0.260
	Roy's Largest Root	0.351	25.439[b]	2.000	145.000	0.000	0.260
Kitchen	Pillai's Trace	0.294	8.374	6.000	292.000	0.000	0.147
	Wilks' Lambda	0.708	9.123[b]	6.000	290.000	0.000	0.159
	Hotelling's Trace	0.411	9.873	6.000	288.000	0.000	0.171
	Roy's Largest Root	0.407	19.808[c]	3.000	146.000	0.000	0.289

H_0 = There is no significant difference between types of kitchen and average inpatient expenditure incurred and average outpatient expenditure incurred.

centration of the odour. The most common symptoms or complaints are eye, nose, and throat irritation as well as headache, nausea, hoarseness, sore throat, cough, chest tightness, nasal congestion, palpitations, shortness of breath, drowsiness, and mood changes. Most of these symptoms will dissipate once the exposure ends, but some may have longer impacts. Some odours may trigger or complicate other illnesses, such as asthma, other respiratory diseases, hypersensitivity, and stress induced illness. In these cases the health effects may be long lasting and more significant.

None of the 150 sample respondents are caused by lung cancer (Table 15). It implies the fact that the households had been free from the chronic and long term exposure of indoor air pollutants. But in future their chronic and long term exposure may cause severe life threatening disease.

Majority of the households (96) incurred average inpatient expenditure of less than Rs. 1000 (Table 16). In the category of outpatient expenditure, majority were found to incur expense between Rs. 500 to Rs. 1000 (Table 17).

There was a statistically significant difference in medical expenses incurred by households in different types of kitchens. $F = 9.123, P < 0.001$, partial $\eta^2 = 0.159$ (Table 18).

CONCLUSION

From the above analysis it can be inferred that indoor air pollution seems to be the prime cause affecting the health of the households. The households living in poor ventilated houses were clearly found to be suffering with respiratory illnesses. The other supporting factors attributing their respiratory sicknesses were smoking habits at home, poor ventilated kitchens without partition inside the home, usage of poor quality cooking fuels, traditional mode of cooking using crop residue and biomass, asbestos roofing and having cattle at home. The poor socioeconomic status of the households makes them more vulnerable to the clutches of indoor air pollution. The proper guidelines were the need of the hour and should be given to rural masses to switch over to clean fuels. If it is not possible, awareness should be created to improve their ventilation facility at home.

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