Indoor Air Pollution and Its Effects on Health of Women in Rural Population of Karnataka - A Community Based Survey

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ABSTRACT

BACKGROUND

Indoor air pollution is responsible for more than 1.5 million deaths and 2.7 % of the global burden of disease as per WHO report. Globally, more than three billion people depend on solid fuels including biomass and coal. Nearly 4 million people die prematurely from illnesses attributed to household air pollution from inefficient cooking practices using polluting stoves paired with solid fuels and kerosene. As a customary involvement in cooking; women are obliged to breathe the air polluted with biomass fuels and tend to experience the largest exposures and health burdens. Hence this study was done to assess the determinants of indoor air pollution (IAP) and its health impact among women residing in rural areas of Bengaluru.

METHODS

A community based cross sectional study was conducted among household women residing in rural population of Bengaluru over a period of 4 months. Based on prevalence rate of sources for indoor air pollution being 49 % from the earlier studies the estimated sample was 500. Household women were interviewed by simple random sampling technique.

RESULTS

The mean age of the participants was 46.9 + 15yrs. where 42.4 % belonged to 40 - 59 yrs. of age group. In majority of households, 84.4 % used LPG as a cooking fuel. Type of fuel, second-hand smoking, smoke from the neighbourhood and use of mosquito repellents were found to be sources while poor housekeeping, inadequate ventilation, and lack of smoke outlet in kitchen were contributing factors for IAP. Irritation in eyes, cough, difficulty in breathing, running nose and chronic respiratory diseases were the perceived symptoms due to IAP.

CONCLUSIONS

Majority of households in the current study were exposed to IAP due to passive smoking, smoke from the neighbourhood and use of mosquito repellents while improper ventilation, absence of smoke outlet and humid conditions accentuated it. Community awareness program and cost effective interventions is the need of the hour.

KEY WORDS

Indoor Air Pollution, Rural Population, Women's Health

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BACKGROUND

Access to modern energy sources is an essential requirement for economic and social development. However, still nearly half of the world's population depend on inefficient and highly polluting solid fuels like biomass and coal. The households using these fuels as a source of energy burn them in open fires / stoves releasing unwanted substances in the indoor air at concentration toxic to health leading to indoor air pollution. Combustion of fuels, building materials, bio aerosols and outdoor pollution are the principal sources of indoor air pollution.[1,2] Indoor air pollutants like Sulphur dioxide, Carbon monoxide, Nitrogen oxide, Formaldehyde, Asbestos, Polycyclic Organic matters, and particulates pose a higher impact on health of the individuals due to longer duration of exposure indoors. Overcrowding, poor ventilation, presence of damp walls / roof, smoky kitchen are certain environmental factors contributing for indoor air pollution.[3]

Indoor air pollution is responsible for more than 1.5 million deaths and 2.7 % of the global burden of disease as per WHO report. Globally, more than three billion people depend on solid fuels, including biomass (wood, dung and crop residues) and coal, for cooking and heating; most of these people are poor and live in low- and middle-income countries. Nearly 4 million people die prematurely from illnesses attributed to household air pollution from inefficient cooking practices using polluting stoves paired with solid fuels and kerosene**.** Among these deaths, 27 % are due to pneumonia, 18 % from stroke, 27 % from ischemic heart disease (IHD), 20 % from chronic obstructive pulmonary disease (COPD) and 8 % from lung cancer. Exposure to indoor air pollution from solid fuels has been linked to acute and chronic respiratory diseases, tuberculosis, asthma, cardiovascular disease, and perinatal health outcomes.[4]

India is one of the ten low- and middle-income countries where indoor air pollution is responsible for a total of more than 1.5 million deaths a year. One in eight deaths in India was attributed to air pollution in 2017, where 4.8 lakh deaths occurred due to household air pollution. In India still 56 % of the population use solid fuels; this proportion was higher in the less developed states and over two-thirds of most Empowered Action Group (EAG) states used solid fuels for cooking. The Global Burden of Diseases, 2015 reports household air pollution as the fourth leading cause of attributable Disability Adjusted Life Years and varied 145-fold among the states of India.[2,5]

The main sources of indoor particulate matter are cooking, tobacco smoking, heating kerosene, burning of woods, mosquito repellents and suspension of particles by pets.[6] In developing countries, women and young children, who spend most of the time at home near the domestic hearth are obliged to breathe the air polluted with biomass fuels and they tend to experience the largest exposures and health burdens.[7] Indoor air pollution and its deleterious effects are much neglected in developing nations.

Objectives

- To assess the determinants of indoor air pollution among women residing in the rural population of Bengaluru.
- To assess the health impact of indoor air pollution among women residing in the rural population of Bengaluru.

METHODS

A community based cross-sectional study was conducted in Kanasawadi village which is a rural field practice area of Department of Community Medicine of a Medical college for a period of 4 months from June - September 2019. Household women residing in the study area for more than 6 months' duration and who gave consent to be a part of the study were included as they spend most of their time indoors. Based on prevalence rate of sources for indoor air pollution being 49 % from an earlier study conducted by Kankaria et al.[8] and at 5 % of precision the estimated sample size was 459 and taking 10 % for non-respondents the minimum sample size came up to 505. Totally, 500 households were surveyed and women in each household were interviewed by using simple random sampling technique. House to house interview was started from a central location in the village - temple was selected and from there the first lane was selected randomly. The first household was selected randomly by using the table of random numbers.

Initially a pilot study was done among 30 household women to check for the feasibility of study tool. After obtaining an informed written consent, participants were interviewed using a pretested questionnaire. One woman in each household was selected randomly to cover a wider study area. Any non-respondents in the household or if the house was found to be locked; then the next house satisfying the inclusion criteria was selected randomly. A pretested structured closed ended questionnaire with multiple choice answers for determinants of IAP and dichotomous questions for perceived health problems in women were used. Study tool contained the details of socio demographic profile containing 9 questions and for determinants associated with indoor air pollution (11 questions on sources for IAP like -type of cooking fuel used, history of second hand smoking, smoke from the neighbourhood, use of insect repellents and any construction in the vicinity of household and contributing factors like housing standards, living conditions and smoke outlet in kitchen and 7 questions on perceived health problems in women due to IAP). Anonymity of study participants was maintained.

Operational Definition

Indoor air pollution is the degradation of indoor air quality by harmful chemicals and other materials - Physical (dust, ash, and suspended particulate matter); Chemical [(pesticides, insect repellents (IR), carbon monoxide (CO), and nitric oxides (NO2)]; and (iii) Biological (bacteria, fungi, microbial spores, and animal dander)[2].

Statistical Analysis

The data was initially coded and entered in Microsoft excel and was analysed using SPSS version 20.0. The collected information was presented using descriptive statistics such as frequency, mean, percentages of qualitative data. Pearson correlation was done to see the association between IAP and its determinants. A P value of < 0.05 was considered to be significant. The study was approved by Institutional Ethics committee. (IEC NO: SIMS & RC/IECC/06/2019).

RESULTS

The findings of the current study reflected on 500 household women residing in Kanasawadi village. The mean age of the participants was 46.9+15 yrs. where 42.4 % belonged to 40 - 59 yrs. of age group. Majority, 98.8 % were Hindus by religion, 17.2 % were illiterates, 51.8 % were homemakers and 55.6 % belonged to Class IV social class as per Modified BG Prasad classification. (Table.1). Majority of households used LPG as a cooking fuel, 422 (84.4 %) followed by 9 % and 3 % of the households used coal and LPG and biomass and LPG as combination fuels. (Fig.1).

Socio - Demographic Variables		Frequency (N)	Percentage
Age(yrs.)	18 - 39	167	33.4
	40 - 59	212	42.4
	> 60	121	24.2
	Mean age+ SD	46.88 yrs+15.22 yrs	
Religion	Hindu	494	98.8
	Muslim	5	1.0
	Others	1	0.2
Occupation	Skilled	18	3.6
	Semiskilled	56	11.2
	Labourer	167	33.4
	Homemaker	259	51.8
Education	illiterate	86	17.2
	Primary school	161	32.2
	High school	190	38.0
	Higher secondary	36	7.2
	Graduate	27	5.4
Socio economic status	Class I	13	2.6
	Class II	59	11.8
	Class III	127	25.4
	Class IV	278	55.6
	Class V	23	4.6
Type of family	Nuclear	246	49.2
	Joint	218	43.6
	Extended	36	7.2

Table 1. Socio Demographic Profile of Study Participants

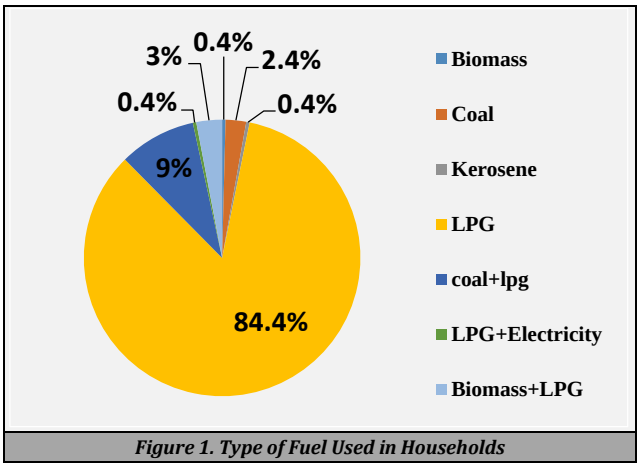

Figure 1. Type of Fuel Used in Households

Among the sources reported for indoor air pollution h / o second-hand smoking contributed to 24.6 % whereas 45.4 % of households used mosquito repellents. Nearly 40 % of households had inadequate ventilation, 41.8 % had no cross ventilation and absence of smoke outlet was seen in 35.6 % of households. Humid conditions were prevalent in 14.6 % of households (Table.2). Type of fuel, second-hand smoking, smoke from the neighbourhood and use of mosquito repellents were found to be sources for IAP. (Table.3).

Parameters			Frequency (N) Total households (N = 500)	Percentage (%)
1. Sources of Indoor air pollution	H / o second hand smoke	Yes	123	24.6
		No	377	75.4
	Smoke from the neighbourhood	Yes	42	8.4
		No	458	91.6
	New construction in the house hold or vicinity	Yes	41	8.2
		No	459	91.8
	Use of insect repellents	Yes	227	45.4
		No	273	54.6
2. Contributing factors for Indoor air pollution	Poor house keeping	Yes	102	20.4
		No	398	79.6
	Overcrowding	Yes	90	18
		No	410	82
	Ventilation	Adequate	317	63.4
		Inadequate	183	36.6
	Cross ventilation	Absent	209	41.8
		Present	291	58.2
	Smoke outlet in kitchen	Absent	178	35.6
		Present	322	64.4
	Humid conditions -		73	14.6
	Leaky roof	Absent	430	86
		Present	70	14
	Damp walls	Absent	476	95.2
		Present	24	4.8

Table 2. Distribution of Households as per Parameters Related to Indoor Air Pollution

Sources of Indoor air pollution N (%)	Perceived Health Problems N (%) Dizziness 10 (2 %)	Eye Irritation 44 (8.8 %)	Difficulty in Breathing 48 (9.6 %)	Dry Cough 46 (9.2 %)	Nasal Congestion 13 (2.6 %)	Running Nose 12 (2.4 %)	Chronic Respiratory Diseases 40 (8 %)
Type of fuel	0.052	0.109*	0.056	0.040	0.062	0.067	- 0.045
Second hand smoking	- 0.015	- 0.063	0.107*	0.091*	0.111*	0.092*	0.003
Smoke from neighbourhood	0.060	0.033	0.097*	0.153*	0.086	0.047	0.150*
New construction in household or in vicinity	0.009	- 0.041	0.002	0.056	- 0.049	0.001	- 0.008
Use of insect repellents	- 0.015	- 0.014	- 0.024	0.085	0.053	0.093*	0.210

Table 3. Correlation of Perceived Health Problems with Sources of Indoor Air Pollution

Note (Figures in parenthesis indicates Pearson correlation coefficients value showing * P < 0.05).

Contributing Factors for Indoor Air Pollution n (%)	Perceived Health Problems N (%) Dizziness 10 (2 %)	Eye Irritation 44 (8.8 %)	Difficulty in Breathing 48 (9.6 %)	Dry Cough 46 (9.2 %)	Nasal Congestion 13 (2.6 %)	Running Nose 12 (2.4 %)	Chronic Respiratory Diseases 40 (8 %)
Poor house keeping	0.034	0.035	- 0.114	0.011	0.167*	0.148*	- 0.040
Overcrowding	0.007	- 0.035	- 0.011	0.067	0.054	0.063	0.015
Ventilation	0.069	- 0.002	0.020	0.117*	0.111*	0.071	- 0.010
Cross ventilation	- 0.082	- 0.066	0.083	0.137*	0.142*	0.106*	0.085
Smoke outlet in kitchen	- 0.073	0.025	0.112*	0.298*	- 0.062	- 0.047	0.034

1.Humid conditions	- 0.019	- 0.108	0.231*	- 0.053	0.004	- 0.028	0.108*
a. Leaky roof	- 0.016	- 0.125	0.240*	- 0.049	0.007	- 0.026	0.115*
b. damp walls	- 0.032	- 0.037	- 0.010	0.026	0.081	0.026	- 0.141

Table 4. Correlation of Perceived Health Problems with Contributing Factors for Indoor Air Pollution

Note (Figures in parenthesis indicates Pearson correlation coefficients value showing * P <0.05).

Poor housekeeping, inadequate ventilation, absence of cross ventilation and lack of smoke outlet in kitchen and leaky roofs were contributing factors for IAP. (Table.4). Symptoms such as irritation in eyes, cough, difficulty in breathing, nasal congestion, running nose and chronic respiratory diseases correlated with sources and contributing factors for indoor air pollution. (Table. 3 & 4).

DISCUSSION

In the current study, majority of households (84.4 %) used LPG as a cooking fuel and the rest used coal and biomass in combination with LPG as cooking fuels (9 %, 3 %) and very few of them used coal, biomass, and kerosene (3.2 %) as main source of fuels. Socio cultural preferences could be one of the reasons for still using combination fuels in the current study. The NFHS - 5 Karnataka data also reported 69.3 % of rural population using clean fuels for cooking. The increased use of LPG in the current study could be due to the effects seen after the implementation of policies like Pradhan Mantri Ujjwala Yojana in the rural areas.[9] Among the sources for indoor air pollution, second hand smoking was reported by 24.6 % of household women and use of insecticide repellents was seen in 45.4 % of households and similar findings were reflected in the study done by Maharana SP et al. where 25 % of women were affected by passive smoking and 62.5 % of them used mosquito repellents [2]. Similarly, Shah K A et al. in their study showed 42 % of households using mosquito repellents had a significant association with ill effects due to indoor air pollution.[10]

Among the contributing factors for indoor air pollution, 40 % of households in the current study had inadequate ventilation, cross ventilation was absent in 41.4 % of households and 35.6 % of households did not have any smoke outlets in kitchen. Singh AL et al. in their study also reported poor ventilation in 45.2 % of households and these factors were found to be associated with respiratory diseases among women[7]. Poojary and Kempaller et al. in their household survey on determinants of indoor air pollution showed 64.2 % of households with absence of cross ventilation.[11] Ranabhat et al. in their study in rural area of Nepal found absence of smoke outlet in kitchens of 41.5 % of households and it was a significant factor contributing to indoor air pollution.[12]

Symptoms such as irritation in eyes, cough, difficulty in breathing, nasal congestion, running nose and chronic respiratory diseases were perceived health problems which correlated with sources as well as contributing factors for IAP in the current study. Ranabhat et al. in their study found watering of eyes, difficulty in breathing, and productive cough as mainly reported health problems due to indoor air pollution.[12] Similar findings were seen in study done by Maharana SP et al. where dizziness, eye irritation, and difficulty in breathing significantly correlated with determinants for IAP.[2]

Limitations of the Study

Due to logistic constraints, perceived health problems of women could not be diagnosed clinically and as few of the collected data were self-reported there could be a possibility of recall bias.

CONCLUSIONS

The present study found second-hand smoking, use of mosquito repellents, smoke coming from the neighbourhood for the sources while poor ventilation, absence of smoke outlet in kitchens, humid conditions in the households as contributing factors for indoor air pollution (IAP). The perceived health problems of women in the current study like tearing of eyes, nasal congestion, running nose, dry cough, breathing difficulty and chronic respiratory diseases correlated with the sources and contributing factors for IAP

Recommendations

Cost effective interventions can be done through provision of improved stoves in the poor households and encouraging the use of cleaner fuels provided at subsidized rates and with that efficient energy technologies can be promoted among the population through an effective and supportive policies. Community to be educated on hazards of indoor smoking and its deleterious effects on women as well as children and along with that installation of exhaust fans in kitchen can be encouraged and promoted among the households with absence of smoke outlets.

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