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Original Research Article

A study on indoor air pollution and its impact on health in urban field practice area: a community-based study

Arun P. Sasi, Rekha S. Udgiri*

Department of Community Medicine, Shri B. M. Patil Medical College, Vijayapura, Karnataka, India

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***Correspondence:**
Dr. Rekha S. Udgiri,
E-mail: rekha.udgiri@bldedu.ac.in

ABSTRACT

Background: As per the 2022 World Air Quality Report, India holds the eighth position globally for air pollution, with Karnataka in South India experiencing notably poor air quality, leading to 95 deaths per 100,000 population annually. Indoor air pollution poses substantial health risks, contributing to conditions such as pneumonia, stroke, diabetes, lung cancer, and premature mortality.
Methods: This study, conducted from April to July 2023 in the urban area of UHTC, Chandabowdi, aimed to assess indoor air pollution's impact. Using simple and systematic random sampling, 128 household members were surveyed through in-person interviews with ethical clearance.
Results: Of 128 participants, 44% reported respiratory symptoms, and 94% practiced unsanitary waste disposal. Ventilation issues affected 32.8%, while 75.8% reported neighborhood pollution. LPG was the primary fuel source for 97.7% of households, indicating significant environmental and health concerns.
Conclusions: Urgent action is needed to address indoor air pollution's health impacts. Clean technologies, improved building design, and lifestyle changes are essential to mitigate risks. Continuous monitoring and collective efforts are necessary for a healthier and sustainable future.

Keywords: Environmental health, Community-based study, Impact on health, Indoor air pollution, Urban field practice area

INTRODUCTION

Globally, the issue of indoor air pollution, exacerbated by harmful compounds, is a significant concern. Delhi holds the unfortunate distinction of being the second most polluted capital and fourth in overall air pollution, contributing to India's ninth place among the world's most polluted countries.[1]

A study focused on South India showed Karnataka reporting the worst air quality and high mortality rates, around 95 persons out of every 100,000 population.[2] Urban centers, especially densely populated ones, suffer from deteriorating air quality, exacerbated by road emissions and industrial accidents.[3] Indoor air pollution poses substantial health risks, contributing to conditions such as pneumonia, stroke, diabetes, lung cancer, and premature mortality.[4]

According to the WHO, indoor air pollution results in 3.8 million annual deaths, primarily stemming from combustion sources like solid fuels and tobacco smoke. PM2.5, a byproduct of incomplete SBF combustion, has significant health and climatic impacts.[5,6] Developing nations relying on unclean fuels face risks from pollutants like sulfur dioxide and carbon monoxide affecting inadequately ventilated dwellings. Different cooking methods emit varying levels of particulate matter.[7,8] Women and children are disproportionately affected and

experience respiratory issues due to prolonged exposure to indoor smoke during cooking time.[9] The literature on indoor air pollution and its effects on health is extremely limited. Thus, this study conducted to assess the determinants of air pollution in urban households and its impact of health among the study population.

METHODS

Study area

A cross-sectional study conducted in the field practice area of UHTC, Chandabowdi which is under BLDE (DU), Shri B. M. Patil medical college, Vijayapura, Karnaataka, India.

Study period

Study was conducted from April 2023 to July 2023.

Study subjects

All house hold members residing in urban field practice area were included.

Sample size

With anticipated proportion of indoor air pollution i.e., difficulty in breathing 4.5%, the study required a sample size of 115 subjects with 95% level of confidence and 4% absolute precision.[1] Considering the dropout rate of 5%, the minimum sample size was calculated at 128.

Sampling technique

Eight gallies (streets) were chosen using a Simple random sampling technique (lottery method) out of the sixteen. A systematic random sampling method was used to select the households, yielding a sample size of 128.

Study technique

A cross-sectional survey using a semi-structured questionnaire was conducted through in-person interviews in the households of urban field practice area, after acquiring ethical clearance from the institutional ethical committee. All questionaries were made in English and then translated into the local language (Kannada), and administered after pilot testing. The questionnaire included socio-demographic variables of the households and variables to assess sources of indoor air pollution. The head of the household or any adult male/female in the household was interviewed after taking informed consent.

Random assessment of the characteristics of the environmental sanitation such as type of house, its nature, dampness, lighting, floor area, number of departing rooms, cross-ventilation, space between doors and windows, kitchen, kitchen drainage, etc., is done using a quantitative questionnaire with a yes/no response system. The results are scored as 0, 1, and 2. A score was computed based on all responses, and the characteristics of the household were categorized as either poor or satisfactory on the basis of responses. Details of the above scoring is given as supplementary data.

Inclusion criteria

Houses belonging to the urban field practice area and gives consent were included.

Exclusion criteria

If a household was found to be locked during the survey, they were not included. The study did not include those who were unwilling to participate.

Statistical analysis

Data were entered into a Microsoft Excel sheet and statistical analysis performed using SPSS-Version 26.

RESULTS

In this study, a total of 128 participants were included, with 47.6% falling within the 30-49 age group, 51.6% were females, and 81.3% were Hindus by religion. 25% of the study participants were illiterates and 30% had only preschool education. 84.5% of unemployed participants, 73.3% of laborers, 62.5% of farmers, and 25% of participants employed in other job categories. Around 33% of the participants belongs to joint family (Table 1).

Table 1: Sociodemographic profile of the participants.

	Variables	Frequency (n=128)	Percentage
Age (years)	<30	22	17.1
	30-49	61	47.6
	50-69	32	25
	70-79	9	7
	>80	4	3.12
Gender	Female	66	51.6
	Male	62	48.4
Religion	Hindu	104	81.3
	Muslim	24	18.8

Continued.

	Variables	Frequency (n=128)	Percentage
Education	Graduate	26	20.3
	Illiterate	32	25.0
	Postgraduate	2	1.6
	Pre-schooling	30	23.4
	PUC	16	12.5
	SSLC	22	17.2
Occupation	Agriculture	8	6.3
	Labors	30	23.4
	Others	20	15.6
	Services	12	9.4
	Unemployed	58	45.3
Total number of the family members	<5	75	58.6
	6-10	44	34.4
	11-15	5	3.9
	16-20	3	2.3
	>21	1	0. 8
Type of family	Nuclear	95	74.2
	Joint	33	25.7

Majority of households were continuous (89.8%). On the Nature of houses, 9.4% of houses were comes under Kutcha, 21.1% as Kutcha/Pucca, and 69.5% as Pucca. Lighting inadequacy were predominant among 84.45% of households. 91.4%, have fewer than 5 living rooms. Around 9.4% lack separate bathing facilities, and 2.3% have bathing within their kitchens. Approximately 5 households do not have latrines, 94% practice unsanitary house waste disposal. Mosquito presence is observed in 58.6% of households. 3.1% of households were keeping cattles inside their house (Table 2).

TABLE 2: Contributing factors of indoor air pollution.

	Variables	Frequency n=128	Percentage
Type of house	Continous	115	89.8
	Separate	13	10.2
Nature of houses	Kutcha	12	9.4
	Kutcha/pucca	27	21.1
	Pucca	89	69.5
Lighting	Adequate	20	15.6
	Inadequate	108	84.4
Number of living rooms	<5	117	91.4
	6-9	6	4.7
	>10	5	3.9
Bathing facility	In kitchen	3	2.3
	Not separate	12	9.4
	Separate	113	88.2
Water supply	Safe	128	100
Latrines	No	5	3.9
	Yes	123	96.1
Sewage drainage	Surface	1	0.8
	Underground	127	99.2
House waste disposal	Unsanitary	94	73.4
	Sanitary	34	26.5
Mosquitoes	Absent	53	41.4
	Present	75	58.6
Cattle in house	Detached	4	3.1
	Inside the house	3	2.3
	Not applicable	121	94.5

TABLE 3: Sources of indoor air pollution.

	Variables	Frequency	Percentage
Overcrowding	Absent	90	70.3
	Present	38	29.7
Fuels	Firewood's	3	2.3
	LPG	125	97.7
Cross ventilation	Absent	42	32.8
	Present	86	67.2
Presence of chimney exhaust	No	104	81.3
	Yes	24	18.8
Neighborhood pollution	Present	97	75.8
	Absent	31	24.2
Small scale industries	Absent	107	83.6
	Present	21	16.4

The presence of overcrowding is evident in 38 households, amounting to 29.7%. Concerning fuel sources, firewood is used in a limited number of cases (3 instances, 2.3%), while LPG dominates in 125 cases, representing a substantial majority at 97.7%. The absence of cross ventilation is noted in 42 cases, constituting 32.8%, and the lack of a chimney exhaust is observed in 104 cases, making up 81.3%. Neighborhood pollution is prevalent in 97 cases, constituting 75.8%, approximately 16.4% of households have acknowledged experiencing the impact of small-scale industries near their premises (Table 3). In the study 44% of participants reported that their household members experienced respiratory symptoms in the preceding 6 months.

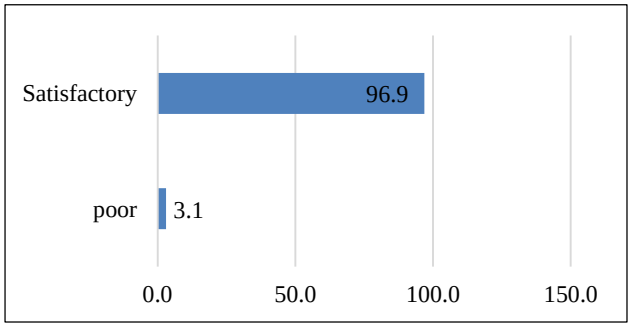

Figure 1: Scoring of the household characteristics.

DISCUSSION

Several studies suggested that both indoor and outdoor air pollution plays a key role in respiratory infections. Lung tissues were affected by the pollutants, especially particulate matter and other key factors involved are the environmental background of the urban areas and that of the fuel which they are using for the cooking purposes.[2]

According to NFHS-4, households using clean fuel for cooking were around 83.8% in Karnataka.[10] Our study shows 97.7% were using LPG and 2.3% were using firewood. This was similar to a study done in Salem, Tamil Nadu by Priyadarshini et al we found out that no one is using kerosene because of its unavailability.[1]

In our study, 29.7% of houses were overcrowded, indicating potential concerns about high occupant density. The absence of cross ventilation was noted in 42 cases (32.8%), and 104 cases lacked chimney exhaust, possibly due to inadequate education on indoor air pollution. It is crucial to raise awareness in the community about indoor air pollution and its effects. The absence of chimney exhaust may hinder effective pollutant dispersion. Additionally, the lack of distinct rooms in many houses, where a single room serves as both living space and kitchen, emphasizes the urgent need for intervention. Immediate action is necessary to improve slum residents' living conditions through well-designed housing solutions, addressing the close proximity of houses and inadequate window space contributing to indoor air pollution.

Most of the age group affected by the respiratory symptoms was the pediatric age group, which may be due to heightened exposure to the environment and their developing physiological systems; children are particularly vulnerable to its impacts, more so than adults.our study also shows the same result as the respiratory symptoms were predominant in the pediatric age group. Neighborhood pollution (75.8%) highlights the significant influence of outside factors on indoor air quality.these findings were similar to a study conducted by Maharana et al. A significant portion of households experienced indoor air pollution due to the infiltration of smoke and dust from external sources, particularly vehicular exhausts.[5]

This study has some limitations. The evaluation of indoor air pollution impact relied on perceived symptoms rather than the optimal PM 2.5 concentration. Additionally, pulmonary function assessment using a spirometer was

omitted, preventing the examination of synergistic influences resulting from multiple exposure.

CONCLUSION

This study highlights indoor air pollution's adverse effects on human health, emphasizing ventilation's pivotal role. Urgency in public awareness and policy interventions is stressed. Mitigating risks requires clean technologies, enhanced building design, and lifestyle changes. Ongoing monitoring and collective efforts are crucial for fostering healthier indoor environments and ensuring a sustainable future.

Recommendations

Recommendations to prevent indoor air pollution include prioritizing ventilation, enforcing no-smoking policies, and promoting clean cooking practices. Regular cleaning, incorporating indoor plants, and using low-emission products aid in reducing pollutants. Conducting radon tests and controlling humidity are essential. Undertake public education initiatives to raise awareness and foster healthier indoor environments, collectively minimizing the risks associated with indoor air pollution.

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PROFORMA USED FOR HOUSEHOLD SCORING

S. no.	Information about house	0	1	2	Total
1	Type of house	Continuous	Back to back	Separate	
2	Nature of house	Kutcha	Kutcha /pucca	Pucca	
3	Dampness	Present	Absent		
4	Lighting	Inadequate	Adequate		
5	Floor space	Below 50 sq.feet	50-100 sq .feet	Above 100 sq.feet	
6	No of leaving rooms	0	1	2	
7	Cross ventilation	Absent	Present		
8	Doors and window spaces	inadequate	Adequate		
9	Kitchen	No separate	Sepearte		
10	Kitchen drainage	Absent	Present		
11	Fuel	Smoke / forming	Smokeless		
12	Bathing facility	Not separate	In kitchen	Separate	
13	Water supply	Unsafe	Safe		
14	Latrine	No	Yes		
15	Sewage drainage	Surface	Underground		
16	House waste disposal	insanitary	Sanitary		
17	Mosquitoes	Present	Absent		
18	Housefly	Present	Absent		
19	Bedbugs	Present	Absent		
20	Total				