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ASSESSING THE HEALTH IMPLICATIONS OF RESIDENTIAL INDOOR AIR POLLUTION IN CALABAR METROPOLIS, NIGERIA.

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Abstract

This study aims to assess the impact of indoor pollution on human health in Calabar Municipality, focusing on the relationship between indoor air quality and the prevalence of respiratory and cardiovascular diseases among residents. A cross-sectional survey design was adopted for this study, with data collected from a representative sample of households within Calabar Municipality. Indoor air quality was assessed using portable air monitoring devices to measure pollutants such as particulate matter (PM), carbon monoxide (CO), and volatile organic compounds (VOCs). Health data were collected through questionnaires and medical records, focusing on the prevalence of respiratory and cardiovascular diseases among the residents. Additionally, interviews with key stakeholders and a review of existing policies were conducted to evaluate the effectiveness of indoor air quality regulations. The findings reveal that indoor air pollution levels in many households exceed the World Health Organization (WHO) recommended limits, with high concentrations of PM, CO, and VOCs detected. The prevalence of respiratory diseases such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD), as well as cardiovascular conditions like hypertension, is significantly higher among residents exposed to poor indoor air quality. The study also identifies major sources of indoor pollution, including cooking with biomass fuels, inadequate ventilation, and the use of chemical-based household products. In conclusion, indoor pollution poses a significant health risk to residents of Calabar Municipality, with a strong correlation between poor air quality and the prevalence of respiratory and cardiovascular diseases. The study recommends the enforcement of stricter indoor air quality regulations, the promotion of cleaner cooking technologies, and public awareness campaigns on the health risks of indoor pollution to improve air quality and protect public health in Calabar Municipality.

Keywords: Indoor Air pollution; respiratory disease; Air quality regulations; volatile organic compounds; Exposure

1. Introduction

Volatile organic compounds (VOCs) from paints and cleaning supplies, radon, mould, particle matter from tobacco smoke, and home chemicals are examples of common indoor contaminants. Indoor pollution has a wide range of detrimental effects on health, from cancer and cardiovascular disorders to respiratory conditions like asthma and chronic obstructive pulmonary disease (COPD). Kumar, Singh, Arora, Singh, & Singh, R. (2023) point out that indoor air

pollution has serious public health consequences, as it causes over 3.8 million premature deaths per year. The impacts of indoor pollution are especially dangerous for the elderly, children, and those with pre-existing medical issues.

Significant environmental effects of indoor pollution have an impact on human health both directly and indirectly. Air quality deteriorates in confined spaces due to the accumulation of pollutants such as particulate matter, biological contaminants (dust mites, mould), and volatile organic compounds (VOCs) (Kumar, Singh, Arora, Singh, & Singh, 2023). Numerous health problems, such as allergies, cardiovascular disorders, and respiratory diseases, are exacerbated by poor indoor air quality. For example, extended exposure to indoor air pollutants such as formaldehyde, which is included in household and construction items and has been identified as a human carcinogen, can cause chronic respiratory issues (Maung, Bishop, Holt, Turner, & Pfrang, 2022). Additionally, because vulnerable groups like children and the elderly are more susceptible to its impacts, indoor pollution exacerbates environmental health inequities.

In Nigeria, indoor pollution is mostly caused by human activity, which has an adverse effect on people's health and general well-being (Nimlyat, Salihu, & Wang, 2024). Using biomass fuels for cooking and heating, such as wood, charcoal, and kerosene, can be a common source as they produce harmful pollutants such carbon monoxide and particulate matter. Research indicates that around 70% of households in Nigeria depend on these conventional fuels, which contributes to high levels of indoor air pollution (Addo & Olajide, 2021). Many homes have inadequate ventilation, which makes it worse for these pollutants to build up and raises the risk of cardiovascular disease, respiratory ailments, and unfavourable pregnancy outcomes. In addition, the pollution burden is increased using low-quality building materials and household goods that release volatile organic compounds (VOCs).

Numerous indoor pollution sources make the effects of indoor pollution on human health in Calabar Metropolis a serious public health concern. These contaminants include emissions from building materials and household items, tobacco smoke, and biomass fuels used for heating and cooking. The use of conventional cooking techniques increases the concentration of dangerous compounds including carbon monoxide and particulate matter, especially in areas with inadequate ventilation (Giwa, Nwaokocha, & Sharifpur, 2022). Research has demonstrated that exposure to these pollutants can cause heart problems, respiratory disorders, and other health problems, especially in susceptible groups including the elderly and children (Ciobanu, Fokkema, & Nedelcu, 2020).

2. Material and methods

Calabar Metropolis lies between longitudes $8^0$18’00’’E to $8^0$24’00’E and latitudes $4^0$54’00’’N to $5^0$04’00’N, bounded by Calabar River, at the west, Kwa River towards the East, Odukpani L.G.A to the Northern sphere, its creeks empty into the Atlantic Ocean through the south. The metropolis has a land area of 406 square kilometers (Fig. 1 is a map of the study area).

The descriptive survey research design was adopted for the study. This design allows for the systematic collection and analysis of data to describe the characteristics of the population being studied, particularly in terms of exposure to indoor pollutants and associated health outcomes (Noel, Vanroelen, & Gadeyne, 2021). The types of data collected for the study included data on; the levels of indoor air pollutants in

households across Calabar Municipality, the prevalence of respiratory and cardiovascular diseases among residents exposed to indoor pollution in Calabar Metropolis, and sources of indoor pollution contributing to poor air quality in Calabar Municipality. Data for the study were obtained from both primary and secondary sources and thus, the sample size for this study was 384 households drawn from the population of this study comprising approximately 1,232 households across Calabar Municipality, Cross River State, Nigeria. The stratified random sampling technique was adopted to ensure that the diverse demographic and socio-economic characteristics of the population in Calabar Metropolis were adequately represented. The metropolis was divided into distinct strata based on key factors such as geographic location, housing types, and income levels. Within each stratum, households were randomly selected to participate in the study, allowing for a more comprehensive and balanced collection of data. The data collection for this study was conducted using a combination of structured questionnaires, air quality monitoring, and health assessments. Structured questionnaires were administered to a sample of residents across various households in Calabar Metropolis to gather information on their exposure to indoor air pollution, including the types of fuels used for cooking, the presence of ventilation systems, and their awareness of indoor air quality regulations.

Air quality monitoring was another critical method employed in this study. Portable air quality monitors were used to measure levels of key indoor air pollutants such as particulate matter (PM2.5), carbon monoxide (CO), and volatile organic compounds (VOCs) within the selected households. The measurements were taken at different times of the day to capture variations in pollutant levels. In addition, health assessments were conducted in collaboration with local healthcare providers, where residents who reported symptoms of respiratory or cardiovascular diseases were examined. Their medical records were reviewed to establish any correlation between their health conditions and exposure to indoor pollutants. It was hypothesized that increased exposure to indoor pollutants in Calabar Metropolis correlates with higher incidence rates of respiratory illnesses among residents. This was tested using Pearson's correlation analysis was used.

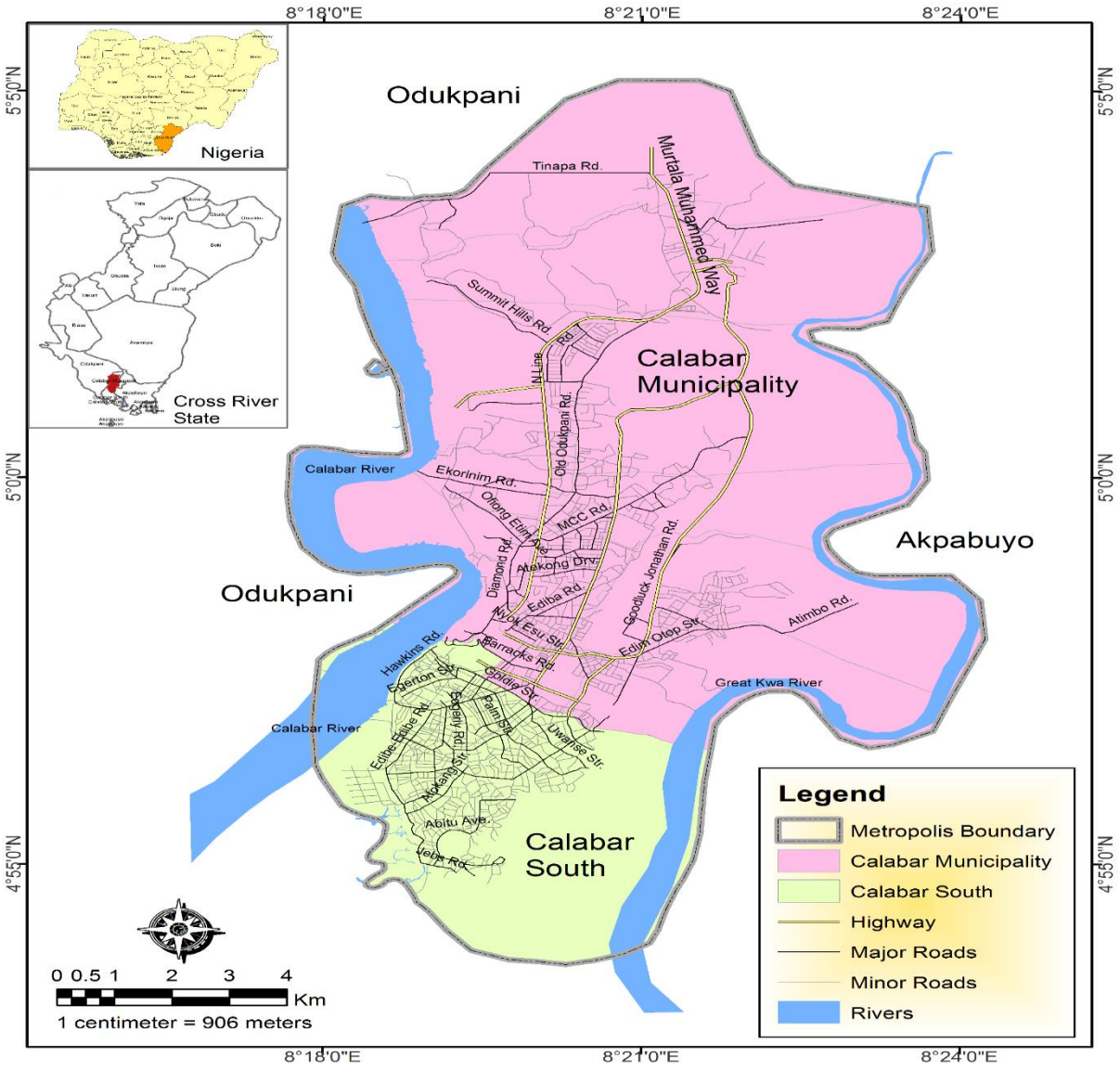

FIG. 1: Map of Calabar metropolis
Source: Surveyor General office CRS, 2023 modified by the Authors, 2024

3. Result and Discussion

3.1 Levels of Indoor Pollutants

Table 1 details the primary sources of indoor air pollution as reported by respondents. The most identified source of indoor air pollution is the use of chemical cleaners, with 123 respondents (32.1%) citing it as the primary contributor. This indicates a significant concern regarding the impact of cleaning products on indoor air quality. Following closely are dust and allergens, reported by 115 respondents (29.9%), highlighting the common issue of particulate matter affecting indoor environments.

Cooking fumes are identified as the primary source of indoor air pollution by 89 respondents, making up 23.2% of the sample. This suggests that activities related to food preparation contribute notably to indoor air quality concerns. Tobacco smoke, while still a significant factor, is reported by 57 respondents (14.8%), which is the smallest proportion among the listed sources. This may reflect varying levels of smoking prevalence or the effectiveness of smoking bans or restrictions. Overall, the table underscores the diverse sources of indoor air pollution, with chemical cleaners' dust and allergens being the most prominent concerns
.

Table 1: Sources of indoor air pollution at home

Sources of pollution	Frequency	Percentage
Tobacco smoke	57	14.8
Cooking fumes	89	23.2
Dust and allergens	115	29.9
Use of chemical cleaners	123	32.1
Total	384	100.0

Source: Authors fieldwork, 2024

Table 2 presents respondents' perceptions of which indoor pollutants they believe to be most harmful to health. The highest proportion of respondents, 104 individuals (27.1%), identified particulate matter as the most harmful indoor pollutant. This suggests a significant concern about the health impacts of fine particles suspended in the air, which can have serious respiratory and cardiovascular effects. Volatile organic compounds (VOCs) were cited by 97 respondents (25.3%) as the most harmful, highlighting concerns about chemical emissions from various household products that can contribute to poor indoor air quality and health issues. Radon, a naturally occurring radioactive gas, was selected by 95 respondents (24.7%), indicating awareness of its potential dangers, despite its often less immediate visibility compared to other pollutants. Overall, the table reflects a diverse understanding of indoor air pollution, with particulate matter and VOCs being perceived as the most pressing health hazards. This distribution provides insight into the areas where public health messages and interventions might be most needed.

Table 2: Indoor pollutants do you believe is most harmful to health

Indoor pollutant	Frequency	Percentage
Carbon monoxide	88	22.9
Particulate matter	104	27.1
Volatile organic compounds	97	25.3
Radon	95	24.7
Total	384	100.0

Source: Authors fieldwork, 2024

Table 3 provides an analysis of the health symptoms respondents associate with indoor air pollution. The most frequently reported symptom is respiratory issues, experienced by 122 respondents or 31.8%. This high percentage highlights a significant concern about the impact of indoor air pollution on respiratory health, including conditions such as asthma, bronchitis, and general breathing difficulties.

Allergies are the second most common health symptom, reported by 97 respondents (25.3%). This indicates that a substantial number of individuals link their allergic reactions to indoor pollutants, which could include dust, mold, and pet dander. Allergic responses to indoor air quality issues are a notable concern, reflecting how pollutants can exacerbate existing sensitivities or trigger new allergic reactions.

Headaches are reported by 93 respondents (24.2%) as a health symptom associated with indoor air pollution. This suggests that a considerable portion of the sample experiences headaches that they attribute to poor indoor air quality, potentially due to exposure to chemical fumes or other pollutants. The smallest group, with 72 respondents (18.8%), reports no symptoms related to indoor air pollution. This figure represents a minority of the sample who do not experience noticeable health effects despite the presence of indoor pollutants. Overall, the table reveals a range of health symptoms linked to indoor air pollution, with respiratory issues being the most prevalent concern among respondents.

Table 3: Health symptoms experienced with indoor air pollution

Health symptom	Frequency	Percentage
Respiratory issues	122	31.8
Allergies	97	25.3
Headaches	93	24.2
No symptoms	72	18.8
Total	384	100.0

Source: Authors fieldwork, 2024

3.2 Prevalence of Respiratory and Cardiovascular Diseases Among Residents

The findings from Table 4 illustrate a significant health burden linked to indoor air pollution in Calabar Municipality. Of the 384 surveyed residents, 25% suffer from asthma, making it the most prevalent respiratory condition, while chronic bronchitis and COPD affect 15% and 10% of the population, respectively. Cardiovascular issues, notably hypertension, affect 30% of the respondents, indicating a clear association between poor indoor air quality and cardiovascular health.

The low prevalence of heart disease (5%) suggests that while present, it is not as widespread as other conditions. Interestingly, 15% of residents reported no diagnosed conditions, which may be due to limited access to healthcare or early stages of exposure without manifesting illness. Overall, the results demonstrate that exposure to indoor air pollution in the area correlates strongly with respiratory and cardiovascular diseases, reinforcing the need for better air quality management and public health interventions.

Table 4: Prevalence of Respiratory and Cardiovascular Diseases Among Residents

Health Condition	Frequency	Percentage (%)
Asthma	96	25
Chronic Bronchitis	58	15
Chronic Obstructive Pulmonary Disease (COPD)	38	10
Hypertension	115	30
Heart Disease	19	5
No Diagnosed Condition	58	15
Total	**384**	**100**

Source: Authors fieldwork, 2024

3.3 Public Awareness and Knowledge of Indoor Pollution

Table 5 evaluates respondents' perceptions of the effectiveness of public awareness campaigns about indoor pollution. The category "Slightly effective" receives the highest number of responses, with 114 individuals (29.7%) rating the campaigns in this manner. This suggests that while some respondents acknowledge the existence of public awareness campaigns, they view them as having only a limited impact on increasing awareness and driving action. The effectiveness of these campaigns may be perceived as marginal, indicating room for improvement in how information about indoor air pollution is communicated to the public.

The "Effective" category follows, with 95 respondents (24.7%) believing that public awareness campaigns are reasonably successful. This group recognizes some level of effectiveness in these campaigns but may still see potential for enhancement in their scope or reach. This moderate level of approval reflects a view that while the campaigns have had some positive impact, there remains a need for more robust or targeted efforts.

The "Very effective" category is chosen by 77 respondents (20.1%), indicating that a smaller segment of the sample views the campaigns as having a strong positive impact. These respondents feel that the

campaigns have significantly contributed to raising awareness and promoting action against indoor air pollution. Conversely, the "Not effective" category, selected by 98 respondents (25.5%), reflects a notable portion of the sample who feel that the campaigns have not achieved their intended goals. Overall, the table highlights mixed perceptions regarding the effectiveness of public awareness campaigns, with a majority seeing room for improvement in enhancing their impact.

Table 5: Effectiveness of public awareness campaigns about indoor pollution

Effectiveness rating	Frequency	Percentage
Very effective	77	20.1
Effective	95	24.7
Slightly effective	114	29.7
Not effective	98	25.5
Total	**384**	**100.0**

Source: Authors fieldwork, 2024

The findings from the survey provide a comprehensive view of the respondents' perceptions and behaviors regarding indoor air pollution. Table 7 reveals the level of knowledge respondents have about the sources of indoor air pollution. Most respondents are "Slightly knowledgeable" (30.2%), with 103 individuals (26.8%) being "Somewhat knowledgeable." This indicates a general awareness of indoor air pollution sources but also highlights a significant proportion who may not fully understand the extent of the problem. The relatively lower percentage of those who are "Very knowledgeable" (19.3%) suggests that there is room for improvement in educating the public about the various sources and health impacts of indoor pollutants.

Health symptoms associated with indoor air pollution reveal that a significant number of respondents experience "Respiratory issues" (31.8%), which is the most reported health effect. This is followed by "Allergies" (25.3%) and "Headaches" (24.2%). The fact that 18.8% report "No symptoms" suggests that while many are affected, a substantial portion may not connect their health issues to indoor air pollution or might not experience noticeable symptoms

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4. Conclusion

The findings of this study highlight the significant health risks posed by indoor air pollution in Calabar Municipality, Nigeria. A large proportion of the residents, as indicated by the data, suffer from respiratory and cardiovascular conditions such as asthma, chronic bronchitis, COPD, and hypertension, which are closely associated with exposure to poor indoor air quality. The primary sources of indoor pollution cooking with biomass fuels, inadequate ventilation, and the use of chemical-based household products have been identified as critical factors contributing to the degradation of air quality within households. The high prevalence of these health conditions emphasizes the urgent need for interventions to mitigate the adverse effects of indoor pollution on the community's health.

5. Recommendations

Based on the findings of the study, the following are recommended:

1. The government should introduce and enforce stricter regulations on indoor air pollutants, particularly concerning emissions from cooking and chemical cleaners.
2. Regular assessments of indoor air quality should be conducted by the Department of Environmental Health to monitor pollution levels and ensure they remain within safe limits.
3. The National Orientation Agency (NOA) and relevant non-governmental organizations (NGOs) such as the Environmental Rights Action (ERA) should spearhead public education campaigns to improve awareness about indoor air pollution and its health impacts.

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