Causative Factors of Indoor Air Pollution in Nigerian Households

Omole D. O., Azubuike T. U., Ogbiye A. S., Ede A. N., Ajayi O. O.
Department of Civil Engineering,
Covenant University,
Ota, Nigeria.
david.omole@covenantuniversity.edu.ng

Abstract - **Air pollution is one of the leading causes of human mortality in the world. Within a space of one year, 396,000 deaths arising from indoor air pollution (IAP) in sub-Sahara Africa was reported in 2006. Besides the loss of human lives, public health challenges such as pneumonia in children, asthma, tuberculosis, upper airway cancer and cataract are caused or aggravated by IAP. A study was conducted among households in Lagos and Ogun States in order to determine risk patterns of IAP among residents through the distribution of questionnaires to 2000 households. Random sampling was adopted in the distribution of the questionnaires. A total of 1,616 responses (81% return rate) was achieved. Questions addressed include type of building, smoking habits of residents, use and location of electricity generating sets, location of cooking, cooking methods and use of alternative lighting system in the event of power failure. Results indicate that 62.2% of the residents lived in buildings where some form of commercial activities are taking place. Also, 6.4% of the residents admitted to smoking within living quarters, 9.2% used electricity generators within the building confines; about 35.2% used kerosene stoves for cooking; and 4% of the respondents cooked in kitchens where there was no proper ventilation. 18.3% of the respondents used candle for lighting in closed rooms while 14.4% used palm oil lit lamps. It was concluded that the use of IAP enhancing methods of illumination and cooking within the households were informed by poverty, poor ventilation within households, security related issues. The enforcement of building codes and environmental regulations could forestall avoidable deaths in future.**

Keywords: Air, pollution, environment, building, sampling, public health.

I. INTRODUCTION

Air pollution can be classified into two categories: outdoor air pollution (OAP) and indoor air pollution (IAP) [1]. Global data, however, shows that IAP is far more lethal than OAP [2]. While less than 300 deaths per million people arising from OAP was reported in 2004, approximately 2,200 deaths per million people arising from IAP was reported in the same year [1-2]. World Health Organization, [3] using data gathered from around the world, also reported that 1.6 million people died from cooking stove fumes. Of the 1.6 million deaths, 396,000 deaths occurred in sub-Sahara Africa, with highest incidents occurring in Nigeria [4]. Another WHO report posited that 78% of African population used biomass burning to cook and that a third of infant deaths associated with IAP occurred in Africa [5]. Health complications arising from IAP include pneumonia in children, asthma, tuberculosis, upper airway cancer and cataract [2]. Aside cooking sources, other common sources of IAP include mosquito repellant fumes, electricity generator fumes, and cigarettes [2, 4-5]. The main casualties of IAP are always children. Sofoluwe [6] visited the homes of nearly 100 children who were his patients and were suffering from bronchiolitis and pneumonia. He observed that all the visited homes had high concentrations of carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and bezene which were responsible for the sickness in the children. In particular, CO is a very dangerous, colourless and odourless gas that arise from incomplete combustion of fuel in electricity generators and cars as well as wood fires. Health challenges that may arise from CO poisoning include vision and hearing impairment, cerebral congestion, fainting, headache, dizziness, asphyxia, edema and death [7-8]. Considering the seriousness of IAP in Africa and Nigeria in particular, the current study embarked on an investigation of domestic practices that may jeopardize public health. The study aims to proffer solutions that would reduce and possibly eliminate the risks of IAP by studying the underlying causes of IAP in Southern parts of Nigeria.

II. METHOD AND MATERIALS

A. Study Area

The study areas for this research was Lagos and Ogun States. These two states are situated in the south-western parts of Nigeria (Fig. 1).

Lagos State has a population of over 21 million people living in a 3,577 km^2 area [2,9]. This gives a population density of 5,870 persons/km^2. This high population density suggests the possibility of congestions in households. Ogun State, on the other hand, has a current estimated population of

5, 010, 251 (using a 3% growth rate and the 2006 census figures) [10]. Ogun State land mass is 16,720 km^2 [9] thereby giving a population density of approximately 300 persons/km^2. The State, however, has a high industrial presence, especially in Ota [11]. Most of these industries also generate air pollution, some of which may contribute to air pollution problems in the environment.

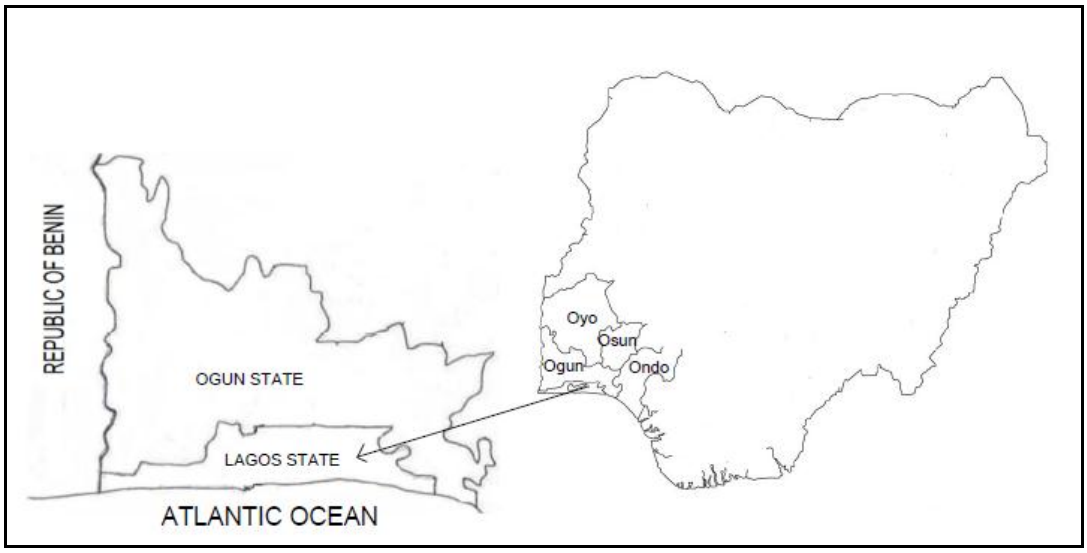

Fig. 1: Map of Ogun and Lagos States in South-west Nigeria

B. Data Collection

Data was collected through the administration of structured questionnaires which were distributed randomly within Lagos and Ogun States. In Lagos State, the questionnaires were distributed in Ikeja, Illupeju and Oshodi while in Ogun State, the questionnaires were distributed in Ota and Ewekoro. The choice of locations was informed by the relatively high population distribution in the respective locations, as well as the presence of industries which are likely to release gaseous and particulate emissions into the environment. Industrialized areas tend to serve as havens for job seekers. Thus, such areas have high population densities with many living in sub-human conditions [12]. A total of 2,000 questionnaires were distributed to the same number of households. However, only 1,616 completed questionnaires were retrieved, thus giving a return rate of 81%. Questions addressed in the questionnaires included type of building, smoking habits of residents, use and location of electricity generating sets, location of kitchen, cooking methods and use of alternative lighting system in the event of power failure. In the course of distributing the questionnaires, oral interviews were also conducted while visual observations of the state of ventilation in the households were also made.

III. RESULTS AND DISCUSSION

A. Types of Buildings

The respondents lived in different types of environments. While 89.4% lived in proper residences, 3.6% lived and worked within private school premises, 1.5% lived and worked within church buildings, 1% lived in industrial premises, 3.2 % lived in commercial/shopping complexes, and 1.2% lived in buildings designed for than one purpose (Fig. 1). This distribution shows that some people live in buildings meant for purposes other than residential.

B. Commercial activities in the Households

When asked if the buildings accommodated any form of commercial activities, 62.2 % of the respondents answered in the affirmative while 36.9% denied that any form of commercial activity took place in their households (Fig. 2). The significance of this question has to do with the fact that

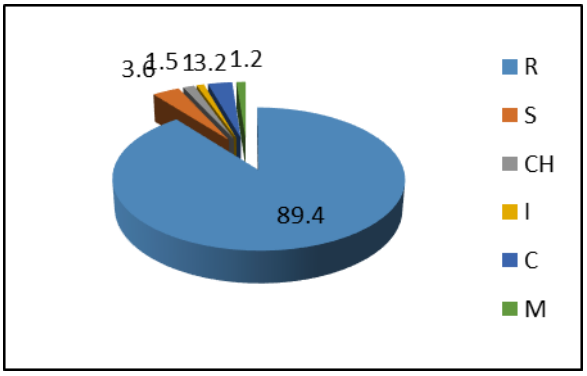

Fig. 2: Building type

commercial activities often require electricity supply which is in short supply in Nigeria. This often results in the use of electricity generating sets. Residents tend to simultaneously use multiple generating sets which result in both noise and air pollution in cramped spaces. When further asked why they indulge in this practice, respondents indicated that cost saving was the primary reason. The cost of paying separately for a shop and the cost of travelling to the workplace was saved when the commercial activity is accommodated in the residence. The opportunity cost of this practice, however, may result in adverse effects on public health.

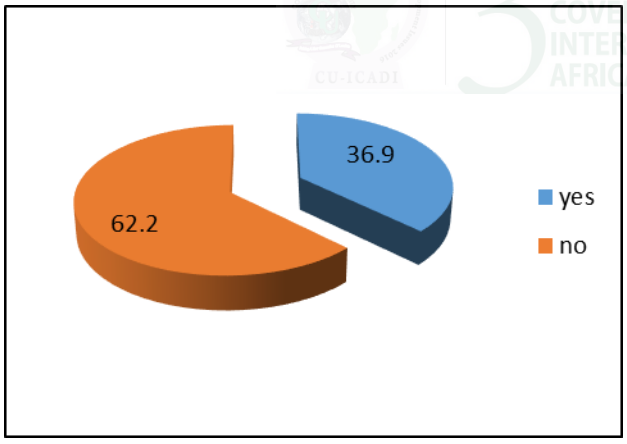

Fig. 2: Proportion of households with commercial activities in the building

C. *Ownership of Electricity Generating Sets*

In response to the question on ownership and operation of electricity generating sets in the households, 95.7% of the respondents responded in the affirmative (Fig. 3). Furthermore, 77.6% of the respondents indicated that the generators were kept outside the building while 9.2% kept the generators within the building while in operation. The reasons given for keeping an operational generating set in closed living quarters included protection of the generator from theft and from the elements such as rain or extreme heat.

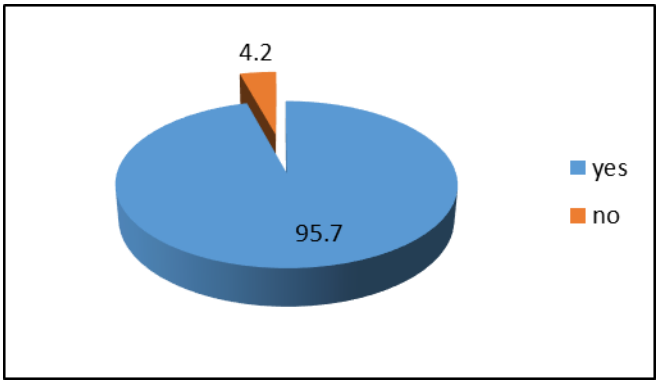

Fig. 3: Proportion of respondents that own electricity generating sets

D. *Indoor cigarette Smoking*

When asked if any of the respondents smoked in the home, 93.3% responded in the negative while 6.4% responded in the affirmative (Fig. 4). Most of the respondents also indicated their awareness of the carcinogenic effects of cigarette smoke, thus explaining the low population of indoor smokers in this research.

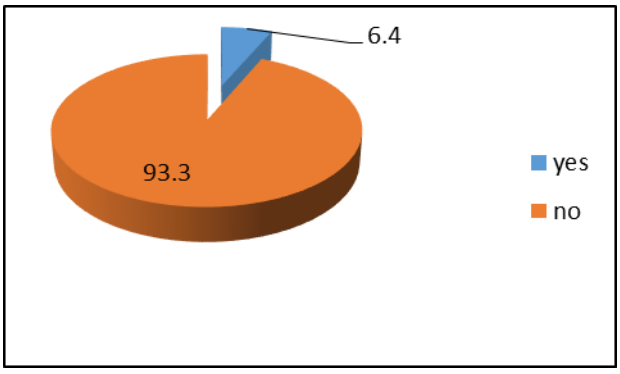

Fig. 4: proportion of respondents that smoke cigarette in the living quarters

E. Energy sources for Cooking

The distribution of the respondents according to energy sources for cooking are as follows: 18% used electricity, 17.7% used gas, 35.2% used kerosene, while 30% used other energy sources which include sawdust, biomass, and biogas.

F. Kitchen location

The proportion of respondents whose kitchens were indoors were 87.4%, while 12.6% situated their kitchens outdoors. 96 % of the respondents believe that their kitchens are well aerated while 4% admitted that their kitchens are not ventilated enough.

G. Alternative lighting in the homes

A major source of IAP in the homes is the alternative lighting sources when there is power cut. Many residents said they keep their windows locked when going to bed while also keeping their lighting on. Rechargeable lanterns were used by 49.4% of the respondents, 18.3% used candles, 14.4% used palm oil lit lanterns, 17.7% used kerosene lit lanterns, while 0.2% did not indicate their alternative lighting sources (Fig. 5). Of this proportion, 69.6% admitted that their left their lighting on while asleep while 30.4% turn off their alternative lighting when going to sleep. Leaving the light on can be dangerous, especially when the alternative lighting source is a candle, palm oil lantern or kerosene lantern. Moreover, candles and kerosene produce fumes that that may adversely impact on human health.

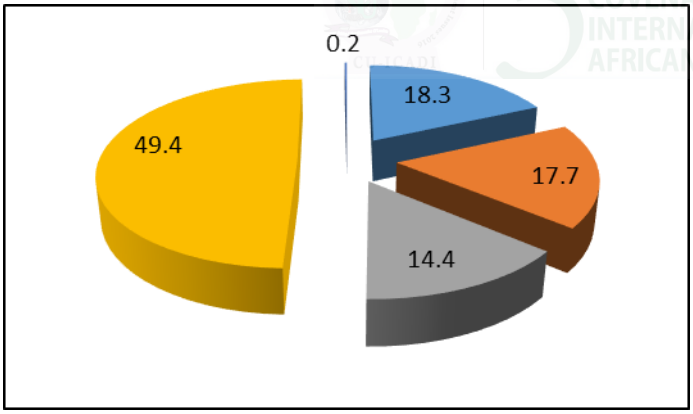

Fig.5: Distribution of respondents according to alternative lighting sources

IV. CONCLUSION

This study showed that many Nigerians are exposed to air pollution arising from generator fumes, residing in non-residential buildings, sleeping with actively burning candle/kerosene lamps in a locked room, and cooking in poorly ventilated kitchens. In order to save costs, some residents lived in their work places while many operated commercial activities in their homes. Many of such commercial activities required electricity generating sets which impact adversely on the standard of living through the release of carbon monoxide and noise pollution. It is therefore recommended that town planning officials should enforce strict compliance with building codes and the uses to which such building are put. Commercial activities should be restricted to commercial buildings while residential areas should be kept free of any unnecessary noise and air pollution that may arise from commercial activities. All buildings that fail to meet standards regarding kitchen sizes, and proper ventilation should not be approved for construction. Moreover, routine inspections should be carried out on such buildings to ensure continual compliance. Furthermore, advocacy programs should be carried by non-governmental organizations, schools, religious organizations and govern agencies to educate the general population on the dangers of IAP, in order to forestall preventable mortalities, especially among children.

REFERENCES

[1] United Nations (UN), ''Sustainability and equity: A better future for all'', Human Development Report 2011, United Nations Development Program: New York, NY, USA, 2011.

[2] D.O. Omole and J.M. Ndambuki, ''Sustainable Living in Africa: Case of Water, Sanitation, Air Pollution & Energy'', Sustainability 2014, 6(8): 5187-5202.

[3] World Health Organization (WHO), ''Fuel for Life: Household Energy and Health'', 2006, Available online: http://www.who.int/indoorair/publications/fuelforlife.pdf (Accessed 23rd March 2016).

[4] S. Margulis, M. Paunio, A. Acharya, ''Addressing Indoor Air Pollution in Africa: Key to Improving Household Health'', 2006. Available online: http://www.unep.org/urban_environment/PDFs/IAPAfrica.pdf (Accessed 23rd March 2016).

[5] World Health Organization (WHO), ''Indoor air pollution, health and burden of disease'', Indoor air thematic briefing 2, Geneva, Switzerland, 2007. Available at http://www.who.int/indoorair/info/briefing2.pdf. Accessed 23rd March 2016.

[6] G.O. Sofoluwe, ''Smoke pollution in dwellings of infants with bronchopneumonia'', Arch. Environ. Health 1968; 16: 670-672.

[7] UNEP, ''Report on Atmosphere and Air Pollution'', African Regional Implementation Review for the 14th Session of the Commission on Sustainable Development (CSD-14), 2005. http://www.un.org/esa/sustdev/csd/csd14/ecaRIM_bp2.pdf. Accessed 23rd March 2016.

[8] T.M. Marufu, ''Photochemistry of the African Troposphere: The influence of Biomass Burning'', PhD Thesis, University of Utrecht, 1999.

[9] D.O. Omole and S.A. Isiorho, ''Waste Management and Water Quality Issues in Coastal States of Nigeria: The Ogun State Experience'', Journal of Sustainable Development in Africa, 2011, 13(6):207-217.

[10] Federal Republic of Nigeria (FRN), ''Legal Notice on Publication of the 2006 Census Report'', FRN official Gazette, 2007, 4(94): 1-8.

[11] D.O. Omole, ''Reaeration Coefficient Modelling: Case study of River Atuwara, Ota, Nigeria'', LAP Lambert Academic Publishing GmbH & Co. KG, Saarbrücken, Germany, 2011. ISBN: 978-3-8443-3177-6.

[12] D.O. Omole and J.M. Ndambuki, ''Nigeria's Legal Instruments for Land and Water Use: Implications for National Development'', In Evans Osabuohien (Ed): *In-Country Determinants and Implications of Foreign Land Acquisitions*, 2015: 354-373). IGI GLOBAL, Hershey, PA, USA: Business Science Reference. DOI: 10.4018/978-1-4666-7405-9.ch018.