AJEHS
African Journal of Environmental Health Sciences
Volume 7, November, 2020
http://www.ehsanonline.org
ISSN: 2476-8030 (Prints)
ISSN: 2714-2930 (Online)
pp 21-31

Risk Factors for Indoor Air Pollution Exposure in Households in Kasangati Town Council, Wakiso District, Uganda

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Keywords:
Indoor Air Pollution, Ventilation, Kasangati Town Council, Housing Characteristics, Uganda

Mots clés:
Pollution de l'air intérieur, Ventilation, connaissances, caractéristiques du logement, pratiques

Abstract

Globally, indoor air pollution is an increasing environmental and public health problem due to several factors such as inefficient burning of solid and fossil fuels including wood, charcoal and kerosene. Indoor air pollution is particularly a significant problem in Sub-Saharan Africa (SSA) including Uganda where the use of such solid fuels is common. This study therefore assessed the risk factors for indoor air pollution exposure in households in Bulamu Ward, Kasangati Town Council, Wakiso District, Uganda. A cross-sectional study involving quantitative data was carried out among 96 households. Systematic sampling was employed to obtain the households involved in the study. Data were collected using a researcher-administered questionnaire by means of Epi-collect 5 software on a mobile phone and analysed using STATA version 13.0. The most common sources of indoor air pollution were solid-fuel smoke (99.0%), dust (89.6%) and indoor smoking (60.4%). The most mentioned potential health effects due to indoor air pollution were cough/cold (79.2%), difficulty in breathing (59.4%), and lung complications (53.1%). The majority of households (87.5%) used charcoal for cooking and 11.5% of respondents cooked inside their houses. Over half of the respondents (54.2%) lived in a house with only one window and only 30.2% houses had windows that allowed cross or through ventilation. The measures suggested against indoor air pollution included cooking outdoors (95.8%) and stopping smoking indoor (70.8%). There was considerable knowledge on common sources, potential health effects and measures to reduce indoor air pollution. However, risk factors identified such as poor house ventilation need to be addressed to reduce the potential effects of indoor air pollution.

Les Facteurs de risque d'exposition à la pollution de l'air intérieur chez les ménages du conseil municipal de Kasangati, district de Wakiso, Ouganda

Abstrait

À l'échelle mondiale, la pollution de l'air intérieur est un problème croissant d'environnement et de santé publique en raison de plusieurs facteurs tels que la combustion inefficace de combustibles solides et fossiles, notamment le bois, le charbon de bois et le kérosène. La pollution de l'air intérieur est un problème particulièrement important en Afrique *subsaharienne (ASS), y compris en Ouganda, où l'utilisation de ces combustibles solides est courante. Cette étude a donc évalué les facteurs de risque d'exposition à la pollution de l'air intérieur dans les ménages du quartier Bulamu, conseil municipal de Kasangati, district de Wakiso, Ouganda. Une étude transversale impliquant des données quantitatives a été menée auprès de 96 ménages. Un échantillonnage systématique a été utilisé pour obtenir les ménages impliqués dans l'étude. Les données ont été collectées à l'aide d'un questionnaire administré par des chercheurs au moyen du logiciel Epi-collect 5 sur un téléphone mobile et analysées à l'aide de la version 13.0 de STATA. Les sources les plus courantes de pollution de l'air intérieur étaient la fumée de combustible solide (99,0%), la poussière (89,6%) et le tabagisme à l'intérieur (60,4%). Les effets potentiels sur la santé les plus mentionnés en raison de la pollution de l'air intérieur étaient la toux / le rhume (79,2%), les difficultés respiratoires (59,4%) et les complications pulmonaires (53,1%). La majorité des ménages (87,5%) utilisaient du charbon de bois pour cuisiner et 11,5% des répondants cuisinaient à l'intérieur de leur maison. Plus de la moitié des répondants (54,2%) vivaient dans une maison avec une seule fenêtre, et seulement 30,2% des maisons avaient des fenêtres qui permettaient une ventilation transversale ou à travers. Les mesures suggérées contre la pollution de l'air intérieur comprenaient la cuisson à l'extérieur (95,8%) et l'arrêt du tabac à l'intérieur (70,8%). Il y avait des connaissances considérables sur les sources communes, les effets potentiels sur la santé et les mesures de réduction de la pollution de l'air intérieur. Cependant, les facteurs de risque identifiés tels que la mauvaise ventilation des habitations doivent être traités pour réduire les effets potentiels de la pollution de l'air intérieur.*

Introduction

Globally, indoor air pollution is an increasing public health problem particularly due to continued inefficient burning of solid and fossil fuels such as wood, charcoal and kerosene. In addition, smoking indoor as well as poor ventilation in houses are also prevalent and contributes to reduced indoor air quality. Indoor air pollution is therefore a significant problem in many parts of Sub-Saharan Africa (SSA) and elsewhere such as South and East Asia and the Pacific where use of such solid fuels is common (Roser and Hannah, 2018). Globally, SSA has the least access to clean energy and improved cooking technologies which increases its problem of indoor air pollution. Women and children in areas characterized by poverty are often exposed to household indoor air pollution because the time spent in or near kitchens where most burning of solid fuels take place (Gordon *et al.,* 2014). These groups should therefore be considered high-risk regarding indoor air pollution. Hence, interventions targeting them are warranted. About 3 billion people worldwide rely on solid fuel inform of wood, animal dungs, charcoal, crop wastes and coal(WHO, 2018).

Close to 1 billion people globally lack access to electricity; therefore, they are likely to use dangerous energy sources such as simple fuel and oil lamps (UN, 2018). Indeed, more than 60% of the population in most developing countries including Uganda, Ethiopia and Kenya relies on kerosene for lighting (Lam *et al.,* 2012). In Uganda, about 94% of the total population uses solid fuel for cooking (UBOS, 2018).

Other factors that increase exposure to indoor air pollution include confined and poorly ventilated buildings, construction of housing and furniture with pollutants such as lead and asbestos, use/storage of pesticides, and indoor tobacco smoking. In addition, cooking indoors can lead to a high concentration of air pollutants which is exacerbated by poor ventilation. These pollutants become harmful to the health of household members, yet formal housings are unaffordable to many households in SSA (Parby *et al*., 2015). Such individuals therefore resort to informal housing which may be characterized by structures with poor integrity and without appropriate facilities such as proper ventilation and adequate size.

Housing is directly linked to income level therefore in areas with high poverty, poor housing will be predominant. Efforts have however been made in parts of South and East Asia and the Pacific to improve access to proper housing with ongoing development that has increased interest in affordable housing schemes (Siew, 2017), few efforts are made in same direction in Africa (IFC, 2018).

Globally, about a quarter of all people are exposed to second-hand smoke notably in many countries in Asia, including in indoor environments such as restaurants (Jeffrey *et al.,* 2018). In addition, half of children younger than 15 years are exposed to second-hand tobacco smoke at home globally (Mbulo *et al.,* 2016). In Uganda, at least 60% of the population have been exposed to second-hand smoke in indoor environments (MoH, 2013). Indoor environments may also be polluted by other substances such as mould, dust, pollen and pathogenic microorganisms. Indeed, studies have found mould in kitchens, bathrooms and living rooms in a significant number of homes (Gqaleni, 2002) and significant levels of radon in homes (Usikalu *et al.,* 2017).

The World Health Organization (WHO) estimates that about four million deaths each year are attributed to indoor air pollution (WHO, 2018) which is predominantly from solid fuel smoke. Improved indoor air quality has a number of benefits some of which are direct and others indirect. These benefits include improved health of the population, reduced environmental degradation, socio-economic development, and climate change mitigation. In order to control indoor air pollution, any solutions put in place should be informed by reliable information. Data from research and programme implementation is therefore important in controlling indoor air pollution. However, there is limited data on indoor air pollution in Uganda to inform policies and practices. Deliberate efforts are therefore required to gather reliable information on indoor air pollution within the country including in urban settings which are many times ignored. This study assessed risk factors for indoor air pollution exposure in households in Bulamu Ward, Kasangati Town Council, Wakiso District, Uganda.

Materials and Methods

Study area and setting

The study was carried out in Bulamu Ward, Kasangati Town Council, Wakiso District, Uganda. Kasangati Town Council is located about 16.5 km north of Kampala, the country's capital city, along Kampala-Gayaza road in the central region of the country. Kasangati is bordered by Nansana Municipality to the north, west and south west; Kira Municipality to the east and south east; and Kampala to the south. The Town Council had a projected population of 194,900 in 2019 and is made up of nine wards: Bulamu, Gayaza, Katadde, Kabubbu, Masooli, Nangabo, Wampeewo, Wattuba and Kiteezi. BulamuWard was randomly selected among the wards for inclusion in the study. The Ward is made up of five zones: Bulamu-Deputy, Bulamu-Kasangati, Namavundu, Kayebe and Kyetume-B. The Ward is a peri-urban setting characterized by many economic activities and recreation spotssuch as bars and lounges. The main economic activities in the area include retail and wholesale shops, salons, small scale industries, supermarkets, eateries and markets. Health services available in the area are from clinics and pharmacies and health facilities including Kasangati Health Centre IV located in the centre of the Town Council. Other available social services include pipe-borne water, electricity, good road network and several primary and secondary schools.

Study Design and Participants

The study was cross-sectional in design and used quantitative methods of data collection. The study units were households in the area, while respondents were household heads. Household heads were involved in the study because it was anticipated that they knew more about their respective households concerning issues of indoor air pollution than other members. In the absence of a household head, another responsible member such as the spouse served as respondent in the study. The respondent should have been in the household for the past one year to be eligible to take part in the study.

Sample Size and Sampling Procedure

Using a formula for cross-sectional studies by Kish and Leslie (1965), an assumed prevalence of risk factors for indoor air pollution exposure of 94% (UBOS, 2018), a 95% confidence interval and adjustment for non-response rate, a sample size of 96 households was obtained. From the five zones in BulamuWard, Bulamu-Deputy was randomly selected to be involved in the study. Within the zone, the first household was randomly selected and subsequent households were obtained by a systematic sampling technique using a sampling interval of 21 households in order to come up with the required sample size. The sampling interval was obtained by dividing the approximate number of households in the zone (2,000 households) by the calculated sample size (96).

Data Collection

A structured questionnaire was designed in English and translated into *Luganda*-the most commonly spoken local language in the area. Pre-testing of the questionnaire was done in a similar area in Kyankima Zone, Gayaza Ward to check for comprehension of questions and appropriateness of responses before actual data collection. Data was collected using a researcher-administered questionnaire and an observational checklist to assess risk factors for indoor air pollution within the households. The questionnaire obtained data on demographics such as socioeconomic status, knowledge on sources of indoor air pollution, potential health effects and ways of reducing indoor air pollution. Other data obtained are practices related to indoor air pollution such as cooking place, main fuel used for cooking and indoor smoking. The observational checklist was used to obtain data on housing characteristics such as number of windows and doors, whether or not cross or through ventilation was available and the type of kitchen used. Both the questionnaire and observational checklist were designed and administered using Epi-collect 5, a data collection application using a mobile phone. The household heads (or other eligible participant such as spouse) of selected households were administered the questionnaire. In cases where there was no eligible person, the next household was administered the questionnaire. Before departure from each household, questionnaires were cross-checked to detect any wrong entries and corrections were made thereafter.

Data Analysis

The data collected in the Epi-collect 5 application on the mobile phone was uploaded on a server. The data file was then downloaded from the server and exported to STATA-version 13.0 software for analysis. Univariate analysis was done to come up with proportions which were used to construct frequency tables and graphs presented in the results.

Ethical consideration

Permission for carrying out the research was obtained from Makerere University School of Public Health as part of the Bachelors of Environmental Health Science programme, Wakiso District Local Government, and the Local Council in Bulamu-Deputy Zone. Written consent was obtained from the respondents before taking part after clearly explaining to them all aspects of the study.

Results

Socio-demographic Characteristics of Respondents

The mean age of the respondents was 31 years, and majority 68.8% (66/96) were between 18 and 30 years. The average household monthly income was 128 USD, with most households earning between 81 and 135 USD. The average number of people who were regularly staying within the households was five, with majority (51.0%, 49/96) having between four and six people. The majority of respondents 83.3% (80/96) were female, and 82.3% (79/96) were married while 62.5% (60/96) were employed. Regarding education, 29.2% (28/96) and 30.2% (29/96) had attained primary and secondary levels respectively as stated in Table 1.

Table 1: Socio-demographic characteristics of respondents

Variable	Frequency(N = 96)	Percentage (%)
Age (years)		
18 - 30	66	68.8
31 - 40	17	17.7
41 - 50	6	6.2
> 50	7	7.3
Occupation		
Self employed	36	37.6
Employed (not in civil service)	18	18.7
Housewife	18	18.7
Unemployed	18	18.7
Employed (civil service)	6	6.3
Gender		
Male	16	16.7
Female	80	83.3
Religion		
Catholic	29	30.2
Anglican	24	25.0
Pentecost	21	21.9
Muslim	14	14.6
Seventh Day Adventist	7	7.3
Others	1	1.0
Tribe		
Baganda	63	65.6
Banyankole	11	11.5
Basoga	7	7.3
Banyoro	3	3.1
Itesot	2	2.1
Langi	2	2.1
Others	8	8.3
Highest level of education		
Primary	28	29.2
Secondary (Ordinary) level	29	30.2
Secondary (Advanced) level	13	13.5
Tertiary / university	17	17.7
No formal education	9	9.4
Marital status		
Married	79	82.3
Single	16	16.7
Widowed	1	1.0
Average monthly income (US dollars)		
81	15	15.6
81 - 135	60	62.5
136 - 216	10	10.4
216	11	11.5
Number of people in the household		
1-3	29	30.2
4-6	49	51.0
7-10	18	18.8

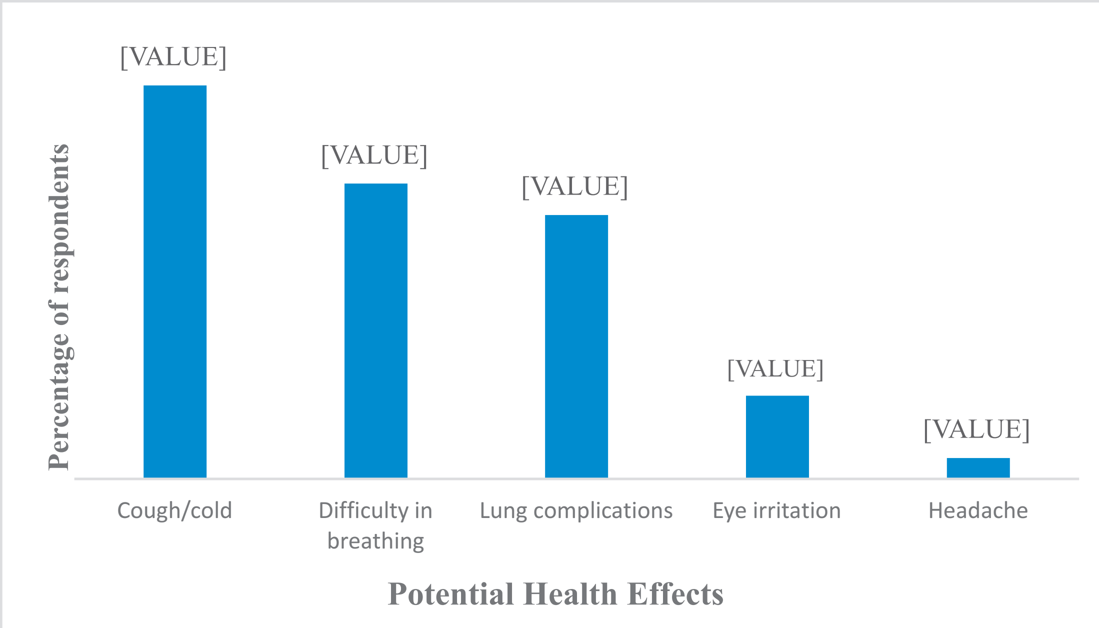

Figure 1: Potential health effects due to indoor air pollution

Household knowledge on indoor air pollution

Regarding known sources of indoor air pollution, respondents mentioned indoor solid-fuel smoke 99.0% (95/96), dust 89.6% (86/96), indoor smoking 60.4% (58/96), filthy environment 24.0% (23/96), animals 18.7% (18/96), overcrowding 4.2% (4/96) and building materials 1.0% (1/96). Regarding potential health effects due to indoor air pollution, majority of the respondents mentioned cough/cold 79.2% (76/96) and difficulty in breathing 59.4% (57/96) (Figure 1).

The respondents suggested cooking outdoor 95.8% (92/96), stopping indoor smoking (70.8% (68/96), cleaning the house interior regularly 51.0% (49/96), having a smoke vent/chimney 29.2% (28/96), limiting solid-fuel use 19.8% (19/96), proper ventilation 11.5% (11/96), keeping animals out of the house 10.4% (10/96), and use of design-improved stoves 2.1% (2/96) as the possible ways to reduce indoor air pollution. Regarding information sources, 30.2% (29/96) of the respondents had heard about indoor air pollution in the past six months. Among the respondents who had heard information on indoor air pollution, 55.1% (16/29) had obtained the information from television, 20.7% (6/29) from radio, 17.2% (5/29) from health workers and 7.0% (2/29) from other sources.

Practices related to indoor air pollution

Charcoal was the most common form of fuel used for cooking 87.5% (84/96), while the rest 12.5% (12/96) used firewood. Women were mostly involved in cooking in 92.7% (89/96) of the households. Nearly half of all the respondents 47.9% (46/96) mainly cooked on verandas outdoors, 40.6% (39/96) cooked in kitchens outside houses, while 11.5% (11/96) cooked indoor. Of those that cooked indoor, 81.8% (9/11) mainly cooked within the living room while 18.2% (2/11) cooked in a kitchen inside the house. Among the respondents, 87.5% (84/96) used electricity for lighting, whereas 6.3% (6/96) used solar energy. The rest of the respondents used kerosene lamps 5.2% (5/96) and candles 1.0% (1/96) for lighting. Among the households, 6.3% (6/96) had at least one smoker and half of these 50.0% (3/6) had at least one smoker who smoked inside the house. Among the households that had indoor smokers 50.0% (3/6), the smoking frequencies were twice a week 33.3% (1/3), thrice a week 33.3% (1/3), and more than

Table 2: Households' housing characteristics related to indoor air pollution

Variable	Frequency (N = 96)	Percentage (%)
Number of rooms in the house		
1	34	35.4
2	33	34.4
3	8	8.3
4	6	6.3
≥ 515 15.6		
Number of windows on the house		
0	8	8.3
1	52	54.2
2	13	13.5
3	6	6.3
≥ 417 17.7		
Windows allowing cross/through ventilation		
Yes	29	30.2
No	59	61.5
N/A	8	8.3
Number of doors on the house		
1	61	63.6
2	25	26.0
≥ 3 10 10.4		

thrice a week 33.3% (1/3). Regarding indoor space spraying, 33.3% (32/96) of households regularly sprayed their houses against insects or pests and 81.3% (26/32) of these had sprayed their houses in the past six months. With respect to engine-powered machines, 6.3% (6/96) of the respondents had at least one engine-powered machine kept inside the house among which four were cars, one motorcycle, and one generator.

Housing characteristics related to indoor air pollution

The respondents living in single room houses were 35.4% (34/96), and 34.4% (33/96) in double rooms. All of these houses were of permanent structure, with a characteristic average room size of 12 square metres per room. Regarding windows, 91.7% (88/96) of the households lived in houses with at least one window, while 8.3% (8/96) lived in houses with no window. Of the houses that had windows, more than half of these had only one window 59.1% (52/88). In addition, of the houses with windows 91.7% (88/96), only 33.0% (29/88) of these had windows that permitted cross or through ventilation. Regarding the number of doors, 36.5% (35/96) of the houses had two or more doors. However, 2.1% (2/96) of the houses had doors that were in a poor state (dilapidating and made of iron sheet). (See Table 2).

There were nearby potential sources of indoor air pollution within a distance of less than eight metres among 24.0% (23/96) of houses. These sources included dusty roads 78.3%(18/23), saw dust from timber works 8.7%(2/23), smoke from kitchens 8.7% (2/23), and burning places for solid waste 4.3% (1/23).Among the households with kitchens 42.7% (41/96), 90.2% (37/41) had permanent structures. In addition, of the households that had kitchens with a means of smoke escape 43.9% (18/41), 27.8% (5/18) of these had one inform of a small-size window of about 0.1 square metres. Of the households that had kitchens located outside the house, 30.8% (12/39) of them had sooty walls.

Discussion

In the study, majority of the respondents exhibited good knowledge on the common sources of indoor air pollution such as solid-fuel smoke (99.0%), dust (89.6%) and indoor smoking (60.4%). Most respondents also had knowledge on potential health effects due to indoor air pollution such as cough/cold (79.4%), difficulty in breathing (59.4%), and lung complications (53.1%). However, there was limited knowledge on the various measures required to reduce indoor air pollution such as limiting solid fuel use (19.8%). This low knowledge could therefore present a barrier to the population regarding reducing their exposure to indoor air pollution. Charcoal (87.5%) was the most common form of fuel used for cooking, while the rest (12.5%) used firewood with none of the households using clean energy. Women were most involved in cooking in 92.7% of households which confirms that they are the category that is highly exposed to poor indoor air quality. Regarding smoking, 6.3% of all households had at least one tobacco smoker, and half of these (50.0%) had at least one smoker who smoked at least twice a week inside the house which aggravates indoor air pollution including passive smoking. Only 33% of the households had cross or through ventilation which increases the effects of reduced indoor air quality. The findings of the study further suggest that in spite of the respondents having some knowledge of sources of indoor air pollution, risk factors such as use of unclean fuel for cooking, smoking indoor as well as poor ventilation do exist in the community.

Knowledge on indoor air pollution is an important determinant regarding practices to prevent the effects of poor air quality among households. The majority of respondents in our study had knowledge on solid-fuel smoke (99.0%), dust (89.6%) and indoor smoking (60.4%), while a small number had knowledge on filthy environment (24.0%), animals (18.7%), overcrowding (4.2%) and building materials (1.0%) as potential sources of indoor air pollution. These findings are consistent with a study conducted in rural Bangladesh that found that majority of the population were generally aware of indoor air pollution, with most attributing it to fuel (Dey *et al.,* 2011). Another study on indoor air pollution among residents of Oke-Oyi in Ilorin, Nigeria also found that majority of the respondents (83.9%) were aware of indoor air pollution, with cooking indoors as one of the most commonly known sources (Osagbemi *et al.,* 2009). However, a study on knowledge of indoor air pollution in the urban population of Mumbai, India found that 98% of respondents were below the minimum level regarding awareness on sources of indoor air pollution (Niphadkar *et al.,* 2009). The difference with this study may be attributable to the scoring mode for knowledge used which involved 4 categories of pollutants – particulate matter (PM), volatile organic compounds, radiation and biological material. With a good amount of knowledge on common sources of indoor air pollution in the community, it is expected that people can use it to reduce their exposure for better health outcomes.

The majority of respondents had knowledge on potential health effects due to indoor air pollution such as cough/cold (79.2%), difficulty in breathing (59.4%), and lung complications (53.1%). This finding is in agreement with a study on indoor air pollution done in Dhakuta, Eastern Nepal that indicated that the majority of respondents thought indoor air pollution affected human health through respiratory problems(Sah *et al.,* 2014). Another study carried out in Nigeria also indicated most respondents (81.3%) were aware of the hazards associated with indoor air pollution including cough (Osagbemi *et al.,* 2009). Knowledge on potential health effects due to indoor air pollution is important as it is expected to influence practices to minimize exposure in households.

In our study, there was generally limited knowledge on appropriate interventions to reduce indoor air pollution except for cooking outdoors (95.8%) and stopping indoor smoking (70.8%). This finding was consistent with a study carried out in rural China that indicated low knowledge on interventions against indoor air pollution from energy use (Jin *et al.,* 2006). With limited knowledge on interventions against indoor air pollution, it is difficult for people in the community to minimize their exposure to it. However, there was generally more knowledge on the common sources, potential health effects and possible ways to reduce indoor air pollution in our study. This maybe attributable to most respondents having attained some level of education, acquired information from mass media, as well as their previous experiences on air pollution. Nevertheless, more health education is required within the population in order to increase awareness on indoor air pollution and ways in which it can be minimized at households and in communities.

Among the respondents, 11.5% cooked indoors including 9.4% who cooked inside their living rooms, while others cooked in kitchens inside the house. A study carried out in Kenya found a higher percentage of those cooking in the living or sleeping room at 20.4% (Jung and Huxham, 2019). This higher number in the Kenyan study maybe attributable to the lower socio-economic status in that population as the study was carried out in areas characterized by subsistence lifestyle and high poverty rate. Another study carried out in Rwanda also found 21% of the respondents fully cooking inside their dwellings(Das *et al.,* 2018). Cooking indoors increases exposure to indoor air pollution hence should be discouraged especially with fuel sources known to pollute the environment such as wood and charcoal which were predominantly being used in our study. Indeed, PM2.5 levels were found highest in living rooms used as cooking areas in a study carried out in Tanzania (Kilabuko *et al.,* 2007). Although most respondents in our study cooked outdoors along verandas or in outdoor kitchens (88.5%), more than half of the kitchens (55.9%) lacked any means of smoke escape which could also increase air pollution exposure. In addition, given all households in our study used biomass as the main fuel for cooking predominantly with charcoal, this increases the risk of effects of indoor air pollution. Change in practices among households regarding where they cook and the form of fuel they use are therefore crucial to reduce the negative effects of pollution indoors.

A few households (6.3%) reported having at least one tobacco smoker, with half of these households (50.0%) having at least one indoor tobacco smoker. This finding was in line with a nationwide survey on tobacco use and associated factors among adults in Uganda that found that 7.4% smoked tobacco (Kabwama *et al.,* 2016). A study on prevalence of chronic respiratory disease in rural and urban Uganda also found a prevalence of tobacco use of 9% (Siddharthan *et al.,* 2019). In addition, a cross-sectional study on exposure to second hand smoke and respiratory symptoms in non-smoking adults in Denmark, Norway found a household indoor smoking prevalence of 5.7% (Fell *et al.,* 2018). Indoor smoking exposes household members to passive tobacco smoke and increases their overall exposure, hence, higher risk of negative health outcomes. Given that smoking indoors even by a single member of a household can affect all members, this practice should be discouraged. Enforcement of the Uganda Tobacco Control Act (2015) which stipulates that every person has a right to a smoke free environment and that a person consuming a tobacco product shall ensure that they do not expose others to tobacco smoke will play a key role in reducing smoking within houses as well as exposure of non-smokers to second-hand smoke.

Over a third of the respondents in our study lived in single (35.4%) and double room (34.4%) houses of permanent structure. These houses had a characteristic average room size of approximately 12 square metres which was attributable to the common building design of rental houses within the area. According to the Public Health (Building) rules that require 40 square feet of sleeping space per person, the houses were crowded especially those of one room. Among the households, 8.3% had no window on their houses. The majority of households had houses with only one window (54.2%) which were mostly one or two roomed houses which is also attributable to the common building design for houses in the area.

Furthermore, of the houses that had windows, only 33.0% had windows that allowed either through or cross ventilation. A study on household air pollution exposure in Nairobi found a higher percentage of houses with no window (37.6%) (Muindi *et al.,* 2016). The difference with our findings may be attributable to the generally lower socio-economic status in the Nairobi study setting. Another study in Tanzania on cooking as a source of indoor air pollution indicated a higher percentage of houses with no window at 92% (Jackson, 2009). Again, the difference in comparison to our study may be attributable to differences in socio-economic status in the Tanzania study which was carried out within rural areas. Households lacking windows on their houses or having inadequate number of windows, and the presence of crowding in houses are all risk factors of exposure to indoor pollution. Due to activities leading to generation or entry of air pollutants into houses continuing such as cooking indoors, poor ventilation leads to concentration of these pollutantsat levels that may turn out to be harmful to the health of household members. Local authorities should therefore ensure that houses in the community are constructed in accordance with the required building regulations so as to promote good indoor air quality.

Although, a larger sample size would increase the generalisability of the findings, the study provides useful insights into risk factors for indoor air pollution which can be used to inform future larger studies in Uganda and beyond. Other studies to assess factors associated with the various risk factors of indoor air pollution are recommended.

Conclusion

There was considerable knowledge on indoor air pollution especially on the common sources and potential health effects due to indoor air pollution. However, there was limited knowledge on appropriate measures to reduce indoor air pollution except for cooking outdoors and reducing indoor smoking. There were also many practices within the community that favoured indoor air pollution such as cooking inside the house, cooking with biomass such as the use of firewood as well as smoking indoors. In addition, majority of the households lived in housing conditions that did not allow adequate ventilation. The local authority therefore needs to make efforts to carry out community sensitization on ways to minimize indoor air pollution to ensure good indoor air quality. In addition, more effort should be directed at enforcement of existing building regulations regarding construction of houses.

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