Outdoor Air Pollution Exposure: Knowledge, Attitudes, and Practices of Traffic Police Officers in Makindye Division, Kampala City

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Abstract
Air pollution is a problem in urban dwellings worldwide; it is ranked 7th among the 19 leading risk factors for global mortality. Air pollution exposure in humans increases the risk of respiratory conditions such as, asthma, cardiovascular disease and metabolic diseases such as diabetes mellitus. Traffic police officers are at higher risk since they are continuously exposed to emissions from passing vehicles in addition to the generally polluted air by other sources. The main objective of this study was to assess the knowledge, attitudes, and practices of traffic police officers towards outdoor air pollution exposure. A cross-sectional study was conducted in Makindye division Kampala district, employing both quantitative and qualitative data collection methods. Majority (95.1%) of traffic officers were aware of at least one source of air pollution; 3.7% had suffered from pollution-related diseases; and, 4.9% had Personal Protective Equipment (PPE). Knowledge on sources of outdoor air pollution and health effects of outdoor air pollution was high among traffic police officers. Most traffic officers were not sure whether outdoor air pollution was a serious problem requiring immediate attention. The study recommends that traffic police officers should be provided with appropriate PPE, and sensitized on the dangers of air pollutants.

Keywords: *air pollution, human respiratory conditions, traffic police*

Introduction

Outdoor and indoor air pollution are major contributors to global illness and mortality. One in every eight deaths in 2016 (a total of 7 million deaths globally), was attributable to air pollution (WHO, 2018). There is indisputable epidemiologic evidence that air pollution exposure in humans increases not only the risk of respiratory conditions such as, asthma and respiratory tract infections, but also cardiovascular disease and metabolic diseases such as, diabetes mellitus (Tian ey al., 2012). In the developing world, air pollution presents a particular threat to the health of populations in cities that are growing in a fast, poorly planned, and unregulated manner (Zhang et al., 2010).

Air pollution is a major source of morbidity and mortality in Africa. By reducing air pollution, countries can reduce the burden of diseases from stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma (WHO, 2021). The recent global burden of disease estimates released by the WHO indicate that exposure to air pollution and particulate matter ranked as one of the most predisposing risk factors for health globally (WHO, 2009). WHO reports that 80% of outdoor air pollution-related premature deaths are due to ischemic heart disease and strokes. While 14% of deaths are due to chronic obstructive pulmonary disease or acute lower respiratory infections, 6% of deaths are due to lung cancer (WHO, 2011). Pollutants of major public health concern include particulate matter (PM), carbon monoxide (CO), Ozone (0_3), Nitrogen dioxide ($NO_{2)}$, Black Carbon (BC), Lead (Pb), and Sulfur dioxide (SO_2). In low- and middle-income countries (LMICs) such as Uganda, there is rapid industrial growth, population increase, and increased car ownership, coupled with poorly developed air quality monitoring and a lack of enforceable regulations. The situation has led to unprecedented declines in air quality in Kampala city (Choudhary & Tarlo, 2014). Road traffic is one of the major sources of air pollution in metropolitan areas of Kampala City. It has been estimated that, about 70% of the pollution released into urban areas is produced by diesel and gasoline engines (WHO, 2005).

BACKGROUND

Kampala, the capital city of Uganda, is the administrative, political, commercial, industrial, teducational and cultural center of Uganda. The city covers an area of 190 km^2 and is located 8 km north of Lake Victoria (the second largest freshwater lake in the world), and approximately 42 km north of the equator. The population varies from about 2.5 million during the day to perhaps 1.2 million at night. Kampala's air quality has deteriorated significantly during the past two decades with a rapidly increasing population and expanding economic growth. There is a growing middle class in Uganda and specifically in Kampala, with fast expanding vehicular traffic comprising imported second-hand and reconditioned cars, aging, exhaust-unregulated cars, trucks, buses, and motorcycles. Furthermore, the national economic strategy gives priority to the industrial and manufacturing sectors. The Kampala Capital City Authority's (KCCA) current policy of mixed urban planning allows industries, residential and commercial premises to occur side by side. In addition to the above challenges, there are ever-growing road traffic and unregulated industrial emissions, and open waste burning.

A recent study in Kampala showed an increase in ischemic heart disease from virtually absent up to the end of the 1990s, to more than 10% of all admissions in the Mulago University Hospital cardiology ward in 2012 (Burgaz et al., 2012). It was estimated that, 34% of lung cancer deaths and 24% of cardiopulmonary deaths in Uganda were attributable to outdoor air pollution (Ogwang, 2011). An estimated 20-30% of pollutants in ambient air derive from automobiles in Kampala's Capital. Concentrations of PM, BC, SO_2, NO_2, Pb, and CO in Kampala's air impact acute and chronic infections such as chronic bronchitis and pneumonia (NEMA, 2011). 34% of lung cancer deaths and 24% of cardiopulmonary deaths in Uganda were attributable to outdoor air pollution (Breysse et al., 2012). The same study demonstrated significant correlations between respiratory and cardiovascular morbidity among the population, with NO_2 and SO_2 exposure.

The number of automobiles in Kampala city has increased by approximately 40% annually over the last several years, and approximately 66% of the cars are more than 10 years old (UBOS, 2012), yet cars with old engines have higher emissions. In addition, the city has been growing with little attention to street planning. Due to the increasing number of vehicles and poor urban planning, there are daily traffic jams that last several hours and deteriorate air quality. In Kampala city, traffic police officers stand on Kampala streets for several hours a day (on average 8 hours per shift) with high traffic loads. Even though there are several studies on outdoor and indoor air pollution in Kampala city, little is known about the knowledge, attitudes, and practices of persons most exposed to ambient pollution. Traffic policemen are at high risk of traffic-related air pollution and provide an ideal population to carry out a study on air pollution exposure. Studying the KAP of traffic police officers regarding outdoor air pollution exposure generated results that may influence policy. This will facilitate the formulation of appropriate intervention for individuals and institutions to protect occupationally exposed persons, particularly traffic police officers. The study, therefore, assessed the knowledge, attitudes, and practices of traffic police officers on outdoor air pollution exposure.

PROBLEM STATEMENT

Air pollution exposure in Kampala is a big public health threat. The major source of air pollution is second-hand vehicles. Key pollutants are PM, NO_2, SO_2, O_3, CO volatile organic compounds

(VOCs), re-suspended dust, dioxins and furans, and hydrocarbons. An emission from automobiles filters through the lungs into the bloodstream causing heart diseases. The air quality concerning CO_2 at Wandegeya, Makerere, Mulago, and Kawempe was found to be higher than the limits in the proposed standards on air quality (NEMA, 2010). This situation is not different from Makindye division in Kampala. Industries that emit black thick smoke have relocated to Kampala. In addition, thermal power stations sitting at Namanve, Nakawa-Lugogo industrial area, and Mutundwe, release unknown but massive amounts of emissions. A study conducted in Kabalagala town Makindye division revealed that both fine and coarse particle concentrations were above 100 µg/m^3 in all the samples collected. Mulago Hospital, for instance, admitted about 2,500 people with asthma in 2009/2010, much higher than 1,899 people registered the previous years (Hospital report, 2010).

Kampala city lacks adequate air quality monitoring stations and laboratories to track the level

of pollution, in addition to absence of well-established control mechanisms. Leaded fuel on the market and importation of old vehicles are at a high rate. Industries are set up in the city as opposed to the industrial parks, in addition to many other factors that escalate the problem of outdoor air pollution exposure. Amidst all these challenges, little is done to protect occupationally exposed persons from all the above-mentioned pollutants. Traffic police officers are the population group at risk due to their inhalation of carbon monoxide-rich air while on duty at the crowded cross-sections of the city (Burgaz et al., 2002).

Currently in Uganda, particularly Kampala, Air Quality Management (AQM) is in its very infancy. On-going projects are aimed at phasing out the use of leaded fuels. Air quality standards have been proposed but are not yet promulgated (Tamale & Wamono, 2010). Baseline measurements of pollutant concentrations of compounds emitted from point sources showed non-compliance with the proposed standards. With the promulgation of fuel specifications and emission standards for motor vehicles, Uganda made a step forward to initiate AQM. Strengthening enforcement procedures would make these standards operational and reduce emissions (Ssempebwa, 2008). Enforcing emission standards for imported second-hand vehicles supports this process. This study addressed the knowledge, attitude, and practice gaps among the occupationally exposed persons such as traffic police officers.

The specific objectives included: 1) To assess the knowledge of traffic police officers on the health effects resulting from outdoor air pollution exposure; 2) To determine the attitudes of traffic police officers towards outdoor air pollution exposure; and, 3)To find out the practices of traffic police officers on exposure to outdoor air pollution.

METHODOLOGY

The study was conducted in Kampala city, Uganda's Capital, specifically, Makindye division - one of the five divisions that make up the city. Makindye division is located in the southeastern part of the city, bordering Wakiso district to the south and west. This division has one of the highest traffic; hence, a significant level of vehicular emissions in addition to emissions from other sources such as surrounding industries to which traffic police officers are exposed for 6-8 hours of the day. Out of 800 traffic police officers in Kampala, 162 are deployed in Makindye division. The study population under consideration was the traffic police officers in Makindye division of Kampala city. The inclusion criterion was that only traffic police officers with more than two years of continuous service, willing to participate and were present at the time of data collection, were selected for the study. All traffic police officers with less than 2 years of working experience were excluded from the study.

The study unit included officers deployed at stations and streets of Makindye division. The study employed a cross-sectional study design, using both qualitative and quantitative methods of data collection. For quantitative data, structured questionnaires were used to collect data on economic, social-demographic, government policies, poverty, occupation, Knowledge, and attitudes. Qualitative data was gathered using a key informants' interview guide to identify and generate data on the outdoor air pollution exposure among traffic police officers, practices, and actions taken when they experience pollution-related health effects. Six key

informants interviews were conducted with station traffic commanders/in-charges and division traffic administration commanders. The observational checklist was used to capture data on practices regarding outdoor air pollution exposure such as the use of personal protective equipment, availability of traffic lights and road signs, Air quality monitoring stations, and size of roads. The dependent Variable was outdoor air pollution exposure; while the Independent variables included knowledge about the health effects resulting from air pollution exposure; attitudes towards air pollution exposure; and, practices on air pollution exposure.

FINDINGS AND ANALYSIS

Socio-demographic characteristics of respondents

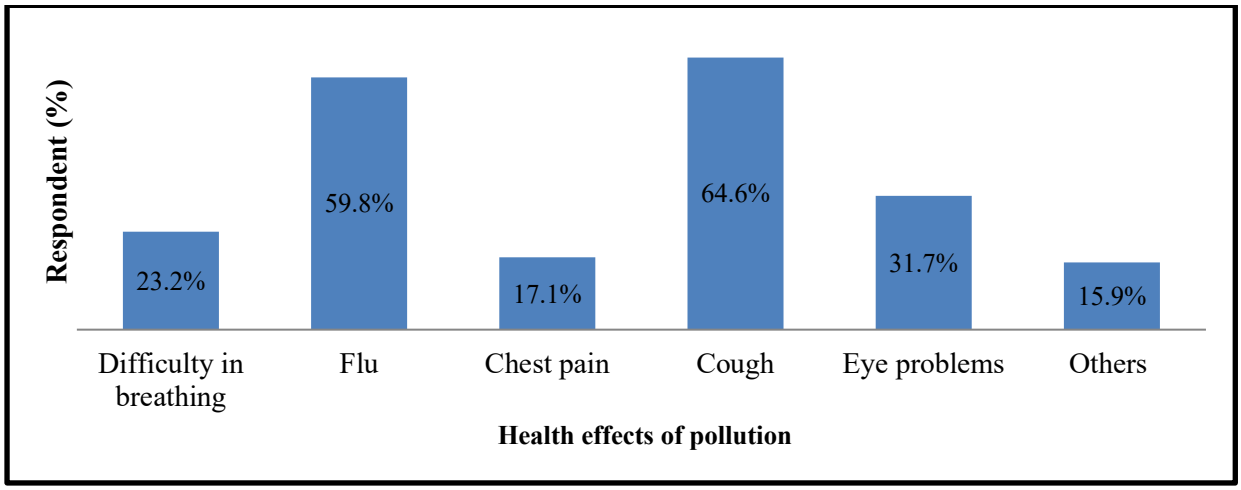
Majority (59.8%) of the respondents were between 25-34 years, with a mean age of 34.9 years. Most of the respondents were male (57.3%), with 85.4% having been in service for 2-10 years. 64.6% of the respondents attained an advanced level of education certificate; 3.7% had a bachelor's degree; while 69.8% had attained a constable rank. The biggest percentage of the respondents (62.2%) had a monthly salary of 300,000-400,000 Uganda shillings, and 52.4% had 3-6 dependents. All the respondents reported that they were transferred to a new duty station every week.

Knowledge regarding air pollution exposure

Although majority (95.1%) of the respondents knew at least one source of outdoor air pollution, about half (48.8%) knew at least one pollutant. Carbon monoxide (57.3%) was the most mentioned pollutant. All respondents mentioned that they were aware of immediate health effects of outdoor air pollution exposure, including cough (64.6%) and flu (59.8%). 93.9% of the respondents reported that they paid medical bills to protect themselves from suspected effects of outdoor air pollution. Only 3.7% of the respondents reported being trained on outdoor air pollution, although none of them knew the agency they had trained with. Police officers were aware that automobiles are a key source of carbon monoxide, but little was known regarding other pollutants, their source, and their long-term effects. One of the key informants stated,

"Almost every traffic police offer is aware that automobiles produce a lot of carbon monoxide which we breathe in. We are not well informed of other chemicals we are exposed to and their health effects. However, there's nothing we can do about them because we must work anyway..." (Traffic officer supervisor).

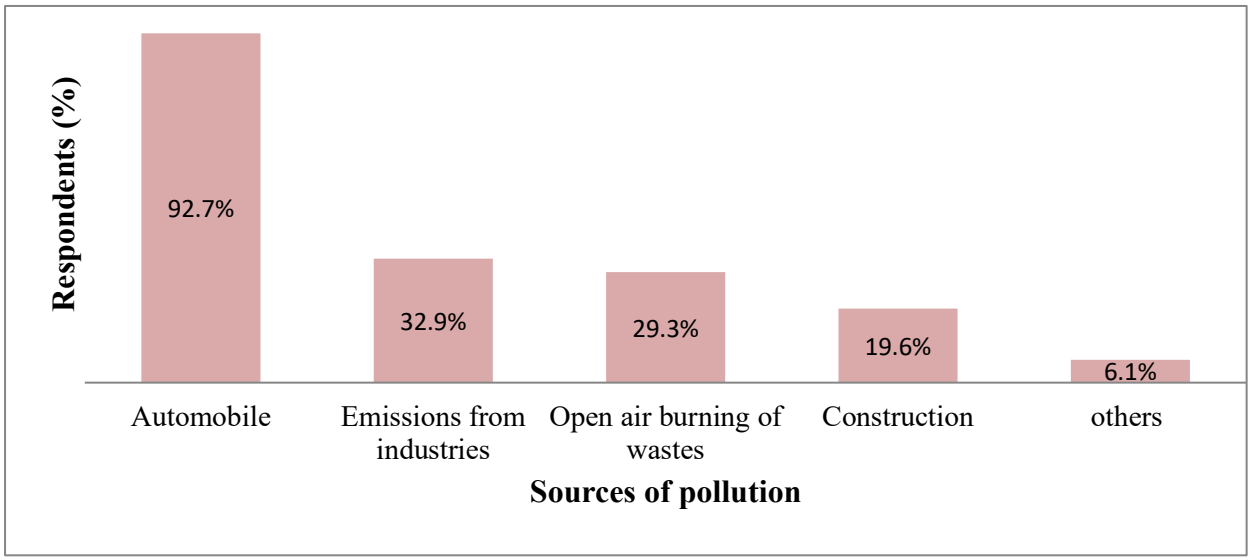
Figure 1: *Perceived immediate health effects of air pollution*



Source: Primary data 2022

Majority (92.7%) of the respondents mentioned automobiles as the major source of outdoor air pollution followed by emissions from industries (32.9%), and open-air burning of wastes (29.3%) as shown in Figure 2.

Figure 2: *Perceived sources of air pollution*



Source: Primary data 2022

Attitudes towards air pollution exposures

92.7% of the respondents thought that they were exposed to some form of outdoor air pollution. All the respondents believed that outdoor air pollution had long-term effects such as respiratory tract infections, asthma, and cardiovascular diseases, among others as indicated in Table 1.

Table 1: Attitudes towards outdoor air pollution

Variable	Frequency (N=82)	Percentage (%)
Long-term effects of outdoor air pollution		
Asthma	33	40.2
Respiratory tract infections	59	72.0
Cardiovascular diseases	3	3.7
Diabetes mellitus	1	1.2
Others	3	3.7

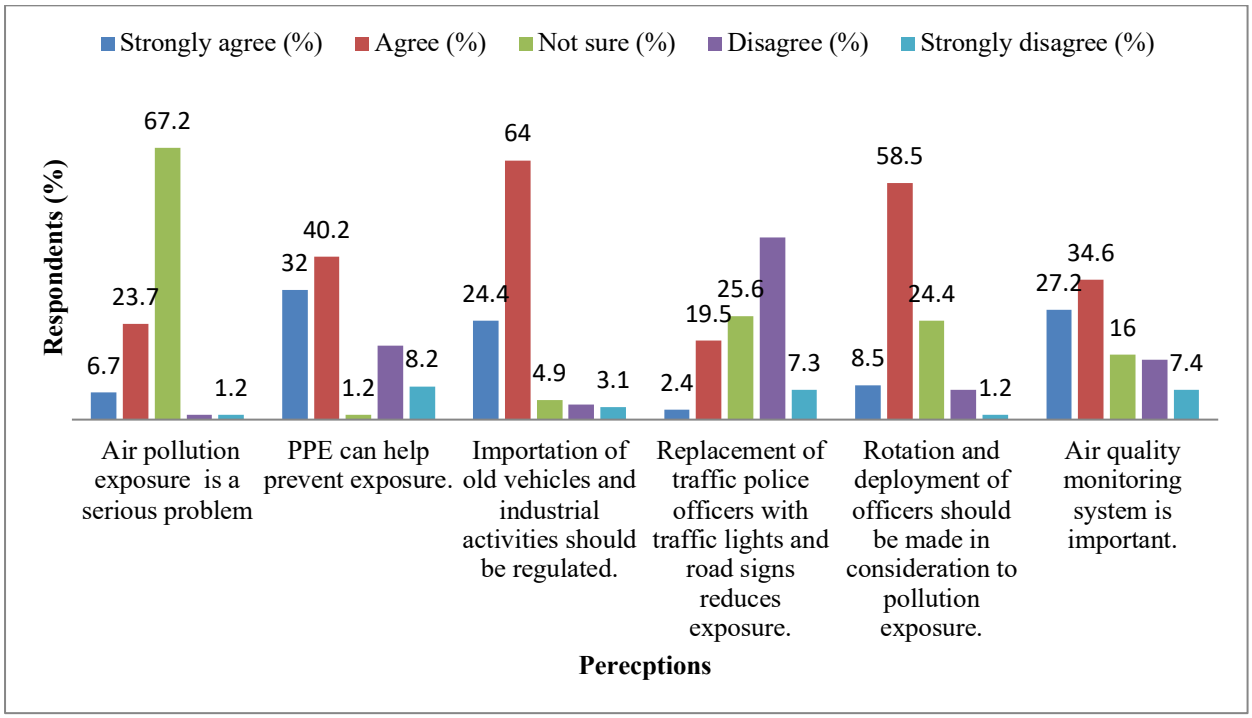
Source: Primary data

Qualitative data indicated that all key informants stressed that outdoor air pollution exposure among police officers was a major point of concern. During an interview, one of the key informants noted,

> "*… outdoor air pollution exposure is a serious problem because even when some of our officers suffer from cough and chest pain, the X-ray reports indicate that they smoke yet some of them have never smoked…. the effect obtained from their exposure could be equivalent to tobacco smoking*" (Traffic officer supervisor).

Most (67.2%) of the respondents were not sure whether outdoor air pollution was a serious problem requiring immediate attention. 40.2% agreed, and 32.0% strongly agreed that personal protective equipment could help prevent exposure to outdoor air pollution. 45.1% of the respondents disagreed with replacing traffic police officers with traffic lights and road signs; while, 19.5% agreed. 34.6% agreed that establishing air quality monitoring stations in different parts of Kampala was important. (see Figure 3).

Figure 3: Perceptions of traffic police officers toward exposure to outdoor air pollution



Source: Primary data 2022

Practices of respondents toward air pollution exposures

Majority (92.7%) of the respondents reported that they had suffered from a pollution-related disease. 54.9% reported working less than eight hours. 51.2% often changed duty stations as a main measure of reducing personal exposure to pollution; while 4.9% used PPE; while 7.4% said that there are government measures implemented to reduce exposure to outdoor air pollution. The mentioned practiced measures to reduce exposure to outdoor air pollution included the installation of traffic lights and road signs (31.7%), and enforcement of laws (3.7%).

Most key informants cited that the government tried to regulate the different activities that pollute the environment and provide PPE to traffic officers, though there was still a lot to be done. One of the key informants said,

> "*We provide personal protective equipment, but only to police officers in charge of riots. Traffic police officers were provided with PPE during the period of Common Wealth Heads of Governments (CHOGM). Usually, even to those provided with such equipment, they cease using them…. we don't find it cost-effective to continue buying equipment that is not going to be used..*" (Traffic police supervisor)

74.4% of the traffic police officers said that they exposed to outdoor air pollutants daily; while 18.3% reported that they were exposed a few days a week.

Discussions

Knowledge of police officers on outdoor air pollution exposure

The study revealed that the majority (95.1%) of the traffic officers knew at least one source of outdoor air pollution, and 92.7% mentioned automobiles as the major source of outdoor air pollution. This was probably because there are no appropriate regulations on the importation of old vehicles. Findings revealed that government regulatory bodies such as National Environmental Management Authority (NEMA), Uganda Revenue Authority (URA), and traffic police hadn't done enough to enforce reduction of the existence of poor mechanical conditioned vehicles on the roads. Road traffic is one of the major sources of air pollution in metropolitan areas of low- and middle-income countries (Choudhary & Tarlo 2014). Similarly, a study conducted in England revealed that automobiles were the major source of air pollution (Volpino, 2004). This implies that there is a need for appropriate measures such as, rules and regulations to reduce air pollution exposures caused by automobiles and traffic in general.

Regarding knowledge on outdoor air pollutants, half of police officers (48.8%) mentioned at least one pollutant. Carbon monoxide was the most mentioned pollutant (57.3%). This agreed with the results of a study conducted in Columbia where many traffic officers could not mention any pollutant. However, the most mentioned pollutant was particulate matter followed by carbon monoxide (Jess et al., 2013). This implies that, there is a need to conduct awareness campaigns among police officers on outdoor air pollutants.

The study also revealed that there was an average level of awareness on the measures to reduce exposure to outdoor air pollution among traffic police officers. Half of the police officers mentioned working in shifts and good mechanical conditioned vehicles as the main interventions. The average level of knowledge was probably because the majority of traffic police officers were not sensitized about outdoor air pollution. These study findings correlated with the findings of Ayzel and Sali (2000) that indicated that there was limited information on the interventions that might be best applied to effectively reduce the risks imposed on occupationally exposed persons to outdoor air pollution, most particularly traffic police officers. The study findings imply that there is a need to increase awareness among traffic police officers on how to reduce exposure to outdoor air pollution.

The study findings showed that all traffic police officers were aware of outdoor air pollution health effects: 64.6% of traffic officers mentioned cough, and 59.8% mentioned common flu. This high knowledge could be because majority of the traffic officers had suffered from some air pollution-related illness, and told by health workers that their illnesses were associated with outdoor air pollution exposure. This finding conflicted with study findings by Tamura et al. (2003) that revealed that traffic police officers are not different from other occupationally exposed persons in low- and middle-income countries, who were not aware of the effects of outdoor air pollution resulting from vehicular emissions, dust and industrial fumes, other than that they caused some mild headache or allergies. Much as traffic officers had good knowledge of perceived health effects of outdoor air pollution, this did not translate into practices related to the reduction of air pollution exposure. This, therefore, implies that there is a need to properly package information and come up with interventions to help translate the knowledge into

practice.

Attitudes of police officers towards outdoor air pollution exposure

67.2% of the traffic police officers were not sure whether outdoor air pollution was a serious problem requiring immediate attention, even though a number of them understood the health effects of outdoor air pollution. This was probably because there was no sensitization on air pollution exposure conducted among traffic officers. These study findings contradicted a similar study in Nigeria which indicated that the majority (68.0%) of the respondents understood the health effects of outdoor air pollution, and perceived it to be a serious health concern (Suresh et al., 2004). The study findings, therefore, imply that there is a need to improve perceptions of the health risk of outdoor air pollution among traffic police officers.

The study revealed that though traffic police officers were not provided with PPE, over 70% of respondents believed that PPE could help prevent exposure to outdoor air pollution. This corresponded with findings on occupational health and safety issues of police officers in Canada, which revealed that respondents believed that personal protective equipment such as respiratory masks, goggles, helmets with eye protection glasses, uniforms that cover the entire body, among others, would greatly reduce exposure to outdoor air pollution (Mortada et al., 2004).

Practices of police officers toward outdoor air pollution exposure

Findings from the study revealed that a small number of police officers used PPE (4.9%). This was probably because they were not provided with PPE, as confirmed by one of the key informants who said that PPE was provided to only police officers in charge of riots and traffic officers during specific events. However, even when this personal protection equipment is provided to the traffic police officers during such occasions, they are used for protecting traffic officers against injuries and tear gas, instead of air pollution exposure. This was not the case in Mexico where traffic police officers were provided with nose masks to reduce air pollution exposure, and it was later reported that there was reduction a in the exposure of traffic police officers to fine particles in a day by half; the officers breathed less health-damaging pollutants (WHO, 2011). The study findings, therefore, imply that there is a need to provide traffic police officers with PPE to reduce the harmful effects of outdoor air pollution exposure.

In this study, traffic police officers worked for a maximum of eight hours a day and, were often changing duty stations. These were the mainly used measures to reduce exposure to outdoor air pollution probably because there were no other measures like PPE provided to traffic police officers. This conflicted with a study on pollution factors affecting health and safety in urban Nigeria, which found that most police officers did not consider changing working shifts and working for shorter periods as an important measure to reduce exposure to outdoor air pollution (Sharath, 2009). This was probably because traffic officers in Nigeria had less knowledge on measures to reduce air pollution. Therefore, there is a need to improve awareness among traffic officers on the different measures to reduce air pollution exposure, and change in attitude.

Majority (92.7%), of traffic officers reported that they had suffered from diseases associated

with pollution, for example, flu and asthma. This was consistent with findings of a study conducted in China and Japan which revealed that almost all respondents had suffered from a disease associated with outdoor air pollution including, respiratory irritation, heart disease, and lung cancer (Ghose et al., 2014). This high proportion of traffic officers that suffered from a pollution-related disease is possibly as a result of their continuous exposure to outdoor air pollution. Therefore, there is a need to design appropriate measures to reduce air pollution exposure among traffic officers to control air pollution-related diseases.

Conclusion

Knowledge among traffic police officers on sources of outdoor air pollution and the health effects of outdoor air pollution was high. The level of knowledge on pollutants and measures to reduce outdoor air pollution was low; traffic officers who knew the pollutants mentioned carbon monoxide, sulphur dioxide, and lead. Only 3.7% of the respondents reported having received training on outdoor air pollution; however, none of them did not know the agency that they had trained with.

Most traffic officers thought that they were exposed to some form of outdoor air pollution, and all of them believed that outdoor air pollution had long-term effects which included respiratory tract infections (72.0%), asthma (40.2%), and cardiovascular diseases (3.7%). Most traffic officers were not sure whether outdoor air pollution was a serious problem requiring immediate attention. This study also established that majority of the traffic officers reported that they had never suffered from any diseases associated with pollution. Working less than eight hours a day and often changing duty stations were the main mentioned measures practiced by traffic officers to reduce exposure to air pollution. Only 4.9% of the respondents used PPE, and only 7.4% said that there were government measures implemented to reduce exposure to outdoor air pollution.

Recommendations

The Uganda police force should consider providing personal protective equipment such as, respiratory masks to traffic police officers to reduce inhalation of outdoor air pollutants. Secondary, The Ministry of Health needs to sensitize traffic police officers on outdoor air pollutants and their short- and long-term health effects to create a perceived need for the adoption of using air pollution reduction measures. The Traffic Police department should employ specialists in occupational health and safety to train police officers on the various measures used to reduce air pollution exposures such as the use of personal protective equipment and working for shorter periods to reduce exposure to air pollutants. Most importantly, the Ministry of Transport, Uganda Revenue Authority, National Environment Management Authority, and the traffic police should jointly make and enforce relevant laws and regulations to reduce the importation of second-hand vehicles as one of the interventions to reducing outdoor air pollution exposure among traffic police officers. The National Environment Management Authority should consider installing air quality monitoring stations in different parts of Kampala to closely monitor the level of pollution in different areas, the source of pollution, and the type of pollutants. This will aid in identifying the riskiest areas for traffic officers' deployment, and help the relevant authorities to intervene and control pollution in such areas.

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