



Assessing the Level of Awareness of Health Hazards Associated with Operations of Medium-Scale DPK Vendors Using Motorized Pumps with ASTs in Ilorin Metropolis, Kwara State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author MLI designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author HOS read the first manuscript and wrote part of the literature. Author AAT performed the statistical analysis and managed all analyses of the study. Authors WTS, KO and LO collected data. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AIR/2019/18i530102

Editor(s):

(1) Dr. José Alberto Duarte Moller, Center for Advanced Materials Research, Complejo Industrial Chihuahua, Mexico.

Reviewers:

(1) Akshat Pandey, India.

(2) Wen-Ching Wang, National Taitung University, Taiwan.

Complete Peer review History: <http://www.sdiarticle3.com/review-history/47761>

Original Research Article

Received 19 December 2018

Accepted 14 March 2019

Published 01 April 2019

ABSTRACT

Introduction: The continuous trend in the increase of diseases and death associated mostly with hazards from the use and transportation of kerosene; coupled with tens of millions of Nigerians depending on it - as a substitute for stoves, cooking and an erratic electric power supply for lamp illumination, this could be as a result of low awareness of these risks amongst kerosene suppliers and retailers. Kerosene being a highly inflammable substance is a major factor in various fire burn injuries, child poisoning incidences reported across the country. Thus, numerous studies have been

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conducted on petrol stations and refineries; with little focusing on kerosene vendors and the operations of these vendors.

Objectives: This study assessed the level of awareness of health hazards associated with operations of medium-scale DPK vendors using motorized pumps with Aboveground Storage Tanks (ASTs) in Ilorin Metropolis, Kwara State, Nigeria.

Methodology: The study adopted a purposive sampling technique. Data was collected with the aid of a structured questionnaire (to elicit the information on the operation of DPK vendors, health hazards and safety measure with their operations), observational checklist and Handheld Germin (GPSmap® 78) GPS.

Results: There was over 2000% increase in the establishment of DPK vendors within Ilorin metropolis from two in 2007 to seventy-six in 2017 with highest (48) found in Ilorin West LGA. A higher percentage of the DPK vendors (77.6%) lack the awareness on the health hazards associated with their operations; with a large proportion of the DPK vendors not engaging in basic safety practices. Few (7.9%) have fire extinguishers and majority (88.5%) of the DPK vendors not using the personal protective equipment (PPEs). The geospatial assessment of the DPK vendors also revealed that only two fire stations are found within Ilorin metropolis with 71% of the DPK vendors lacking the knowledge of their locations and all were ignorant of the fire station emergency numbers in case of fire mishaps. There is significant association between basic safety precaution practices and awareness on health and environmental hazards among DPK vendors.

Conclusion: The study revealed there is an uncontrolled proliferation of DPK vendors, low awareness level on the health hazards associated with their operations, lack of compliance to basic safety practices and high level of non-compliance to the use of PPEs. There is need for massive awareness campaign on the various health hazards associated with DPK vendors operations, basic precaution practices, the use of safety wears, fire stations emergency numbers and the precautions to avoid fire outbreaks and other disasters associated with their trade is sacrosanct.

Keywords: Aboveground storage tanks; basic safety practices; medium-scale DPK vendors; motorised pumps.

1. INTRODUCTION

Dual Purpose Kerosene (DPK) has been an important household fuel since the mid-19th century. In developed countries the use of DPK has greatly decreased as a result of availability of electricity. Meanwhile, in developing countries, kerosene use for cooking and lighting remains widespread [1]. DPK is a by-product derived from series of fractionating processes of petrol from its initial crude form crude oil. Characteristically, kerosene is a colorless to yellowish, oily liquid with a strong odor. It is a mixture of petroleum hydrocarbons and is used in heating oil, lamps, stoves, flares, degreasers, pesticides and paint thinners, and as jet fuel [2]. It is a highly hazardous product and Nigeria with a population of over 180 million is one of the largest producers of crude oil where kerosene is derived [3]. Because kerosene is a combustible liquid, risk of fire hazards is usually associated. Kerosene may form an ignitable vapor/air mixture in closed tanks or containers, with flow or agitation generating electrostatic charges. Since kerosene vapor is heavier than air, it can travel a long distance to cause a fire or explosion far from the source [4].

Healthwise, kerosene can irritate the nose, throat and lungs. Repeated exposure may cause bronchitis to develop with coughing, phlegm, and/or shortness of breath. Prolonged or repeated exposure can cause burns and itching of the skin with rash, redness and blisters. High exposure can affect the nervous system causing both severe and mild headache, dizziness, nausea and vomiting, weakness, restlessness, disorientation and drowsiness [2]. Convulsions and coma may follow very high exposure to DPK. Chronic (long-term) health effects can occur at some time after exposure to Kerosene and can last for several months or years at times [3]. Long term exposure of people to kerosene has been known to cause various health hazards such as toxicity through inhalation of kerosene vapours, respiratory irritations, dermatitis and irritation to the eyes, among others [5].

Fuel based lighting made up of kerosene continues to find essential use in West Africa. Although Nigeria is the sixth largest producer of crude oil among members of the Organization of Oil Producing Exporting Countries (OPEC), petroleum products, especially kerosene, are not always available. Surprisingly, kerosene is more

readily available through sub-dealers and retailers than at licensed pump stations [6] despite the product being subsidized. According to Merem et al. [7], factor such as corruption is responsible for the product not been readily available at the licensed pump stations as these stations sells to middle men thus increasing the demand-supply chain thus leading to scarcity of the product. Such retailers/vendors who sell DPK through installed tanks can be found at almost every nook and crannies of Ilorin metropolis and their activities seem non-regulated. Installation of kerosene tanks at close proximity to residential areas and at close proximity to one another is a potential environmental health hazard. The indiscriminate siting of kerosene tanks, overpopulation of vendors in the business and unrestricted operations and activities of the DPK vendors may cause accumulation of kerosene toxic wastes, release of vapours, fire explosions and various environmental hazards [8].

As at present, there is dearth of information the activities of kerosene vendors; and where present, results are sparse and literature is scarcely available [1]. With the continuous environmental degradation and health hazards occurring as a result of various activities of man, this study is justified with the rationale to assess the level of awareness of health hazards associated with operations of the numerous medium-scale DPK vendors who make use of motorized pumps within the highly populated Ilorin metropolis. This study assessed the level of awareness of health hazards associated with operations of the numerous medium-scale DPK vendors using motorized pumps with ASTs in Ilorin metropolis by estimating the number of medium-scale DPK vendors using motorized pumps with ASTs in Ilorin metropolis, identifying the locations of these medium-scale DPK

vendors operating within Ilorin metropolis using GIS tool, determining the level of awareness of these vendors on the health risks associated with their trade, identifying the basic safety precautions that are being practiced by these DPK vendors and recommending safety measures and controls to mitigate the associated adverse effects.

2. METHODOLOGY

2.1 Study Area

Study was conducted in the three (3) Local Government Areas of Ilorin; namely: Ilorin East, Ilorin West, and Ilorin South. Ilorin, the state capital of Kwara State is located on latitude 8°30' and 8°50'N and longitude 4°20' and 4°35'E of the equator. Ilorin city occupies an area of about 468sqkm and it is situated in the transitional zone within the forest and the guinea savannah regions of Nigeria. It is about 300 kilometers away from Lagos and 500 kilometers away from Abuja the federal capital of Nigeria [8]. The city is situated in the transitional zone between the forest and savannah region of Nigeria. The geology of Ilorin consists of Pre-Cambrian basement complex with an elevation that varies from 273m to 333m in the West having an isolated hill (Sobi hills) of about 394m above sea level and 200m to 364m in the East. Oyegun [9] further asserted that a large part of Ilorin town is laid by sedimentary rock, which contains both primary and secondary laterites and alluvial deposits. The major river in Ilorin is Asa, which flows North-South direction dividing the plain into two, Western and Eastern part. The Eastern part covers those areas where the GRA is located while the core indigenes' areas of Ilorin fall under the Western part as shown in Fig. 1.

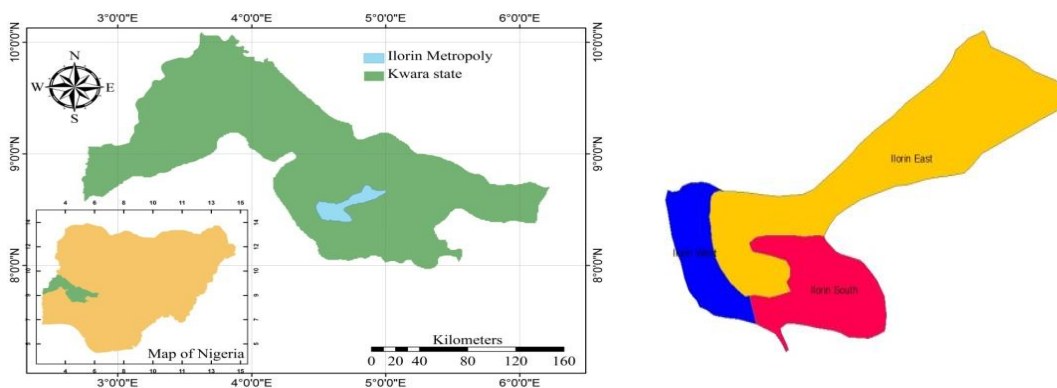


Fig. 1. Map showing Kwara state with indication of the study area

2.2 Study Design

The study design used is descriptive cross sectional studies to evaluate the health hazards associated with operations of medium-scale DPK vendors using motorised pump with aboveground storage tanks in Ilorin metropolis for the purpose of mitigating associated adverse effects.

2.3 Sampling Techniques

The sampling frame consisted of all medium-scale DPK vendors using motorised pump with aboveground storage tanks within the three Local Government Areas of Ilorin metropolis. These medium-scale DPK vendors using motorised pumps were classified using the their storage facility methods which was based on either an Aboveground Storage Tank (AST) or Underground Storage Tank (UST) using purposive sampling method, all the DPK vendors which met the inclusion criteria was studied.

2.4 Data Collection

Data were collected via face to face interviews with the DPK vendors salespersons and owners on the awareness of the health hazards associated with the vending of kerosene, observational checklist was used to collect data on the availability of safety equipment and the use of personal protective equipment related to the occupational health and safety of DPK vendors operations, use of Global Positioning System (GPS) and Measuring tape.

2.5 Data Analysis

The data obtained were analysed using Statistical Package for Social Sciences (SPSS Vs21) for descriptive and inferential statistics. The spatial coordinates gotten with the aid of GPS was displayed on the map with the aid of Arc View GIS software. Results were presented in tables, figures and maps.

2.6 Ethical Considerations

Permission to conduct this research was obtained from the Ministry of Environment Kwara State. The purpose and nature of the study were explained to each respondent after which consent was sought and obtained. Each of the respondents was assured of confidentiality of the information he/she may divulge.

3. RESULTS

Table 1 showed the distribution of the DPK vendors across the three local governments in Ilorin metropolis, the results of the data from the field survey revealed that there are 76 DPK vendors operating within Ilorin metropolis. 10(13.2%) are located in Ilorin East, 18(23.7%) are located in Ilorin South and 48(63.2%) are located in Ilorin West. The high percentage of the DPK vendors being found in Ilorin West Local Government can be attributed to the social economical status of the population of the people that dominated the area. According to 2006 census, Ilorin West has the largest population of residents in comparison with the other two local governments that makes up Ilorin metropolis with about 395,735 people. Most of the residents in this area are local farmers, traders, weavers of fabrics popularly known as “aso oke”. It was discovered that 2(2.6%) of the DPK vendors were established in 2007, 1(1.3%) was established each in the year 2009, 2010 and 2011 respectively, 4(5.3%) were established in the year 2012, 9(11.8%) were established in the year 2013, 17(22.4%) in the year 2014, 19(25.0%) in the year 2015, 15(19.7%) were established in the year 2016 and 7(9.2%) were established in the year 2017.

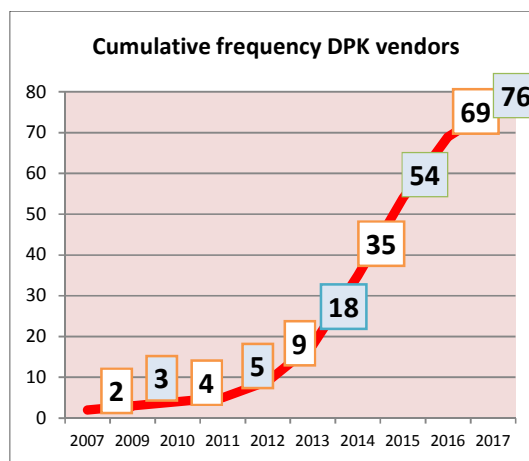


Fig. 2. The year of establishment of the DPK vendors within Ilorin metropolis

In Fig. 2, it is of great importance to note that from year 2012 to 2017, the establishment of DPK vendors increased sporadically as it coincides with the scarcity of the product in the filling stations nationwide and the high cost of kerosene in the country. According to Oduwole et al. [6], kerosene is more readily available through

sub-dealers and retailers than at licensed pump stations. This point is further emphasized by Merem *et al.* [10] who revealed that during this period, the nation devoted more than \$5billion annually for the imports and subsidy of paraffin coupled with massive corruption in the petroleum industry which made kerosene unavailable in the fuel stations.

In Table 2, it was revealed that 10(13.2%) of the vendors are located in the eastern part of Ilorin metropolis; while a greater proportion 48(63.2%) were located in the western part of Ilorin. The age distribution showed that majority 58(76.3%) of the respondents were in the age group 21-40 years. There was more of the females 56(73.7%) and all of the respondents were Yoruba. Majority (81.6%) were Muslim and 27(35.5%) had secondary education. More than half (60.5%) of the respondents were owners of these DPK ventures and were married. The spatial coordinates of the medium-scale DPK vendors operating within Ilorin metropolis are shown in Fig. 3. The latitudinal range is between 08°22.918' and 08°30.843'. The longitudinal range is between 004°29.767' and 004°32.993'. These coordinates were analysed using the spatial statistic tool to determine the pattern of distribution of the medium-scale DPK vendors across Ilorin metropolis.

Majority of the respondents (68.4%) had no formal training on vending of DPK as shown in

Fig. 4. Only about 17(22.4%) were aware that there are hazards associated with vending of kerosene which is considerably low compare to the geometric increase in the number of people venturing into the business coupled with the fact that location of these DPK vendors are found mostly in the western part of Ilorin metropolis where the core indigenes reside (Fig. 6). Fig. 6 showed that out of the 17 vendors that were aware of the health hazards associated with DPK trade, 9(14.8%) reported shortness of breath, 6(9.8%) reported coughing, 12(19.7%) reported burns. This is in line with the information obtained from the US Department of Health and Human Services that kerosene can irritate the nose, throat and lungs. Repeated exposure may cause bronchitis to develop with coughing, phlegm, and/or shortness of breath. Studies conducted by Ayakeme *et al.* [3] which was further corroborated by information from NJH [2], revealed that high exposure to kerosene can affect the nervous system causing headache, dizziness, nausea and vomiting, weakness, restlessness, disorientation and drowsiness, convulsion and coma may follow very high exposure to kerosene. Fadebiyi *et al.* [5] also reported that kerosene is a culprit in various incidences of burn injuries which is very high in developing countries- Long term exposure of people to kerosene has been known to cause various health hazards such as toxicity through inhalation of kerosene vapour, respiratory

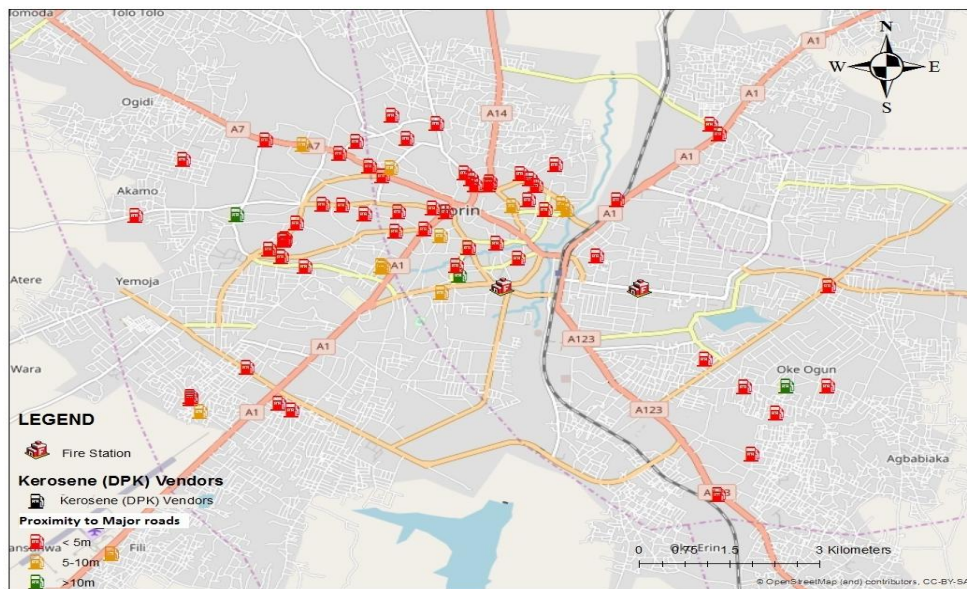


Fig. 3. The spatial coordinates of the medium-scale DPK vendors and fire stations operating within Ilorin metropolis

irritations, dermatitis and irritation to the eyes, to mention a few [5]. About 15(88.2%) of those that were aware got their information from friends and family while 2(17.8%) read it from newspaper which further reiterate the clarion call made by

Musa et al. [11] and buttressed by Merem et al. [7]; that there is a need for public enlightenment on safe fire lighting and cautious use of kerosene in Ilorin metropolis (Fig. 7).

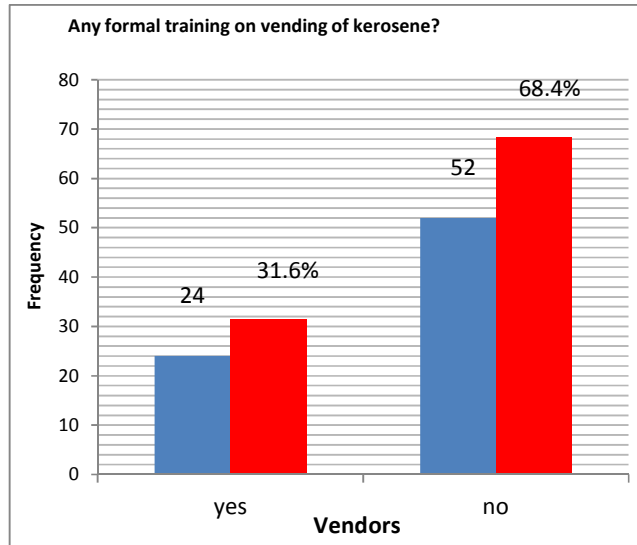


Fig. 4. The distribution of vendors that got formal training on vending of kerosene

Table 1. Total number of DPK vendors operating in the various LGAs in Ilorin

Variable	Characteristics	Frequency	Percent (%)
Local Government	Ilorin east	10	13.2
	Ilorin south	18	23.7
	Ilorin west	48	63.2
	Total	76	100.0

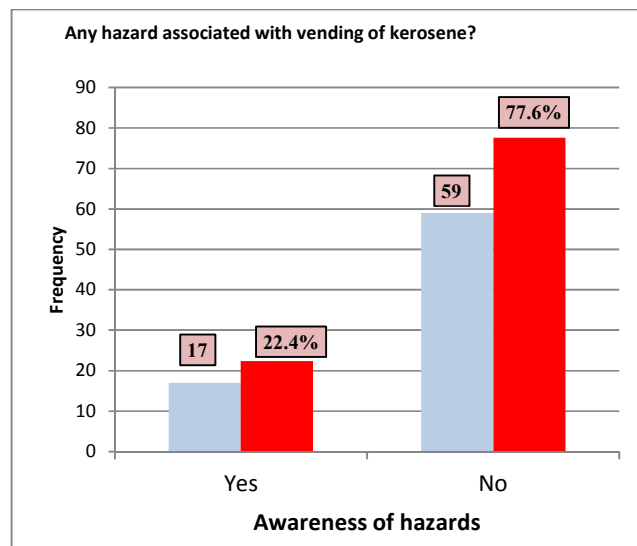


Fig. 5. The awareness of hazards associated with vending of kerosene

Table 2. Demographic characteristics of the population studied

Variable	Characteristics	Frequency	Percent (%)
Local Government	Ilorin east	10	13.2
	Ilorin south	18	23.6
	Ilorin west	48	63.2
	Total	76	100.0
Age	10-20years	12	15.8
	21-40years	58	76.3
	41-60years	6	7.9
Gender	Male	20	26.3
	Female	56	73.7
Tribe	Yoruba	76	100.0
Religion	Islam	62	81.6
	Christianity	13	17.1
	Traditional	0	0.0
	Others	1	1.3
Educational status	No formal education	3	3.9
	Primary	21	27.6
	Secondary	27	35.5
	Tertiary	25	32.9
Position	Owner	46	60.5
	Salespersons	30	39.5
Marital status	Single	27	35.5
	Married	49	64.5

Results from Table 3 reveals likely environmental health hazards associated with the operations of these medium-scale DPK vendors, about 5(6.6%) of the DPK vendors had case of spillage/leakage of kerosene from their tanks and the pipes that connect the tanks with the dispensing pumps- although it looks insignificant but one of the principles of environmental health sciences (the precautionary principle) stipulates that caution should be exercised in matters that could be deleterious to health even if no incidents/accidents has been reported. 52(68.4%) of the DPK vendors have their tanks situated at place less than 5m to residential buildings, while 61(80.3%) of the DPK vendors have their tanks situated at place less than 5m to major road. Majority (69.7%) have their tanks situated at distances greater than 10m to water sources. A similar study which was conducted by Samuel [12] on distribution of filling stations in Kaduna North revealed that 69.5% of the filling stations did not conform with the 15m setback thus can pose a serious environmental health hazards. Oloko-oba *et al.* [13] in a study conducted in Ilorin metropolis on the assessment of filling stations in Ilorin using geospatial techniques also revealed that 28.4% of the filling stations violated the distance from the edge of the road to the nearest pump which should be

not be less than 15 m as being stipulated by the DPR guidelines for the approval of construction and operations of a filling stations. Similarly, Mshelia *et al.* [14] revealed that the guidelines for sitting petrol stations have not been adhered by most of the petrol stations thereby posing serious threat on residence in close range to them even though some of these petrol stations were situated much earlier than the residential houses close to them. This study is corroborated in a study by Abdullahi [15] in Agege Local Government in Lagos State. Although, there is no written requirement for sitting of DPK sales point or ventures in the DPR guidelines thus this has created a loophole that has lead to the indiscriminate sitting of DPK sales points all over Ilorin metropolis- which could result in numerous environmental health and health hazards to the DPK vendors and to the populace surrounding them. During the field study, it was discovered that majority of this DPK vendors uses a generator to power their motorized pump used in dispensing the product and this generator is placed close to the aboveground storage tank (ASTs) thus increasing the risk of fire explosion and further pollution of the air which constitute a major environmental health and health hazards respectively.

Table 3. The likely environmental health hazards associated with the operations of these medium-scale DPK vendors in Ilorin metropolis

Variable	Characteristics	Frequency	Percentage (%)
Any case of spillage/leakage of kerosene	yes	5	6.6
	no	71	93.4
Any case of fire explosion incidence/accidence	yes	0	0.0
	no	76	100.0
Proximity to residential building	< 5m	52	68.4
	5-10m	16	21.1
	>10m	8	10.5
Proximity to major road	< 5m	61	80.3
	5-10m	12	15.8
	>10m	3	3.9
Proximity to a water source	< 5m	11	14.5
	5-10m	12	15.8
	>10m	53	69.7

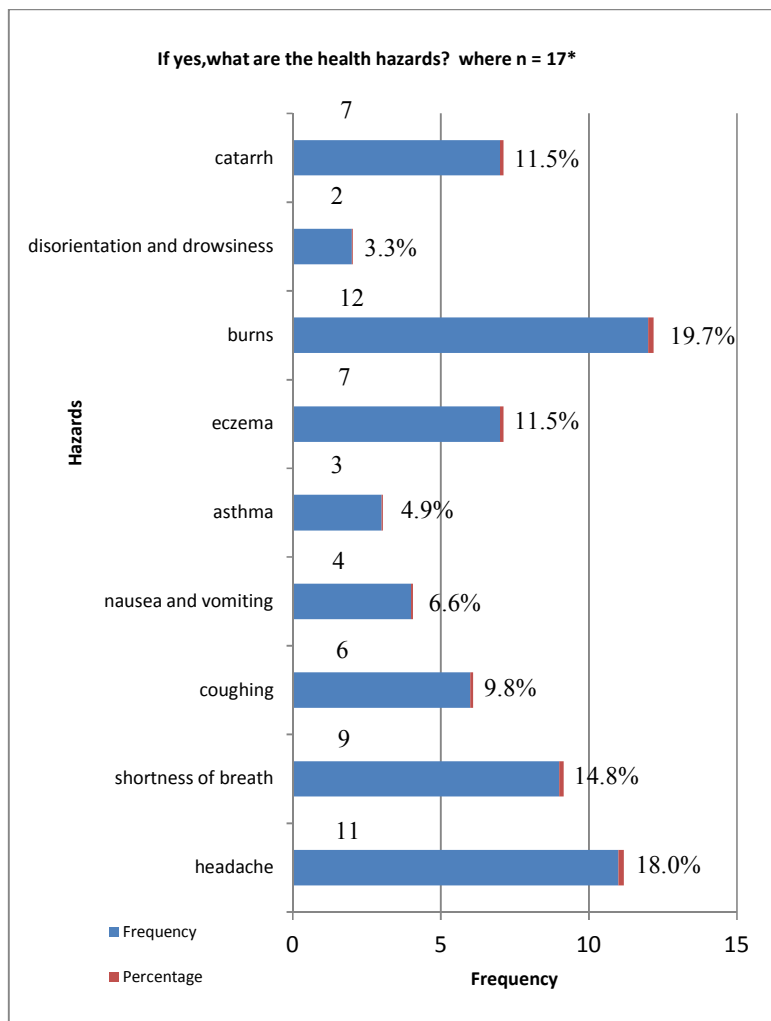


Fig. 6. The various hazards that respondents are aware are associated with vending of kerosene

* The multiple response

Majority (92.1%) of the vendors did not have fire extinguisher with only very few (7.9%) that had a fire extinguisher. On the assessment of their knowledge on the use of fire extinguisher, it was discovered that only 8(10.5%) had knowledge on the usage of fire extinguisher, majority 68(89.5%) do not which is in contrast with the study conducted by Afolabi et al. [16] where about 55.5% of the filling stations in Ife central LGA in Osun State had knowledge on the usage of fire extinguisher. On further evaluation of other safety equipment, it was discovered that only about 17.1% had bucket with sand and only

13.2% had fire blanket. The presence of Personal protective equipment (PPE) was also assessed. A very few 9(11.8%) had overall garment/apron, 1(1.3%) had face mask, 1(1.3%) had nose mask and none had hand gloves. 65(85.5%) had no PPE (Table 4). It was evident from the earlier result revealed in Fig. 4 where 59(77.6%) were not even aware of the hazards associated with the operations of medium scale DPK vendors thus it is important that there should be a rigorous enlightenment campaign on basic safety practices in order to prevent accidents and illness that arise from vending of

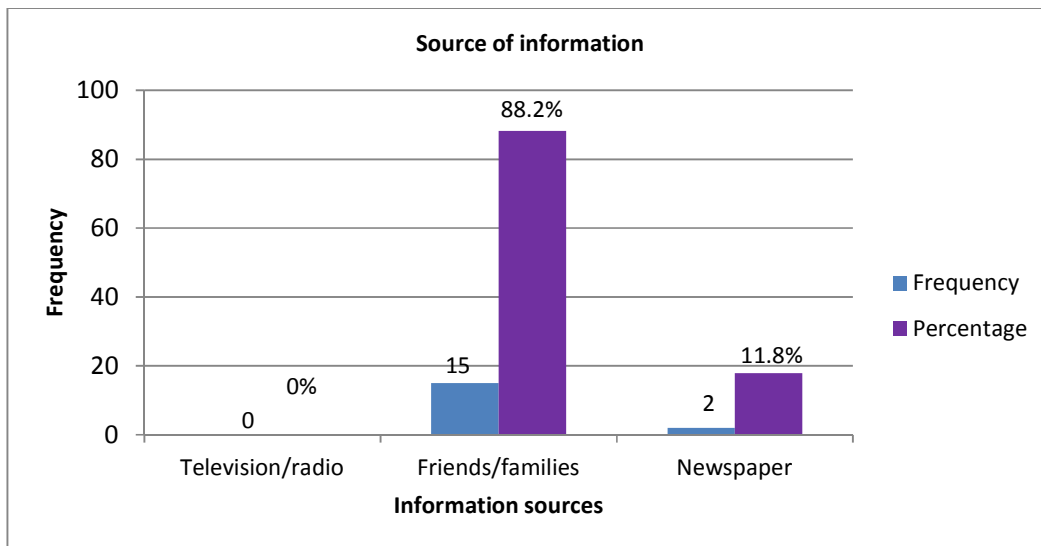


Fig. 7. The distribution of source of information

Table 4. The basic safety precautions being practiced by the DPK vendors in Ilorin metropolis

Variable	Characteristics	Frequency	Percentage (%)
Availability of fire extinguisher	yes	6	7.9
	no	70	92.1
Knowledge on the usage of fire extinguisher	yes	8	10.5
	no	68	89.5
Availability of bucket with sand	yes	13	17.1
	no	63	82.9
Availability of fire blankets	yes	10	13.2
	no	66	86.8
Presence of personal protective equipment	overall garment/apron	9	11.8
	face mask	1	1.3
	nose mask	1	1.3
	hand gloves	0	0.0
	no PPE	65	85.5
Reasons for not using PPE	availability	11	14.5
	convenience	15	19.7
	ignorance	47	61.8
	cost	3	3.9
	others	0	0.0

Table 5. Chi square test of association between safety precaution practices and awareness of health hazards associated with DPK vendors' operations

Basic safety practices and awareness of health hazards associated with DPK vendors operations	Value	df	P value
Variables	High	Low	
Availability and Usage of fire extinguisher			
Yes	4(23.5%)	2(3.4%)	7.361 1 0.007
No	13(76.5%)	57(96.6%)	
Availability and Usage of bucket with sand and fire bucket			
Yes	7(41.2%)	6(10.2%)	8.948 1 0.003
No	10(58.8%)	53(89.8%)	
Presence and Usage of personal protective equipment			
overall garment/apron	3(17.6%)	6(10.2%)	8.136 3 0.043
face mask	1(5.9%)	0(0.0%)	
nose mask	1(5.9%)	0(0.0%)	
no PPE	12(70.6%)	53(89.8%)	

kerosene. Many reasons were cited for not using personal protective equipment, 11(14.5%) gave their reason as availability, 15(19.7%) claimed it was not convenient, 47(61.8%) was discovered to be ignorant, 3(3.9%) claimed it was because of the cost of purchasing the equipment. It is pertinent that the Ministry of Environment through the Environmental Health Officers (EHOs) and Ministry of Health should enlighten the populace of Ilorin metropolis on the need to take safety precautions seriously as it was discovered during the field survey that some of these DPK vendors engages in the sales of Petroleum Motor Spirit (PMS) as black marketers. It was also observed that the some of the DPK vendors store the petrol in the same jerrycans and aboveground storage tank (AST) used in storing kerosene which can invariably lead to kerosene contamination. Kerosene contamination has been a chief culprit in the various instances of fire outbreaks in Nigeria (134 cases in February 2001, WHO Nigeria [17]. The epidemiological study conducted by Musa et al. [11] concerning a recent kerosene tragedy reported in Ilorin in which 12(18.5%) deaths out of 65 cases of burns investigated was recorded while 12(23%) of the remaining 53 cases receiving treatment were at risk of death due to severe burns they sustained in which adulteration of the kerosene was a major factor identified as the cause of the mishap. Thus, appropriate precautions by kerosene suppliers and users, and health education can help prevent similar disasters in the future.

Result from Table 5 shows there is significant association between basic safety precaution

practices and awareness on health and environmental hazards among DPK vendors.

5. CONCLUSION

Results from the study shows a sporadic increase in the proliferation of DPK vendors in Ilorin metropolis within a decade; and the indiscriminate siting of these DPK vendors close to residential building and major roads, causes environmental degradation and environmental health hazards.

It is of great concern as results from this study also revealed that a larger percentage of the DPK vendors lack the awareness of the health hazards associated with vending of DPK, almost everyone had no fire extinguisher and majority do not use PPEs. These increase the vulnerability of the vendors and population surrounding them to fire mishaps, kerosene poisoning, asthma, dermatitis and even death.

Lastly, it is worthy of notice that only 2 fire stations serves the entire Ilorin metropolis, which is too little to serve the populace of Ilorin metropolis in the case of fire mishaps.

The following recommendations are hereby suggested;

- The Environmental Health Officers in collaboration with Town Planning ministry should enhance their enforcement activities to ensure that proper set-backs are maintained so as to prevent

indiscriminate citing of DPK stations near residential buildings and major roads.

- Promotion of public education on the dangers of DPK, basic safety practices, use of PPEs, emergency toll lines through posters, the media and publicity campaigns by all stakeholders saddled with the affairs of environmental health, environment and health.
- There should be establishment of an agency which will be saddled with emergency/disaster preparedness, mitigation and relief with a toll free emergency line like LASEMA in Lagos state.
- The Government through the State assembly should enact laws to curb the uncontrolled proliferation of medium-scale DPK vendors in Ilorin metropolis and storage of toxic and flammable substances.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Lam NL, Smith KR, Gauthier A, Bates MN. Kerosene: A review of household uses and their hazards in low- and middle-income countries. *J Toxicol Environ Health B Crit Rev.* 2012;15(6):396–432.
2. New Jersey Department of Health (NJH, 2016). Hazardous Substance Fact Sheet. Available: atnj.gov/health/eoh/rtkweb/documents/fs/1091.pdf. (Accessed on 11/08/2018).
3. Ayakeme T, Ebiere EJ, Azibalua AA. Evaluation of health and environmental hazards of poorly refined kerosene from household users in Bayelsa state, Nigeria. *Acad. J. Environ. Sci.* 2013;1(7):147-151.
4. Olugbenga SA. Adulterated kerosene burn disaster: The Nigeria experience. *Ann Burns Fire Disasters.* 2005;18(1):40–44.
5. Fadeyibi IO, Omosebi DT, Jewo PI, Ademiluyi SA. Mass burns disaster in Abule-egba, Lagos, Nigeria from a Petroleum Pipeline Explosion Fire. *Ann Burns Fire Disasters.* 2009;22(2):97–103.
6. Oduwole EO, Sanni AO, Oduanya O, Fadeyibi IO. Contaminated kerosene burns disaster in Lagos, Nigeria. *Ann. Medit. Burns Club.* 2003;16:208–216.
7. Merem EC, Twumasi Y, Wesley J, Isokpehi P, Fageir S, Crisler M, Romorno C, Hines A, Ochai GS, Leggett S, Nwagboso E. Assessing the effects of fuel based lighting: The case of kerosene use and disasters in Nigeria, *Public Health Research.* 2018;8(1):6-23.
8. Kwara state Government. The state of harmony: Geography; 2017. Available: <https://kwarastate.gov.ng/geography/>. (Accessed November 11, 2018)
9. Oyegun RO., Water resources in Kwara State Nigeria, Matanmi and Sons, Ilorin; 1983.
10. Merem EC. Assessing the effects of fuel based lighting: The case of kerosene disasters in Nigeria. In *Proceedings of the 25th Annual AEHS Conference.* San Diego, CA; 2017.
11. Musa OI, Akande IM, Saka MJ. Epidemiological Investigation of Kerosene Burn Tragedy in Ilorin, Kwara State, Nigeria. *Sahel Med. Journal.* 2002;5(4): 186-189.
12. Samuel JA. Spatial location of filling stations in Kaduna. Kaduna: Scribid Inc; 2011.
13. Oloko-Oba OM, Ogunyemi SA, Alaga AT, Badru RA, Ogbale JO, Popoola OS, Samson AS. Spatial distribution of primary schools in Ilorin West Local Government Area, Kwara State, Nigeria. *Journal of Scientific Research & Reports.* 2016; 9(6):1-10.
14. Mshelia AM, John A, Emmanuel DD. Environmental effects of petrol stations at close proximities to residential buildings in Maiduguri and Jere, Borno State, Nigeria. *IOSR Journal of Humanities And Social Science (IOSR-JHSS).* 2015;20(4):1-8.
15. Abdullahi K. Spatial distribution of filling stations in Agege Local Government Lagos State. Unpublished Research Essay Submitted to the Department of Geography, Bayero University Kano (BUK); 2012.
16. Afolabi OT, Olajide FO, Omotayo SK. Assessment of safety practices in filling stations in Ile-Ife, South Western Nigeria. *Journal of Community Medicine and Primary Health Care.* 2011;23:1-2.

17. WHO Nigeria. Monthly News Bulletin of WHO Lagos Nigeria. 2001;15(2). scale dual purpose kerosene vendors using motorized pumps with aboveground Storage Tanks In Ilorin Metropolis, Kwara State, Nigeria, Advances in Research, (Article in press); 2019.
18. Moshood Liman Ibrahim, Henry Olawale Sawyerr, Aliyu Nda Isiaku. Health hazards associated with operations of medium-

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