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SMALL-SCALE VEGETABLE FARMERS KNOWLEDGE, ATTITUDE, PRACTICES AND HEALTH PROBLEMS ASSOCIATED WITH PESTICIDE USE IN SOME LOCAL GOVERNMENT AREAS OF LAGOS, NIGERIA

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ABSTRACT

This study was conducted to assess the pesticide knowledge, attitudes, and practices of small-scale vegetable farmers in three vegetable farming locations in some local government areas in Lagos. In all, 187 vegetable farmers were sampled for this study in all three local government areas using a structured questionnaire. Data obtained were subjected to descriptive statistics. Most of the farmers used pesticides on their farms, mainly for the control of diseases and insect pests. A large number of the farmers (79.36%, 58.98%, and 70.58%) agreed that pesticides use poses risk also to the environment while 71.43%, 58.97%, and 70.59% agreed that pesticides use poses some potential risk to human health, however, this does not reflect the percentage of farmers with formal education (20.64%, 5.13%, and 31.76%) across the 3 LGAs. A higher percentage of the farmers sometimes or always use a form of PPE either singly or combined. The most used PPE is the coverall, followed by the hand gloves. The least used PPE is the respirator/nose mask. This study revealed serious and lethal consequences of pesticide exposure to human health when adequate and appropriate protection was not used. A substantial percentage of the respondents reported at least one symptom of acute pesticide poisoning in the previous year immediately after applying or handling pesticides. Generally, the study shows a paucity of training and knowledge regarding the safe use of pesticides among small-scale farmers. Similarly, there is also a high risk of pesticides exposure. Urgent need for regular and updated training of farmers on the safe use of pesticides and additional pest management methods.

Keywords: Pesticides, safety practices, risk, health, vegetable farmers, exposures

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INTRODUCTION

The ubiquity usage of pesticides as essential chemicals used to protect against crop damage and improve agricultural output by preventing, destroying, repelling or mitigating any pests is never in contention (Adesuyi *et al*., 2018; Mergia *et al*., 2021, Omoyajowo *et al*., 2022). Pesticide's use is a key part of contemporary day farming for increasing agricultural productivity. It was estimated that about 125,000 - 130,000 metric tons of pesticides are applied every year in Nigeria (Asogwa and Dongo,2009). Studies have shown that pesticide levels are generally declining in developed countries with regard to the environment, but are increasing in developing countries because they are still in use for agricultural and public health purposes (WHO, 2007; Agmas and Adugna, 2020).The extensive use of pesticides has led to an accumulation of

a huge volume of residues in the environment, thereby causing a substantial environmental health hazard due to uptake and accumulation of these toxic compounds in the food chain and drinking water (Adesuyi *et al*., 2015; Njoku *et al*., 2017; Njoku *et al*., 2018; Adesuyi *et al*., 2018).

All pesticides have the potential to harm humans, animals, or other living organisms and the environment if used incorrectly (Gesesew *et al*., 2016). Several studies on both humans and animals provide strong evidence of the toxic potential of exposure to pesticides especially through ingestion of contaminated food (Yazgan and Tanik, 2010). Long-term health adverse effects such as increased likelihood of reproductive failures (infertility), respiratory failures, kidney failure, nervous defects like depression, birth defect, endocrine disruption, immune system dysfunction, and cancer (prostate cancer, leukemia) have also been reported (Okoffo *et al.*, 2016; Adesuyi *et al*., 2018). There are also reports of effects such as headaches, body aches, coughing, stomach ache, skin and eye irritation, respiratory problems, dizziness, impaired vision and nausea (Okoffo *et al*., 2016; Jallow *et al*., 2017). Studies have also showed that pesticides have a strong potential to cross placental barriers even at minute concentrations and cause serious neonatal damage (Yazgan and Tanik, 2010).

Farmers, and especially those directly involved in the handling of pesticides, are at a very high risk of exposure to pesticides through contact with pesticide residues on treated crops, unsafe handling, storage and disposal practices, poor maintenance of spraying equipment, and the lack of protective equipment or failure to use it properly. These accompanying risks may be heightened by lack of information on pesticide hazards, the perception and attitude of farmers regarding risk from pesticide exposure, and lack of education and poor knowledge and understanding of safe practices in pesticide use, including storage, handling and disposal (Karunamoorthi *et al*., 2012; Jallow *et al*., 2017). Plethora evidence exists of pesticide-related health effects in Nigeria. Pesticide residues have been detected in a number of vegetables and foods in Nigeria (Njoku *et al*., 2017; Akan *et al*., 2014; Ogbeide *et al*., 2015, 2016; Omoyajowo *et al*, 2018), and the presence of chlorinated pesticides in the breast milk of lactating women has raised even greater concerns about possible health risks to breastfed infants (Olisah *et al*., 2020).

Therefore, the aim of the study was to describe and compare current practices, knowledge and attitudes of smallholder vegetable farmers in three local government areas in Lagos regarding the safe handling and application of pesticides in relation to the adoption of PPE to reduce occupational pesticide exposure, operational habits that lead to exposure and toxicity symptoms.

MATERIALS AND METHODS

Study Area

The study was carried out in some part of the Lagos. Three (3) small vegetables farming areas in 3 Local Government Areas; Mushin (Idi-araba), Lagos Mainland (Tejusoho) and Kosofe (Alapere) were assessed for this study.

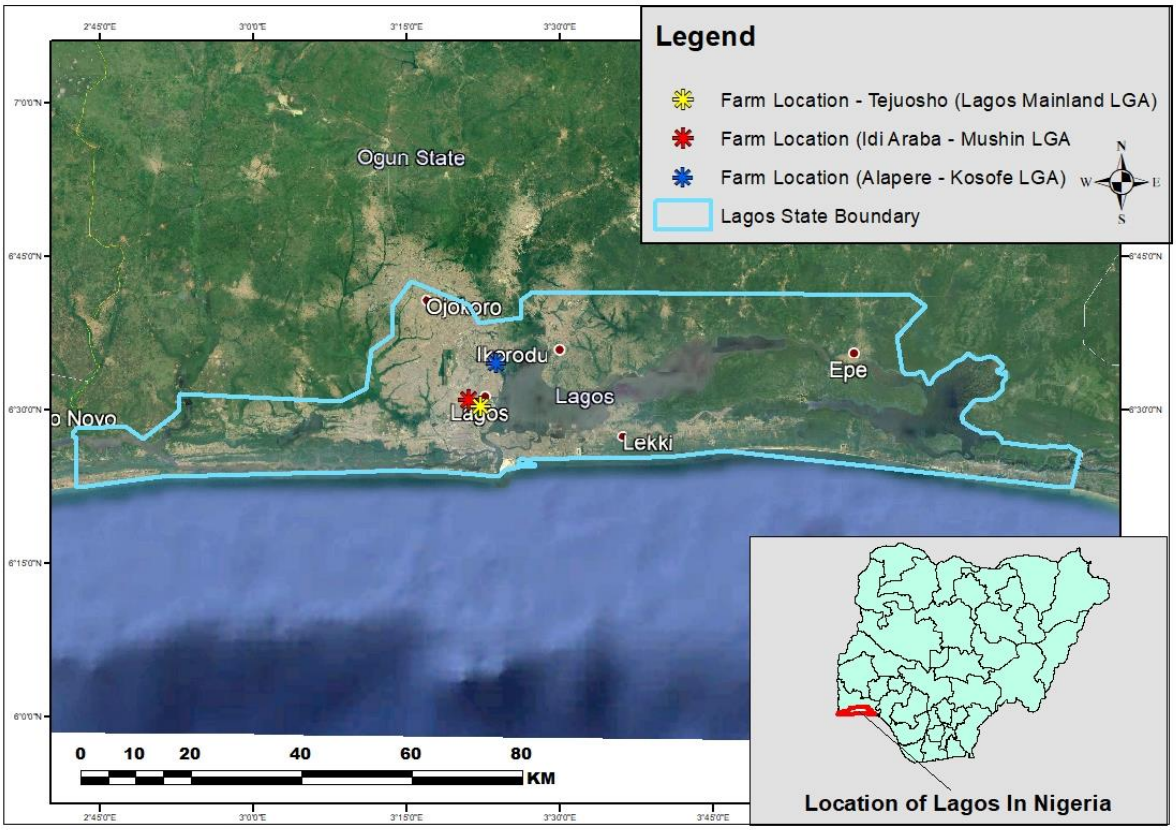

Figure 1: Map of study areashowing locations of small-holder vegetable farms

Sampling technique and data collection

The study was carried from September 2018 and May 2019. The fundamental information for the analysis was gotten from primary data collected with the aid of a pre-tested semi-structured questionnaire. Most of the identifiable small-scale vegetable farms in the farming locations during the survey were assessed and used for the study. Sixty-three (63) from Idi-araba in Mushin local government area (LGA), thirty-nine from Tejuosho in Lagos mainland and eighty-five from Alapere in Kosofe LGA. In all, 187 vegetable farmers were sampled for this study in the three local government areas. The research survey encompassed demographic characteristics of farmers, pesticides use and practices, and the use of PPE, operational habits exhibited by farmers during and after pesticides applications, and reported symptoms experienced within the last one year. All the respondent farmers consented to participate in the study by signing the informed consent forms.

The designed questionnaire was closed and open-ended and was pretested by randomly interviewing twenty-five farmers. The closed questions were all multiple choicesto make respondents select only the appropriate answer or answers that they thought well expressed their opinion or attitude on a particular question. The validated questionnaire was made up of three main parts. The first section was designed to gather information on the personal characteristics of the farmers including age, educational level, years of experience in farming, and sizes of farmlands. The second section focused on obtaining information on farmers' level of awareness of pesticide regulations, knowledge and understanding of pesticides relating to the environmental risk and human health. Moreover, we also collected data on self-reported toxicity symptoms associated with pesticide use and handling, as well as farmers' knowledge about exposure routes. While symptoms were assessed, respondents were inquired if within the past year before the date of the interview they experienced at least one health impairment immediately after applying or handling pesticides. If they answered yes, respondents were further inquired to specify which symptoms they had experienced. The third section included questions relating to pesticide handling and

safety practices as well as reading and following label instructions, storing and disposing of pesticides and empty containers, and use of PPE and other protective practices for the period of pesticide application.

Data Analysis

All data were analysed using SPSS version 19 (SPSS Inc., Chicago, IL, USA) and Microsoft Office Excel (Microsoft Corporation, Redmond, WA, USA). All descriptive results were expressed as frequencies and percentages.

RESULTS

Demographic characteristics of the respondents in the study areas

The demographic characteristics of respondent farmers in the three local government areas are shown in Table 1. It was evident from this study that males dominated farming in this study areas, 98.41%, 87.18% and 96.47% were males while 1.59%, 12.82% and 3.53% were females in smallholders farming in Mushin, Lagos mainland and Kosofe local government areas respectively.

The majority of the farmers were between 25 – 34 and 35 – 44 years' age bracket. Only 14.29%, 2.56% and 3.53% of the farmers were above 55 years in smallholders farming in Mushin, Lagos mainland and Kosofe local government areas, respectively. Also, a large number of the farmers had formal education (79.36%, 94.87% and 68.24%), however, mainly secondary education (44.44%, 38.46%, and 37.65%), with 20.64%, 5.13% and 31.76% of the farmers with no formal education in smallholder's vegetable farming in Mushin, Lagos mainland and Kosofe local government areas, respectively.

Most of the respondents had 6 – 15 years of farming experience. More than 70% of the farmers across the study areas agreed to apply pesticides once and twice, while less than 30% applied thrice or more annually. A higher percentage of the smallholders' vegetable farmers were farmers with less than 5 plots per respondent. The vegetable farmers in the study area are growers several varieties of vegetables such as pepper (*Capsicum annum*), tomato (*Lycopersicon esculentum*), spring onions (*Allium fistulosum*), fluted pumpkin (*Telferia occidentalis*, Ugu), Ewedu (*Corchorus olitotius*), Green amaranth (*Amaranthus hybridus*, tete), Soko (*Celosia argentea*) and Okro (*Abelmoschus esculentus*).

Table 1: Demographic characteristics of the respondents in the study areas

Description	Variable	Mushin LGA (63)		Lagos M/land LGA (39)		Kosofe LGA (85)	
		Freq (N)	%	Freq (N)	%	Freq (N)	%
Sex of Farmers	Male	62	98.41	34	87.18	82	96.47
	Female	01	1.59	05	12.82	03	3.53
Age of Farmers	15 – 24	13	20.64	09	23.08	07	8.24
	25 – 34	21	33.33	10	25.64	28	32.94
	35 – 44	10	15.87	17	43.59	42	49.41
	45 – 54	10	15.87	02	5.13	05	5.88
	Above 55	09	14.29	01	2.56	03	3.53
Educational Level	No formal education	13	20.64	02	5.13	27	31.76
	Primary	21	33.33	13	33.33	22	25.88
	Secondary	28	44.44	15	38.46	32	37.65
	Tertiary	01	1.59	09	23.08	04	4.71
Farmer's years of experience	1 – 5	08	12.70	06	15.38	21	24.71
	6 – 10	23	36.51	19	48.72	33	38.82
	11 – 15	30	47.62	09	23.08	20	23.53
	16 – 20	02	3.17	05	12.82	11	12.94
Farm sizes	1 plot	18	28.57	09	23.08	39	45.88
	2 - 5 plots	33	52.38	21	53.84	30	35.30
	> 5 plots	12	19.05	09	23.08	16	18.82
Pesticides use (freq per year)	Once	41	65.08	12	30.77	31	36.47
	Twice	19	30.16	17	43.59	39	45.88
	Three and more	03	4.76	10	25.64	15	17.65

Farmer's knowledge and understanding of pesticides

Farmers' knowledge of the health risk of pesticides including potential effects on the environment, awareness of pesticides laws and exposure routes were presented in table 2. In all the farms across the three local government areas, 79.36%, 58.98% and 70.58%of the farmers agreed that pesticides use poses risk also to the environment while 71.43%, 58.97% and 70.59% agreed that pesticides use poses some potential risk to human health.

The majority of farmers in this study were aware of the route of pesticide exposure including inhalation and ingestion. Although, the farmers are aware of the human health effects of pesticide residue, they strongly believe that increasing agricultural productivity and high crop yield is possible only through the usage of pesticides (79.37%, 76.92%, and 74.12%). Also, in this study, many farmers were also aware of the route of pesticide exposure to the human body. Ingestion (96.83%, 46.15% and 84.71%), dermal (77.78%, 56.41% and 52.94%) and inhalation (42.86%, 38.46% and 25.88%) were stated as the most common routes of exposure to pesticides. Most of the farmers are aware that some pesticides have been banned or are restricted for use. However, sources of information on the use of for the farmers were pesticide sellers (91.67%, 80.00%, and 80.77%), co-farmers (80.56%, 60.00%, and 46.15%) and agricultural officers (33.33%, 33.33% and 38.46%).

Table 2: Farmer's knowledge and understanding of pesticides

Question	Variable	Mushin LGA (63)		Lagos M/land LGA (39)		Kosofe LGA (85)	
		Freq (N)	%	Freq (N)	%	Freq (N)	%
Do you think that pesticides harm the environment?	Strongly agree	28	44.44	19	48.72	27	31.76
	Agree	22	34.92	04	10.26	33	38.82
	Disagree	08	1270	13	33.33	13	15.29
	Strongly disagree	05	7.94	03	7.69	12	14.12
Do you think that pesticides affect human health?	Strongly agree	26	41.27	17	43.59	48	56.47
	Agree	19	30.16	06	15.38	12	14.12
	Disagree	10	15.87	10	25.64	10	11.76
	Strongly disagree	08	12.70	06	15.38	15	17.65
How do pesticides enter the human body?*	Skin	49	77.78	22	56.41	45	52.94
	Oral	61	96.83	18	46.15	72	84.71
	Eye contact	10	15.87	13	33.33	09	10.59
	Inhalation	27	42.86	15	38.46	22	25.88
	Don't know	04	6.35	10	25.64	05	2.35
Do you think pesticides are essential for high crop yield and productivity?	Strongly agree	50	79.37	30	76.92	63	74.12
	Agree	10	15.87	06	15.38	10	11.76
	Disagree	02	3.17	03	7.70	07	8.23
	Strongly disagree	01	1.59	0	0.00	05	5.88
Do you read and follow pesticides labels?	Yes	44	69.84	28	71.79	39	45.88
	No	19	30.16	11	28.21	46	54.12
Do you know any banned or restricted pesticides?	Yes	22	34.92	19	48.72	45	52.94
	No	41	65.08	20	51.28	40	47.06
Do you know the reason pesticides are banned or restricted? *,y	Highly Toxic	22	34.92	18	46.15	44	51.76
	Not effective	19	30.16	15	38.46	35	41.18
	Expensive	17	26.98	08	20.51	25	29.41
	Don't know	05	7.94	10	25.64	15	17.65
Informed about the proper use of pesticides	Informed	36	57.14	15	38.46	26	30.59
	Non informed	27	42.86	24	61.54	59	69.41
Source of information *, b	Pesticides sellers	33	91.67	12	80.00	21	80.77
	Agric Extension officers	12	33.33	05	33.33	10	38.46
	Co-farmers	29	80.56	09	60.00	12	46.15

**Multiple responses allowed; [y] percentage of respondents who knew that pesticides are banned or restricted for use (n=47); [b] percentage of respondents who were informed about the use of pesticides*

Farmers' practices on storage and disposal of pesticides

Table 3 showed ways of storing pesticides and disposal of pesticide residue solutions, expired stocks, and empty pesticide containers by smallholder's vegetable farmers in the study areas. Among the smallholder's vegetable farmers in Mushin, many of the farmers (50.79%) stored their pesticides in the open shed for pesticides, 26.98% stored in the open field while 17.46% don't store pesticides but buy when needed. However, amongst the smallholder vegetable farmers in Lagos mainland, 53.85% don't store pesticides but buy when needed, 35.90% store in the open field, 7.69% keep them locked in chemical stores designated only for pesticides. The storage of some pesticides in the homes implied the likeliness and possibility of exposure to the farmers and their family members.

Some of the respondents were not concerned about overdosing, 7.94%, 17.95% and 8.24% across the three local government areas applied the leftover solution on the crops reputably. Also, 19.05%, 10.26% and 15.29% of respondents reported storing in containers to be reused. However, the majority of the farmers (61.90%, 61.54% and 68.24%) reported mixing only the recommended amounts of pesticides needed for the application at hand. The most common ways of disposing of empty pesticide containers were placing them in waste collection bins (33.33%, 35.90% and 50.59%) followed by reuse for other purposes (30.16%, 38.46% and 40.00%).

Table 3: Farmers practices on storage and disposal of pesticides

Question	Variable	Mushin LGA (63)		Lagos M/land LGA (39)		Kosofe LGA (85)	
		Freq (N)	%	Freq (N)	%	Freq(N)	%
Store of pesticides	Open shed just for pesticides	32	50.79	01	2.56	18	21.18
	In the open field	17	26.98	14	35.90	26	30.59
	Locked chemical store	02	3.18	03	7.69	15	17.64
	Living Area	01	1.59	0	0.00	08	9.41
	Don't store pesticides	11	17.46	21	53.85	18	21.18
What do you do with the unused left over (mixed, diluted) pesticides?	Disposed on the field	05	7.94	01	2.56	02	2.35
	Mix only needed pesticides	39	61.90	24	61.54	58	68.24
	Apply on other crops	05	7.94	07	17.95	07	8.24
	Wash off	02	3.17	03	7.69	05	5.88
	Stored in a container to be reused	12	19.05	04	10.26	13	15.29
What do you do with old pesticides stocks?	Buy what is needed	42	66.67	27	69.23	65	76.47
	Dispose on the field	02	3.17	03	7.69	04	4.71
	Add with new to reuse	19	30.16	09	23.08	16	18.82
What do you do with empty pesticide containers?	Discard on-farm	07	11.11	04	10.26	02	2.35
	Bury/burn on-farm	16	25.40	06	15.38	06	7.06
	Waste collection bins	21	33.33	14	35.90	43	50.59
	Reuse for other purposes	19	30.16	15	38.46	34	40.00

Farmers' use of PPE during the preparation and application of pesticides to prevent occupational exposure

A higher percentage of the farmers sometimes or always use a form of PPE either singly or combined. The most used PPE is the coverall, followed by the hand gloves. The least used PPE is the respirator/nose mask (79.36%, 56.41% and 75.31%). The main reason mentioned for not using PPE was the discomfort under hot and humid conditions typical of the tropical region, showing the propensity of farmers more willing to risk exposure to pesticides than to use PPE with such climatic conditions.

Table 4: Farmers use of PPE during preparation and application of pesticides to prevent occupational exposure

Protective Equipment	Variable	Mushin LGA (63)		Lagos M/land LGA (39)		Kosofe LGA (81)	
		Freq (N)	%	Freq (N)	%	Freq (N)	%
Coveralls	Always	45	71.43	21	53.85	33	40.74
	Sometimes	12	19.05	10	25.64	12	14.82
	Never	06	9.52	08	20.51	36	44.44
Protective boots	Always	30	47.62	24	61.54	38	46.91
	Sometimes	25	39.68	10	25.64	29	35.80
	Never	08	12.70	05	12.82	14	17.28
Glasses/goggles	Always	05	7.94	08	20.51	18	22.22
	Sometimes	10	15.87	15	38.46	11	13.58
	Never	48	76.19	16	41.03	52	64.20
Gloves	Always	47	74.60	22	56.41	62	76.54
	Sometimes	14	22.22	13	33.33	11	13.58
	Never	02	3.18	04	10.26	08	9.88
Respirator/nose mask	Always	05	7.94	07	17.95	09	11.11
	Sometimes	08	12.70	10	25.64	11	13.58
	Never	50	79.36	22	56.41	61	75.31
Hat/hair dress	Always	12	19.05	13	33.33	33	40.74
	Sometimes	33	52.38	15	38.46	15	18.52
	Never	18	28.57	11	28.21	33	40.74

Some operational habits exhibited by respondents during preparation and application of pesticides

All the interviewed small-scale farmers adopted pesticides usage on their farms. Moreover, none of the vegetable farmers reported using biological methods or other such integrated pest management (IPM). Also, apart from PPE use, farmers were asked if they implement other safety measures to reduce their risk of exposure to pesticides. A very low percentage (1.59%, 10.26% and 0%) of the respondents in all the LGAs stated they talk while mixing or applying pesticides. Besides, a higher percentage of farmers (93.65%, 84.61% and 95.29%) stated they always and sometimes take a shower after mixing or spraying pesticides. Across the respondent farmers in three local government areas, a lower percentage (31.75%, 20.51% and 35.29%) of the small-scale farmers did not consider wind direction during spraying.

Problems reported by farmers after mixing or spraying pesticides

The findings of this study revealed serious and lethal consequences of pesticide exposure to human health when adequate and appropriate protection was not used. A substantial percentage of the farmers (71.43% - Mushin, 46.15% - Lagos mainland and 71.76% - Kosofe) reported at least one symptom of acute pesticide poisoning in the previous year immediately after applying or handling pesticides, while 19.05%, 51.28% and 24.71% of the respondents did not ascribe any health problem encountered to pesticide exposure across three 3 LGAs. The most frequently reported symptoms were headaches (61.90%, 33.30% and 71.76%), skin irritation (71.43%, 38.46% and 63.53%), itchy eyes (33.33%; 15.38% and 48.24%), fatigue (28.57%, 30.77% and 45.88%), coughing (9.52%, 41.03% and 12.94%), excessive sweating (15.87%, 38.46% and 18.82%) and shortness of breath (19.05%, 15.38% and 15.29%). Other symptoms reported by respondents were dizziness, vomiting, nausea and Stomach ache.

Table 5: Some operational habits exhibited by respondents during preparation and application of pesticides

Question	Variable	Mushin LGA (63)		Lagos Mainland LGA (39)		Kosofe LGA (85)	
		Freq (N)	%	Freq (N)	%	Freq (N)	%
Talking while mixing or spraying	Always	01	1.59	04	10.26	0	0.00
	Sometimes	13	20.63	20	51.28	19	22.35
	Never	49	77.78	15	38.46	66	77.65
Singing while mixing or spraying	Always	02	3.18	0	0.00	03	3.53
	Sometimes	18	28.57	03	7.69	42	49.41
	Never	43	68.25	36	92.31	40	47.06
Eating while mixing or spraying	Always	05	7.94	02	5.13	0	0.00
	Sometimes	19	30.16	09	23.08	10	11.76
	Never	39	61.90	28	71.79	75	88.24
Drinking water while mixing or spraying	Always	04	6.35	10	25.64	02	2.35
	Sometimes	21	33.33	19	48.72	23	27.06
	Never	38	60.32	10	25.64	60	70.59
Smoking while mixing or spraying	Always	10	15.87	0	0.00	03	3.53
	Sometimes	21	33.33	12	30.77	09	10.59
	Never	32	50.80	27	69.23	73	85.88
Stirring/scoping chemicals with hands	Always	0	0.00	0	0.00	0	0.00
	Sometimes	0	0.00	0	0.00	02	2.35
	Never	63	100.00	39	100.00	83	97.65
Sprayed along the wind direction	Always	10	15.87	15	38.46	23	27.06
	Sometimes	33	52.38	16	41.03	32	37.65
	Never	20	31.75	8	20.51	30	35.29
Washing of PPE before reuse	Always	15	23.81	21	53.84	34	40.00
	Sometimes	39	61.90	09	23.08	36	42.35
	Never	09	14.29	09	23.08	15	17.65
Bathing after application	Always	21	33.33	23	58.97	40	47.06
	Sometimes	38	60.32	10	25.64	41	48.23
	Never	04	6.35	06	15.39	04	4.71

Table 6 - Problems reported by farmers after mixing or spraying pesticides *

Symptoms	Mushin LGA (63)		Lagos Mainland LGA (39)		Kosofe LGA (85)	
	Freq (N) [y]	Percentage (%)	Freq (N) [y]	Percentage (%)	Freq (N) [y]	Percentage (%)
Headache	39	61.90	13	33.30	61	71.76
Skin irritation	45	71.43	15	38.46	54	63.53
Dizziness	13	20.63	04	10.26	10	11.76
Vomiting	01	1.59	09	23.08	05	5.88
Nausea	05	7.94	11	28.21	13	15.29
Itchy eyes	21	33.33	06	15.38	41	48.24
Coughing	06	9.52	16	41.03	11	12.94
Stomach ache	02	3.17	18	46.15	09	10.59
Shortness of breath	12	19.05	06	15.38	13	15.29
Excessive sweating	10	15.87	15	38.46	16	18.82
Fatigue	18	28.57	12	30.77	39	45.88
No health effect	12	19.05	20	51.28	21	24.71

** Respondents were asked if they experienced at least one heath impairment immediately after applying or handling pesticides in the last 12 months; [y] Multiple responses allowed*

DISCUSSION

The demographic characteristics of respondent farmers from this study showed that males dominated farming in these areas. The male to female ratio in this study could be attributed to the intensive nature of the activities, and it corroborates an earlier report by Ugwu et al. (2015) and Adesuyi et al. (2018). The majority of the farmers were young and also a large number of the farmers had formal education mainly secondary education. According to Adesuyi et al. (2018), lower education of farmers might affect their ability to carry out some critical tasks (e.g., calibration of sprayers and mixing of pesticides) that required a little bit of higher education or training. Earlier

studies have reported education has a great influence on the overall behaviour and the dispositions of individuals towards adoptions of agricultural-related innovation and operational habits with chemical usage (Kamonteet al., 2014; Okoffo et al., 2016). As evident in the study, the farmers had some years of farming experience. This is an indication that most of the farmers in the study areas have quite adequate experience in vegetable production. It is therefore very likely that their adoption levels of technologies in pesticide use, and application would be high if well trained and encouraged.

The issue of knowledge, attitudes and practices about pesticide usage and related health problems among farmers has been left neglected in Nigeria especially among smallholder vegetable farmers in Lagos. The understanding of this knowledge and practices is vital for providing sound educational and policy strategies that aim at limiting the health and environmental hazards caused by pesticides. The majority of farmers in this study were aware of the route of pesticide exposure including inhalation and ingestion, a finding consistent with other studies in Sub-Saharan Africa (Adesuyi et al., 2018; Agmas and Adugna, 2020). Although, the farmers are aware of the human health effects of pesticide residue, they strongly believe that increasing agricultural productivity and high crop yield is possible only through the usage of pesticides. This is an indication that farmers are more concerned with the high economic returns of their crops than with their health (Mengistie et al., 2017). It is imperative to educate farmers on the use of alternative cropping systems and organic farming to reduce the high dependence on pesticides use. Also, integrated pest management practices should be highly encouraged among these farmers. Moreover, this study corroborated other African studies that reported farmers' awareness about all the route of exposure including the dermal route to be high (Lekei et al., 2014; Adesuyi et al., 2018). Proper training programs on pesticide safety and hazards of exposure be developed to address gaps in smallholder farmers' knowledge. Also, as suggested by Recena et al. (2006) and Gesesew et al. (2016) occupational health and safety should be integrated into agricultural healthcare programme and training.

The storage of some pesticides in the homes implied the likeliness and possibility of exposure to the farmers and their family members. These risky hazardous practices can be attributed to farmers' lack of technical knowledge and training on safe pesticide usage (Jallow et al., 2017; Kafle et al., 2021). Their poor pesticide handling practices can ultimately lead to harmful residues in harvested crop produces, and soil and water contaminations, hence, posing a threat to both human and environmental health. However, the reuse of pesticide container in all the local government areas was lower than 53% reported by Adesuyi et al. (2018) by small-holder wetland farmers. Reports have shown the widespread practice of the reuse of empty pesticide containers for domestic use in many low-income countries (Afari-Sefa et al., 2015; Okoffo et al., 2016; Adesuyi et al., 2018). Studies by Ndayambaje et al. (2019) in Rwanda, Nadja et al. (2011) in Tanzania, and Jallow et al. (2017) in Kuwait reported that farmers used empty pesticide containers for holding drinking water and storing food ingredients. The re-use of pesticide containers could represent a route of serious non-occupational human exposure, as several traces of pesticides could still be found in the containers even after washing and rinsing (Damalas et al., 2008; US EPA, 2020).

The appropriate use of PPE and the adoption of other protective measures and good personal hygiene such as not smoking, eating or drinking while handling pesticides are considered good practices to reduce exposure to pesticides. Studies have shown that an increase in the use of protective measures decreases the probability of poisoning by 44.3% to around 80% (Keifer, 2000; Dasgupta *et al*., 2007).

All the interviewed small-scale farmers adopted pesticides usage on their farms. Moreover, none of the vegetable farmers reported using biological methods or other such integrated pest management (IPM). The use of PPE in our study was much lower when compared to findings from a study carried out in Ethiopia

that reported 100% usage of PPE by the study participants (Negatu *et al*., 2016).

The small-scale farmers did not consider wind direction during spraying, this is lower than the study in Ethiopia where over 65% of the small-scale farmers didn't consider wind direction during the application of pesticides (Mergia *et al*., 2021). The disregard for wind direction during pesticides application can result in bad odour, difficulty reaching the targeted crop with the spray, as well as inhalation by the person spraying the pesticides. This might also cause pollution of the environment (soils and nearby water bodies) due to spray drift (Khanal and Singh, 2016; Adesuyi *et al*., 2018). Inadequate knowledge of pesticide uses, and method of application reported in the present study is in agreement with other studies carried out in low-income countries (Nguetti *et al*., 2018; Ndayambaje *et al*., 2019).

Like other studies examining the side effects of pesticide on human health, the findings of this study revealed serious and lethal consequences of pesticide exposure to human health when adequate and appropriate protection was not used. According to the United States Environmental Protection Agency (2013), all of the symptoms observed could be indications of pesticide exposure, as most of these symptoms are considered to be common manifestations of acetyl cholinesterase inhibition (Yassin *et al*., 2002). Additionally, in addition to work-related exposures, human exposure to pesticides can occur through exposure to polluted water sources (Mergia *et al*., 2021).

There are worth noting limitations in the current study, it is based mainly on self-reported data, relying on the honesty of respondents which is subjected to bias. As a self-report questionnaire, there may be some inaccurate data such as respondent farmers wanting to report socially desirable or acceptable behaviours. Such as, self-report usage of personal protective equipment and safe disposal of empty pesticide containers, and the adoption of other safety practices may be influenced by the respondents' desire to indicate that they comply to the use of appropriate protective measures against occupational pesticide exposure.

Additional limitation is the inability to directly link health symptoms experienced by respondents to pesticide exposure. The health symptoms experienced by respondents, such as headaches and fatigue, were not specific, and in some of the cases, these symptoms might have been due to causes other than exposure to pesticides, such as long exposure in the sun, particularly if no head protective equipment is worn. Several of the symptoms of pesticides intoxication are similar to symptoms resulting from other common diseases and hence, the findings should be interpreted with caution. Nevertheless, that the symptoms reported by respondents happened immediately after applying or handling pesticides and the frequency of occurrence is a great cause of concern.

CONCLUSION

In conclusion, this study showed that the pesticide handling practices of smallholder vegetable farmers across the three LGAs in Lagos represent a relevant occupational health issue. Although respondent farmers were found to have positive attitudes towards the harmful effect of pesticides on human health, their practices were poor. Poor knowledge deficits such as the poor use of PPE and other safety measures and the improper storage and disposal of pesticides. To further increase farmers' knowledge about pesticides and limit the hazards associated with pesticides, it is recommended that priority is given to developing and implementing pesticide safety educational training and certification programs for farmers. Also, they should be introduced to integrated pest management (IPM) as a way of improving productivity and combating pests and diseases.

REFERENCES

Adesuyi, A.A., Nnodu, V.C., Njoku, K.L.,Jolaoso, A. (2015). Nitrate and Phosphate Pollution in Surface Water of Nwaja Creek, Port Harcourt, Niger Delta, Nigeria. International *Journal of Geology, Agriculture and Environmental Sciences*, 3(5):14-20.

Adesuyi, A.A., Njoku, K.L., Ogunyebi, A.L., Dada, E.O., Adedokun, A.H., Jolaoso, A.O., Akinola, M.O. (2018) Evaluation of the Cytogenotoxic Effects of Emulsifiable Concentrate form of Amitraz Pesticide on Allium cepa L. *Journal of Applied Sciences and Environmental Management*, 22(11):1837–1843.

Adesuyi, A.A., Njoku, K.L., Akinola, M.O., Nnodu, V.C. (2018) Pesticides related knowledge, attitude and safety practices among small-scale vegetable farmers in lagoon wetlands, Lagos, Nigeria. *Journal of Agriculture and Environment for International Development*, 112(1):81–99.

Agmas, B., Adugna, M. (2020). Attitudes and practices of farmers with regard to pesticide use in NorthWest Ethiopia. *Cogent Environmental Science*, 6:1, DOI: 10.1080/23311843.2020.1791462.

Akan, J.C., Abdulrahman, F.I., Chellube, Z. M. (2014). Organochlorine and Organophosphorus Pesticide Residues in Fish Samples from Lake Chad, Baga, North Eastern Nigeria. International *Journal of Innovation, Management and Technology;* 5(2): 87-92

Asogwa, E.U., Dongo, L.N. (2009). Problems associatedwith pesticide usage andapplication in Nigerian cocoa production: A review. *African Journal Agricultural Research,* 4(8):675-683

Damalas, C.A., Telidis, G.K., Thanos, S.D. (2008). Assessing farmers' practices on disposal of pesticide waste after use. Science of The Total Environment, 390(2–3):341-345.

Dasgupta, S., Meisner, C., Wheeler, D., Xuyen, K., Lam, N.T. (2007). Pesticide poisoning of farm workers-implications of blood test results from Vietnam. *International Journal of Hygiene and Environmental Health*, 210(2):121-132.

Gesesew, H.A., Woldemichaelk, M.D., Mwanri, L. (2016). Farmers Knowledge, Attitudes, Practices and Health Problems Associated with Pesticide Use in Rural Irrigation Villages, Southwest Ethiopia. PLoS ONE 11(9): e0162527.

Jallow, M.F.A., Awadh, D.G., Albaho, M.S., Devi, V.Y., Thomas, B.M.(2017). Pesticide Knowledge and Safety Practices among Farm Workers in Kuwait: Results of a Survey. *International Journal of Environmental Research and Public Health;* 14: 340,

Kafle, S., Vaidya, A., Pradhan, B., Jørs, E., Onta, S. (2021). Factors Associated with Practice of Chemical Pesticide Use and Acute Poisoning Experienced by Farmers in Chitwan District, Nepal. *International Journal of Environmental Research and Public Health*, 18(8):4194.

Karunamoorthi, K., Mohammed, M., Wassie, F. (2012). Knowledge and practices of farmers with reference to pesticide management: Implications on human health. Archives of Environmental and Occupational Health, 67:109-116.

Keifer, M.C. (2000). Effectiveness of interventions in reducing pesticide overexposure and poisonings. The *American Journal of Preventive Medicine*, 18(4 Suppl):80-89.

Kemabonta, K.A., Obi, I.E., Ezeobiora, I.(2014). Knowledge and compliance with pesticide safety precautions among stakeholders in Lagos state, South western Nigeria. Nigeria Journal of Ecology, 13:85–96.

Khanal, G., Singh, A. (2016). Patterns of pesticide use and associated factors among the commercial farmers of Chitwan, Nepal. *Environmental Health Insights,* 10(1):1-7.

Mengistie, B.T., Mol, P.J.,Peter, O. (2017). Pe sticide use practices among smallholder vegetable farmers in Ethiopian Central Rift Valley. *Environment, Development and Sustainability*, 19(1):301–324.

Mergia, M.T., Weldemariam, E.D., Eklo, O.M, And Yimer, G.T. (2021). Small-scale Farmer Pesticide Knowledge and Practice and Impacts on the

Environment and Human Health in Ethiopia. Journal of Health and Pollution, 11(30):210607.

Nadja, S., Aviti, J.M., Sonja, D., Emma, G., Linda, K. (2011). Pesticide use among smallholder rice farmers in Tanzania. *Environmental Development and Sustainability*, 13:641-656.

Ndayambaje, B., Amuguni, H., Coffin-Schmitt, J., Sibo, N., Ntawubizi, M.,Vanwormer, E. (2019). Pesticide Application Practices and Knowledge among Small-Scale Local Rice Growers and Communities in Rwanda: A Cross-Sectional Study. International *Journal of Environmental Research and Public Health*, 16(23): 4770.

Negatu, B., Kromhout, H., Mekonnen, Y., Vermeulen, R. (2016). Use of Chemical Pesticides in Ethiopia: A Crosssectional comparative study on knowledge, attitude and practice of farmers and farm workers in three farming systems. *Annals of Occupational Hygiene*, 60(5):551–566.

Nguetti, J.H., Imungi, J.K., Okoth, M., Wang'ombe, W.J., Mbacham, W.F., Mitema, S.E. (2018). Assessment of the knowledge and use of pesticides by the tomato farmers in the Mwea Region, Kenya. *African Journal of Agricultural Research*, 13(8):379-388.

Njoku, K.L., Ezeh, C.V., Obidi, F.O., Akinola, M.O. (2017). Assessment of Pesticide Residue Levels in Vegetables sold in some Markets in Lagos State, Nigeria. *Nigerian Journal of Biotechnology*, 32:53-60.

Njoku, K.L., Ulu, Z., Adesuyi, A.A., Jolaoso, A.O., Akinola, M.O. (2018).Mycoremediation of Dichlorvos Pesticide Contaminated Soil by Pleurotus pulmonarius (Fries) Quelet. *Pollution*, 4(4):605-615.

Ogbeide O., Tongo I., Enuneku A., Ogbomida E., Ezemonye L. (2016). Human Health Risk Associated with Dietary and Non-Dietary Intake of Organochlorine Pesticide Residues from Rice Fields in Edo State, Nigeria. *Exposure and Health*, 8(1):53–66.

Ogbeide, O., Tongo, I., Ezemonye, L. (2015) Risk assessment of agricultural pesticides in water, sediment, and fish from Owan River, Edo State, Nigeria. *Environmental Monitoring and Assessment*, 187(10):654.

Okoffo, E.D., Mensah, M., Fosu-Mensah, B.Y. (2016). Pesticides exposure and the use of personal protective equipment by cocoa farmers in Ghana. *Environmental Systems Research*, 5:17.

Olisah, C., Okoh, O.O., And Okoh, A.I. (2020) Occurrence of organochlorine pesticide residues in biological and environmental matrices in Africa: A two-decade review, Heliyon, 6(3): e03518

Omoyajowo, K.O., Adesuyi, A.A., Omoyajowo, K.A., Odipe, O.E., and Ogunyebi, L.A. (2022). Strategies to reduce pesticide residues in food: remarks on pesticide food poisoning scenarios in Nigeria (1958–2018). *Journal of Agricultural Sciences (Belgrade)* 67(2):105-125.

Omoyajowo, K., Njoku, K.L., Amiolemen, S., Ogidan, J., Adenekan, O., Olaniyan, K., Akande, J., Idowu, I. (2018). Assessment of pesticide residue levels in common fruits consumed in Lagos State, Nigeria. *LASU Journal of Research and Review in Science*; 4:56-62.

Recena, M.C., Caldas, E.D., Pires, D.X., Pontes, E. R. (2006). Pesticides exposure in Culturama, Brazil-knowledge, attitudes, and practices. *Environmental Research*, 102(2):230–236.

US EPA (2020). Rinsing Procedures for Dilutable Pesticide Products in Rigid Containers. Retrieved from: https://www.epa.gov/pesticide-worker-safety/rinsing-procedures-dilutable-pesticide-products-rigid-containers. Accessed on 10th August, 2021.

USEPA (2013) Occupational Pesticide Safety and Health. 2013. Accessed [2021 March 31]. https://www.epa.gov/pesticide-worker-safety

WHO (2007) Implementation of indoor residual spraying of insecticides for malaria control in the WHO African region report. pp20–22.

Yassin, M.M., Mourad, T.A., Safi, J.M. (2002) Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farmworkers in the Gaza Strip. *Occupational and Environmental Medicine*, 59(6):387-393.

Yazgan, M.S., and Tanik, A. (2010) A new approach for calculating the relative risk level of pesticides. *Environment International*, 31(5):687–692.