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Assessment of Health Impact on Agricultural Workers and Rural Inhabitants Exposed to Pesticide in Selected Towns in Southern Region of Ekiti State, Nigeria

Adeyemi Mojisola., Babalola Toyin & Sam-Ijadele Kemi

Department of Environmental Health, Ekiti State College of Health Sciences and Technology, Ijero

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ABSTRACT

Many studies in and outside Nigeria has established that Nigerian farmers depend heavily on pesticides for agricultural purposes. Exposure to it have shown varying health impairment. Thus, this study assesses the effect of pesticide exposure on health of agricultural workers an rural inhabitant of southern Ekiti. The study adopts a cross-sectional descriptive, while convenience sampling was used to sample 306 agricultural workers who have record of pesticide use. Descriptive statistics were used to describe information. Chi-square test was used to test the dependence of pesticide exposure and health impairment. 72% of the farmers used pesticide for agricultural purposes while 83.7% use pesticides at home. Most of them used for over 2 years (69.6% on the field and 56.2% at home). Of the respondents, 53.4% have experienced at least one health challenges or the other due to pesticide exposure. The Chi square test of independence between pesticide exposure and health impairment shows a P-value of 0.0439, the P-value of the test between knowledge and use of pesticide is 0.275, and the P-value of type of crop cultivated and health impairment is 0.093. This reveals that exposure to pesticide results in health challenges; farmers' knowledge about pesticide did not influence proper use of it; and exposure to pesticide due to type of crop planted by farmers did not significantly lead to health impairment of farmers. The study concludes that improper use of pesticide among the farmers results in one health challenge or the other. It is thus recommended that farmers should carefully read and adhere to instruction on pesticide containers; farmers should adopt the use of PPEs; government should build and maintain health care facilities to aid prompt treatment of short-term effect of pesticides.

INTRODUCTION

In increasing crop yield as well as curbing vectors of human/livestock diseases, pesticides have been found to play crucial roles. As of 2012, the estimated production of pesticides globally was 5.8 billion lbs. of active ingredients (Environmental Protection Agency, 2017). Tariku *et al.*

(2021) states that chemical pesticides are divided into families, such as organochlorine pesticides (OCPs), organophosphates, and synthetic pyrethroids (SPs). Adesuyi *et al.* (2018) define pesticides as substances used for preventing, destroying, repelling, or mitigating any pest (insects, mites, nematodes, weeds, rats, etc.), such as insecticide, fungicide, herbicide and many other substances used to control pests".

Exposure to organophosphorus (OP) and pyrethroid (PYR) insecticides and phenoxy acid (PA) herbicides, formerly referred to as "Universal Pesticides" in the National Health and Nutrition Examination Survey (NHANES) of the Centers for Disease Control and Prevention (CDC), has received considerable attention

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among several classes of pesticides. Exposure to these pesticides has been associated with impaired reproduction, neurobehavioral disorders, metabolic disorders, macular degeneration, and asthma (Coker *et al.*, 2018; González-Alzaga *et al.*, 2014; Hoppin *et al.*, 2017; Montgomery *et al.*, 2017; Saillenfait *et al.*, 2015).

Farmers, gardeners and people working in the production, transportation and sales of these compounds are main subjects who are professionally exposed to pesticides. Some categories of workers such as greenhouses workers may be exposed to high concentrations of pesticides with potential health consequences (Suratman *et al.*, 2015; Kim & Jahan, 2017). A growing number of studies indicate that exposure to OP, PYR, and PA pesticides provokes oxidative stress (Guyton *et al.*, 2015; Wang *et al.*, 2016c).

Desalu *et al.* (2014) noted that Farmers in Nigeria have been relying heavily on pesticides for the control of various weeds, insect pests and diseases, leading to the high importation of these products. Farmers who are involved directly in the handling are at a high risk of exposure to pesticides through contact with pesticide residues on treated crops, unsafe handling, storage and disposal practices (Koureas *et al.*, 2014; Manyilizu *et al.*, 2017). Another form of exposure to pesticides is the lack of maintenance of spraying equipment and the lack of protective equipment or failure to use it properly are another form of exposures (Matthews, 2008 cited in Adesuyi *et al.*, 2018).

The exposure of pesticide can occur through four routes, and they include, mouth, skin, inhalation into the lungs and the eyes, (Desalu *et al.*, 2014; Jallow, 2017). The exposure of Inhalation can occur while mixing granular and powder forms of pesticides, spraying of the solvent and during the burning of empty containers. The exposure of inhalation provides the fastest route of exposure into the bloodstream (Desalu *et al.*, 2014).

Aim and objectives

The primary aim of carrying out this study is to assess the impact of pesticide exposure on the health of agricultural workers and rural inhabitants of Ekiti Southern dwellers.

The specific aims of this wok include:

1. To assess the knowledge of respondents on pesticide and attitude towards pesticide use.
2. To examine the effect of pesticide exposure on respondents health.
3. To examine the effect of type of crop planted by farmers on the level of exposure to pesticide and health impairment.

Research Hypotheses

Ho: Knowledge of pesticide users does not have significant effect on their use of pesticide
Ho: Exposure to pesticide does not have significant effect on the health of those exposed
Ho: Pesticide usage does not have significant effect on the environment.

MATERIALS AND METHOD

Study Area

Ekiti State is situated entirely within the tropics. It is located between longitudes 40°51′ and 50°451′ East of the Greenwich meridian and latitudes 70°151′ and 80°51′ north of the Equator. It lies South of Kwara and Kogi State, East of Osun State and bounded by Ondo State in the East and in the south, with a total land Area of 5887.890sq km. Ekiti State has 16 Local Government Councils. By 1991 Census, the population of Ekiti

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State was 1,647,822 while the estimated population upon its creation on October 1st 1996 was put at 1,750,000 with the capital located at Ado-Ekiti. The 2006 population census by the National Population Commission put the population of Ekiti State at 2,384,212 people. Ekiti South is a senatorial zone/district in Ekiti State, comprising of the entire geographical areas of:

1. Ekiti East Local Government Area
2. Ekiti South West Local Government Area
3. Emure Local Government Area
4. Gbonyin Local Government Area
5. Ikere Local Government Area
6. Ise / Orun Local Government Area

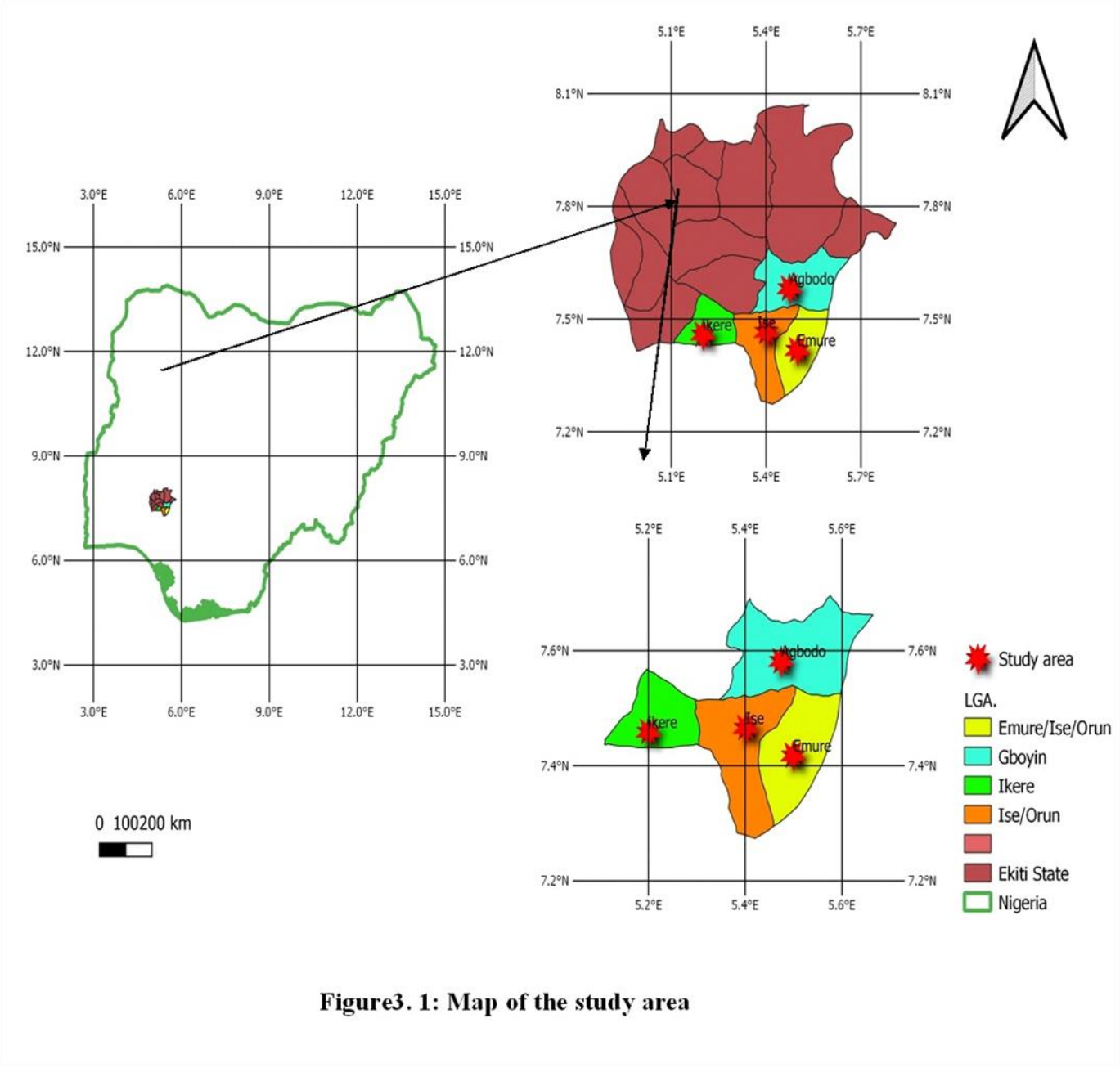

Figure3. 1: Map of the study area

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Study Design

The study employed cross-sectional research design type. Quantitative survey method through the administration of structured questionnaire and a face to face interview is used to assess the effect of pesticide exposure of agricultural workers and inhabitants of Ekiti South Senatorial district, Ekiti State.

Inclusion Criteria for Selection of Study Subjects

All consenting agricultural workers and inhabitants of Ekiti South Senatorial district, Ekiti State was included in the study.

Exclusion Criteria for Selection of Study Subjects

The study excludes all non-consenting agricultural workers and non-consenting inhabitants of Ekiti South Senatorial district, Ekiti State as well as agricultural workers and inhabitants outside Ekiti South Senatorial district, Ekiti State.

Sample Size Determination

The minimum Sample size was determined by using the fisher's formula for descriptive study, the formula is given below:

$$n = \frac{z^2 p(1-p)}{I^2}$$

n= Sample size z = Desired confidence level (95%) p= proportion of the population with the desired characteristic q= proportion of the population without the desired characteristics

I = Degree of precision (probability of error)

Z = 95% = 1.96

P = 50% = 0.5

Q = 1-p = 50% = 0.5

$$n = \frac{(1.96)^2(0.5)(0.5)}{(0.10)^2}$$

$$n = \frac{(1.96)(1.96)(0.5)}{(0.05)(0.05)}$$

$$n = \frac{0.9604}{0.0025}$$

$$n = 384$$

Research Instruments

From earlier studies, well-structured questionnaire and interview guide was develop to collect information

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from farm workers and inhabitants. The Questionnaire includes the following:

Section A comprised of demographics information on farm workers' and inhabitants' ages, education levels and ethnicities, type of farming, information on job types and duties, practices while handling pesticides at work, and after-work hygiene practices. **Section B** comprised of the Pesticide Inventory and Pesticide Use Survey, provided information on residential chemical storage and use in and around the home and garden for pests and information on farming characteristics (e.g. ventilation and cleaning habits).

Statistical Analysis

Statistical Package for Social Sciences (SPSS 22) was used for data analysis. Frequencies of the perception and experience of non-agricultural and agricultural respondents was analyzed using frequencies and percentages. The Chi-Square test of Independence was used to test the dependence of one variable against another. The level of significance for all tests is 0.05.

DATA ANALYSIS AND DISCUSSION

Table 1.1: Bio-data and Social Demographic Information of respondents

0	QUESTION	RESPONSES	FREQUENCY	PERCENTAGE (100%)
1	AGE	LESS THAN 30	28	9.2
		30 AND ABOVE	278	90.8
		Total	306	100
2	SEX	MALE	228	74.5
		FEMALE	78	25.5
		Total	306	100
3	GEOGRAPHICAL LOCATION	EKITI SOUTH	306	100
		Total	306	100
4	TRIBE OF THE RESPONDENTS	YORUBA	264	86.3
		HAUSA	4	1.3
		IGBO	15	4.9
		NUPE	45	3
		TAPA	2	0.7
		FULANI	2	0.7
		IGALA	16	5.2
		BORORO	2	0.7
		Total	306	100
5	FORMAL EDUCATION	YES	255	83.3
		NO	51	16.7
		Total	306	100
6	LEVEL OF SCHOOL ATTENDED	PRIMARY	17	5.6
		TERTIARY	152	49.7
		VOCATIONAL	19	6.2

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		ADULT LITERARY CLASS IN	8	2.6
		OTHERS	34	11.1
		NONE	16	5.2
		Total	306	100
7	MARITAL	SINGLE	44	14.4
		MARRIED	235	76.8
		DIVORCED	13	4.2
		OTHERS	4	1.3
		Total	306	100
8	NUMBER OF YEARS SPENT IN THE VILLAGE	LESS THAN 30 YEARS	191	62.4
		30 YEARS AND ABOVE	115	37.6
		Total	306	100
9		LESS THAN #50,000	89	29.1
		#50,000 – #100,000	106	34.6
		#101,000 – #200,000	92	30.1
		More than #200,000	19	6.2

Table 1.2: Occupation and Farming

S/N	QUESTION	RESPONSES	FREQUENCY	PERCENTAGE (%)
1	SOURCE OF INCOME	IRRIGATION	27	8.8
		DRY LAND FARMING	53	17.3
		LIVE STOCK REARING	91	29.9
		GARDENING	25	8.2
		PERMANNET EMPLOYMENT	35	11.4
		CASUAL WORK	15	4.9
		SMALL BUSSINESS	19	6.2
		OTHERS	41	13.4
		Total	306	100
2	NO OF HOUSEHOLD FARMERS	LESS THAN 3	154	50.3
		03-May	91	29.7
		06-Sep	27	8.8
		MORE THAN 9	34	11.1
		Total	306	100
		COTTON	35	11.4
		MAIZE	103	33.7
		RICE	53	17.3
		VEGETABLE	43	14.1
		OTHERS	26	8.7

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		Total	306	100
4	MEMBER OF ANY FARMERS ORGANIZATION	YES	167	54.6
		NO	137	45.5
		Total	306	100
5	AWARENESS ON PESTICIDE SAFETY	ONLY FARMING	14	4.6
		ONLY PESTICIDE	46	15.6
		BOTH FARMING & SAFETY	189	61.8
		NO	28	9.2
		DON'T KNOW	29	9.5
		Total	306	100
6	MAIN PROBLEM FACED ON A FARMLAND	POOR CROP FIELD	88	28.8
		LIMITED WATER	18	5.9
		PEST (INSECT & WILD FIRE)	120	39.2
		SOIL EROSION	44	14.4
		DRYNESS	36	11.7
		OTHERS	34	11.1
		NONE	16	5.2
		Total	306	100

Table 1.3: how often the respondents have experienced the following symptoms in the past 12 months.

Symptoms in the past 12 months	**Never**	**Sometimes**	**Often**	**Always**
Dizziness or headache	131(42.8%)	130(42.5%)	22 (7.2%)	23 (7.5%)
Feeling tense, anxious, or nervous	116(37.9%)	139(45.4%)	37(12.1%)	14(4.6%)
Vomiting	101(33%)	136(44.4%)	53(17.3%)	16(5.2%)
Feeling tired or sleepy most of the day	129(42.2%)	117(38.2%)	40(13.1%)	20(6.5%)
Sweating a lot more than usual	164(53.6%)	101(33%)	31(10.1%)	10(3.3%)
Difficulty seeing at night	154(50.3%)	112(36.6%)	34(11.1%)	6(2%)
Being forgetful or confused	159(52%)	99(32.4%)	42(13.7%)	6(2%)
Blackout	159(52%)	100(32.7)	37(12.1%)	10(3.3%)
Loss of appetite	97(31.7%)	125(40.8%)	72(23.5%)	12(3.9%)
Fast heart rate	150(49%)	105(34.3%)	41(13.4%)	10(3.3%)
Difficulty with balance	143(46.7%)	107(35.6%)	43(14.1%)	13(4.2%)
Blurred vision or double vision	148(48.4%)	90(29.4%)	52(17%)	16(5.2%)
Difficulty concentrating	142(46.4%)	100(32.7)	46(15%)	18(5.9%)
Numbness in your hands and feet	137(44.8%)	115(37.6%)	39(12.7%)	15(4.9%)
Momentary loss of consciousness	139(45.4%)	107(35.6%)	47(15.4%)	13(4.2%)
Feeling excessively irritable or angry	146(47.7%)	99(32.4%)	48(15.7%)	13(4.2%)
Shaking or trembling of your hands	107(35.6%)	131(42.8%)	51(16.7%)	17(5.6%)

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Difficulty falling asleep or staying Asleep	135(44.1%)	117(38.2%)	39(12.7%)	15(4.9%)
Difficulty speaking	147(48%)	90(29.4%)	50(16.3%)	19(6.2%)
Weakness in your arms or legs	95(31%)	119(38.9%)	58(19%)	34(11.1%)
Changes in your sense of smell or taste	94(30.7%)	110(35.9%)	69(22.5%)	33(10.8%)
Feeling depressed, indifferent or quiet	119(38.9%)	122(39.9%)	48(15.7%)	17(5.6%)
Twitches of your arms or legs	123(40.2%)	83(27.1%)	43(14.1%)	57(18.6%)
Excessive salivation	136(44.4%)	69(22.5%)	27(8.8%)	74(24.2%)
Ringing in your ears	148(48.4%)	110(35.9%)	31(10.1%)	17(5.6%)
Respiratory effects, trouble breathing	138(45.1%)	90(29.4%)	41(13.4%)	37(12.1%)

Answering Research Questions

Table 1.2 shows the relationship between pesticide use and pesticides knowledge. The majority (95.8%) of the respondents perception reveals that having knowledge about pesticides affect the uses of it while the remaining respondents negate it making up 4.2%.

Table 1.3 shows the relationship between the use of pesticides and its effect on the health of the user. The majority (73.5%) of the respondents shows that the use of pesticides affects the health of the user while the remaining respondents claim otherwise, making up 26.5%.

Table 1.4 shows the relationship between crops planted by farmers against the health effect of the type of pesticide they are exposed to. Majority of the farmers has experienced the at least one of the symptoms of exposure to pesticide in the last 12 months making up 55.62% while the rest have not making up 44.38%. Table 4.8.1: Cross tabulation of use of pesticide and pesticide knowledge

Inferential difference (Hypotheses Testing)

To further examine the validity of the outcome of the research questions, the study seeks to test the following hypotheses using Chi Square test of independence. Exposure to pesticide (proxy by pesticide use) is tested against effect of exposure to pesticide use (proxy by health effect of pesticide use and environmental effect of pesticide use).

Research Hypothesis One: Knowledge of pesticide users does not have significant effect on their use of pesticide.

To check if the knowledge of respondents about pesticide affected their use of pesticide. Some questions under knowledge of pesticide are crossed against questions under use of pesticide. The Pearson Chi Square is used to judge this hypothesis. The Pearson Chi Square value of 0.275 is observed, which greater than 0.05 alpha level. This implies that although respondents have knowledge of pesticide, but their knowledge did not have significantly have effect on the way they used pesticides. Also, the Phi and Cramer's V, which shows the strength level 0.124 and 0.120 of the association between these variables, reveals that the association between knowledge of pesticide and the use of pesticide is weak.

Table 1.4: Chi-Square Tests of independence between knowledge and use of pesticide

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.923[a]	4	.275
Likelihood Ratio	4.808	4	.270
Linear-by-Linear Association	1.929	1	.396

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N of Valid Cases	306		

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.124	.257
	Cramer's V	.120	.257
N of Valid Cases		306	

Research Hypothesis Two: Exposure to pesticide does not have significant effect on the health of those exposed

The possibility of dependency between exposure to pesticide and its negative effect on the human health is tested above. To test this hypothesis, some questions under use of pesticides and health effect of pesticides are crossed. The P-value of the Pearson Chi Square test is 0.0439. This

P-value is less than 0.05 alpha level of significance, which shows that the respondent's exposure to pesticide does affects their health. In addition, the Phi and Crammer's V values shows a low index of 0.092 and 0.088. This shows that the relationship between exposure to pesticide and its effect on respondents' health is weak.

Table 1.5: Chi-Square Tests of independence between use of pesticide and its health effect

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.240[a]	3	.0439
Likelihood Ratio	3.106	3	.449
Linear-by-Linear Association	1.121	1	.514
N of Valid Cases	306		

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.092	.439
	Cramer's V	.088	.439
N of Valid Cases		306	

Research Hypothesis Three: Exposure to pesticide does not have significant effect on the health of those exposed

The possibility of dependency between exposure to pesticide and its negative effect on the human health is tested above. To test this hypothesis, some questions under use of pesticides and health effect of pesticides are crossed. The P-value of the Pearson Chi Square test is 0.093. This

P-value is less than 0.05 alpha level of significance, which shows that the respondent's experience of health impairment is due to the type of crop they grow. In addition, the Phi and

Crammer's V values shows a low index of 0.092 and 0.088. This shows that the relationship between exposure to pesticide and its effect on respondents' health is weak.

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Table 1.6: Chi-Square Tests of independence between health effect and type of crop planted

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.230[a]	3	.093
Likelihood Ratio	1.306	3	.249
Linear-by-Linear Association	1.021	1	.415
N of Valid Cases	306		

Table 1.7: Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.072	.093
	Cramer's V	.078	.093
N of Valid Cases		306	

DISCUSSION

The study reveals that 83.3% of the respondents are formally educated. 37.6% of the respondents have lived above 30 years in agricultural environment while 62.4% of have lived less. 49.7% of them have more than three people dwelling with them while 50.3% have less. 95.1% of them have used pesticide for one purpose or the other but 4.9% claim they have never used pesticide. Also, 86.3% of the people claim to have been exposed to pesticide safety education but 13.7% have not. 69.6% of the farmers have been exposed to pesticide for over one year while only 30.4% have less than 1 year exposure. Desalu *et al.* (2014) confirmed that Nigerian farmers heavily rely on pesticide to control different weeds, insect pests and diseases that lead to the high importation of these products. The studies of Suratman *et al.* (2015) and Kim *et al.* (2017) also confirmed that farmers are more likely to be more exposed to pesticide due to the nature of their work.

Research question one and hypothesis one found that the acclaimed knowledge of farmers about pesticide and its use did not reflect in their use of the same. Barrón *et al.* (2020) in a bit to revealed that the danger of ignorance during pesticide use claimed that the use of pesticides without the awareness of their toxicity and dosage may be the cause of some severe of health problems which include headache, loss of consciousness, dark vision, blood pressure, cancer, diabetes, infertility, and Parkinson's disease are results of the excessive use of pesticides against pests has been found in the blood of vegetable-producing farmers.

The effect of exposure of farmers to pesticide was examined on the health impairment they experienced. The study found that as many that are exposed to pesticide suffered at least one health impairment or more. This affirms that exposure to pesticide have effect on health of those exposed. Several studies by Coker *et al* . (2018); González-Alzaga *et al.* (2014); Hoppin *et al.* (2017); Montgomery *et al.* (2017) and Saillenfait *et al.* (2015) agreed that exposure to these pesticides has an association with a list of things that include, impaired reproduction, metabolic disorders, neurobehavioral disorders, macular degeneration, and asthma.

Desalu *et al.* (2017) asserted that pesticide exposure can occur through four routes, and the routes include mouth, skin, inhalation into the lungs and the eyes. These are the means by which farmers were exposed to pesticide. Negatu *et al.* 2021; Elibariki and Maguta, (2017) also submit that risks of pesticide exposure might be due to occupational pesticide exposure, a lack of postregistration monitoring mechanisms, or farmers' lack of awareness of pesticide storage, application, and disposal.

The studies of Adesuyi *et al.* (2018), Okoffo *et al.* 2016, and Jallow et al. (2017) supported the findings that

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exposure to pesticides is said to have adverse effects which include, headaches, body aches, coughing, stomachache, skin and eye irritation, respiratory problems, dizziness, impaired vision and nausea.

Finally, research question and research hypothesis three tested the possibility of type of crop been a factor that influence the rate of exposure to pesticide and the experience of the consequence of the exposure. The study found that the type of crop farmers cultivate is a significant contributor to the health impairment they experienced. The study of Ladapo *et al.* (2020) found out that health challenges that were faced by the rice farmers as a result of pesticide that were used on their farms included, skin irritation, eye irritation, breathing difficulty, headache, food and water poisoning and dizziness. This further affirmed that crop type contributes to pesticide exposure and consequently health impairment.

CONCLUSION

From a series of studies, it has been asserted that, Nigerian farmers have traditionally relied heavily on pesticides to control different weeds, insect pests and diseases that lead to the high importation of these products. This present study seeks to examine the effect of pesticide exposure to the health of humans and the immediate environment. The study found that 95.1% of the farmers use pesticide on the farm and at home; 53.4% of them claim to have experience health impairment due to pesticide exposure; and crop type is a factor that contributes to pesticide exposure and health impairment. It is therefore sufficient to submit that pesticide exposure is detrimental to the health of agricultural workers and rural inhabitants of Ekiti south dwellers.

RECOMMENDATIONS

Sequel to the findings of this study, the following recommendations are made:

1. Those producing pesticide should make the instructions on the container easy to understand. This will help the users to use the pesticides properly.
2. Farmers should first read and obey the instructions on the pesticide container before they apply it, so that the negative effect of its misuse will reduce.
3. Government and non-governmental organization should provide and enlighten farmers on personal protective equipment. This will help the farmers to improve it their use and reduce exposure to pesticide.
4. To attend to short term effect of pesticide exposure, community health center development should be considered by government and non-government organizations. This will help the farmers to report short term effects, prevent long term effect of pesticides and get medical advice.
5. Expertise in agriculture should embark on seminars to enlighten farmers on what pesticide to use for their crop, how to use them and when to use them. This will help prevent misuse of pesticides.

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