ASSESSMENT OF THE LEVEL OF AWARENESS IN OCCUPATIONAL SAFETY AND HEALTH AMONG PESTICIDES HANDLERS IN KISUMU COUNTY, KENYA

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Abstract
Pesticides are chemicals used to control, destroy, attract or repel pests. Exposures to these chemicals occur through inhalation, ingestion and contact. Lack of knowledge, information and inadequate Personal Protection Equipment (PPE) increases the risk of exposure to pesticides. There is therefore need to assess the awareness level of pesticides handlers. To this effect a survey targeting 464 pesticides handlers (384 farmers and 80 stockists) was carried out in Kisumu County in the month of October, 2015. Data were collected by use of questionnaires. Chi-square test ($\chi 2$-test) was used to test the associations between independent and dependent variables. Results indicated that the majority 97% of the participants were aware that pesticides have negative effects on human health: 96% of the participants could read and understand instructions on pesticides labels and 76% were aware of pesticides exposure level. Inhalation (97%) was the most known route of exposure. Gloves (85%) and dust coat/apron (69%) were the most commonly used PPEs. There was significant association between the age and awareness on pesticides exposure level ($\chi 2 = 24.611$; $p < 0.00$), knowledge on exposure through contact ($\chi 2 = 13.757$; $p < 0.02$), dust mask use ($\chi 2 = 12.122$; $p < 0.03$) and dust coat/apron use ($\chi 2 = 12.789$; $p < 0.03$). Participants with higher level of education were more instructed on safe handling of pesticides than those with lower ($\chi 2 = 11.304$; $p< 0.00$). The majority (96%) who had experience of more than 24 months knew ingestions as a route of exposure to pesticides. The difference was significant ($\chi 2 = 11.914$; $p< 0.01$). Therefore, it is recommended that special pesticide safety and health trainings, IPM training and legislation be developed to impact knowledge and promote safe handling of pesticides in Kisumu County.

Key words: Pesticides, awareness, exposure, PPEs, Kisumu, Kenya

1.0 Introduction

Pesticides are chemicals that are used to control, destroy, attract or repel pests (Bhandari, 2014). These chemicals may be classified into different groups based on their chemical composition which include; organochlorines (OCs), organophosphates (OPs), carbamates, formamidines, thiocyanates, organotins, denitrophenols, synthetic pyrethroids and antibiotics (Bhandari, 2014). These chemicals may also be classified based on their target pest such as insecticides,

fungicides, herbicides (Dey *et al.,* 2013), molluscicides and rodenticides (Shomar, 2006). Further, World Health Organization (WHO) classified pesticides by hazard which include; Ia (extremely hazardous), Ib (highly hazardous), II (moderately hazardous), III (slightly hazardous) and U (unlikely hazardous) (WHO, 2010).
Use of pesticides in modern agriculture has significantly increased productivity and quality of yield but has also brought negative effects on human health and the environment (Andersson *et al.,* 2014). The effects of pesticides to humans are documented all over the world (Raksanam *et al.,* 2012; Bhattacharjee *et al.,* 2013; Njogu *et al.,* 2013; Andersson *et al.,* 2014). Pesticide exposures occur through inhalation of vapour, ingestion/oral and dermal/contact (Oesterlund *et al.,* 2014).
Low schooling level, lack of knowledge, lack of information and inadequate Personal Protection Equipment (PPE) worsens the risk of exposure to pesticides (Khan, 2012; Tofolo *et al.,* 2014). In a study conducted in Lebanon, 69.9% of handlers considered pesticides as toxic products, most of them lacked adequate information, did not know any pesticide name, any of their dangers and the majority ignored protective measures or knew little about them (Salameh *et al.,* 2003). In India, a few people were aware that pesticide enters the body through nose and affects lungs but knowledge on other modes of entry was low (Kumari and Reddy, 2013). In addition, more educated and adult respondents have shown good results on handling pesticides than younger and illiterate (Kumari and Reddy, 2013).

Elsewhere, many of the handlers talked about in appropriate protective measures such as use of tissue or a paper and rags as face mask which increased pesticides absorption rate (Salameh *et al.,* 2003; Bhattacharjee *et al.,* 2013). The high risk groups include farm workers and retail workers (Stadlinger *et al.,* 2012). It was also noted that among 212 who were with personal protective equipment (PPE) usage information, only 28 wore PPE (Calvert *et al.*, 2007). Of these 28 cases, 25 used disposable or chemical resistant gloves, 7 of the 25 that used gloves reported dermatologic effects, five used goggles and only one had eye symptoms (Calvert *et al.*, 2007).

In Tanzania it was reported that pesticides retail workers had low knowledge of pesticides exposure routes and only a few were aware of pesticides poisoning symptoms (Stadlinger *et al.,* 2012). In Uganda Oesterlund *et al.* (2014) observed that farm workers used their home clothes and a small number used gloves, overalls, masks or hats during application and handling of pesticides which exposed them, their families and the environment to pesticide risks. In addition, problems in reading and interpreting labels can also contribute to exposure of the handlers to pesticides (Tofolo *et al.,* 2014).

In Kenya, Njogu et al. (2013) found out that 83.3% of the respondents could read pesticide labels before use, 50% of the respondents always wear apron when

applying pesticides, 45.8% never wear nose mask and 61.1 % never wore gloves when applying pesticides which caused exposure of handlers to pesticides hence poor human health.

The Pest Control Products Act requires sellers to have adequate knowledge on efficacy and handling precautions of pesticides (RoK, 1982). The Factory and Other Places of Work (Hazardous Substances) Rules of 2007 requires the manufacturers or suppliers to ensure proper labelling of hazardous substances, indicating the nature of their contents, health hazards and instructions for safe handling of the substance (Ministry of Labour, 2007).

Though the dangers associated with lack of PPE among workers were reported in parts of Rift valley and Central Provinces of Kenya (Nyakundi *et al.,* 2012), it is not known whether handlers in Kisumu County also lack these equipment.

2.0 Materials and Methods

2.1 Study Design

The study was a cross-sectional survey in nature. Structured questionnaires were used for data collection. The study population consisted of 100 stockists and 280,000 farmers located in Kisumu County. The study questionnaire was pre-tested among 3 stockists and 5 farmers from the County who were not involved in the final study.

2.2 Study Area and Population

The study was conducted in Kisumu County. The county has 7 Sub- Counties namely Kisumu East, Kisumu West, Kisumu Central, Seme, Nyando, Muhoroni and Nyakach.

The economic activities in Kisumu County are farming, livestock keeping, fishing and small scale trading (KIRA, 2014). The study involved retail shop workers who were selling pesticides as their way of making a living. These included employees and the self-employed who handled pesticides on daily basis. The study also targeted those selling WHO class Ia, 1b, II, III and class U pesticides. These included Chemists, Agrovets and Agro-Hardware shops**.** Farm workers who were working within the study area and who handle class Ia, Ib, II, and III pesticides were also included in the study and interviewed

2.3 Sampling Method and Sample Size

Stratified and convenience sampling techniques were employed for the purpose of selecting the sample size of the study. For the pesticide outlets the County was sub-divided into 7 strata namely Nyakach (9), Muhoroni (8), Kisumu East (11), Kisumu West (7), Kisumu central (50), Nyando (8) and Seme (7) Sub- Counties. The method of proportional allocation under which the size of the sample from the different strata are kept proportional to the size of the strata as described by Kothari (2004) was followed for pesticides outlets.

The targeted sample size was 80 stockists and 384 farmers; determined by Kothari (2004) method of determining the sample size for a finite population.

2.4 Research Instruments

A structured survey method was used in the study and a questionnaire was administered to the respondents to collect primary data. The questionnaire contained questions related to the participants' awareness on safe handling, PPEs use and routes of exposure. The participants were asked a set of questions which they responded with yes or no.

2.5 Data Analysis

All data were coded, entered, and then analysed using the Statistical Package for Social Sciences (SPSS) program. Descriptive results were expressed as frequencies and percentages. Chi-square test (χ2-test) was used appropriately to test the significant differences or associations between independent and dependent variables.

3.0 Results and Discussions

3.1 Demographic Characteristics

The study sought to establish the age of the participants and the findings are provided in Figure 1.

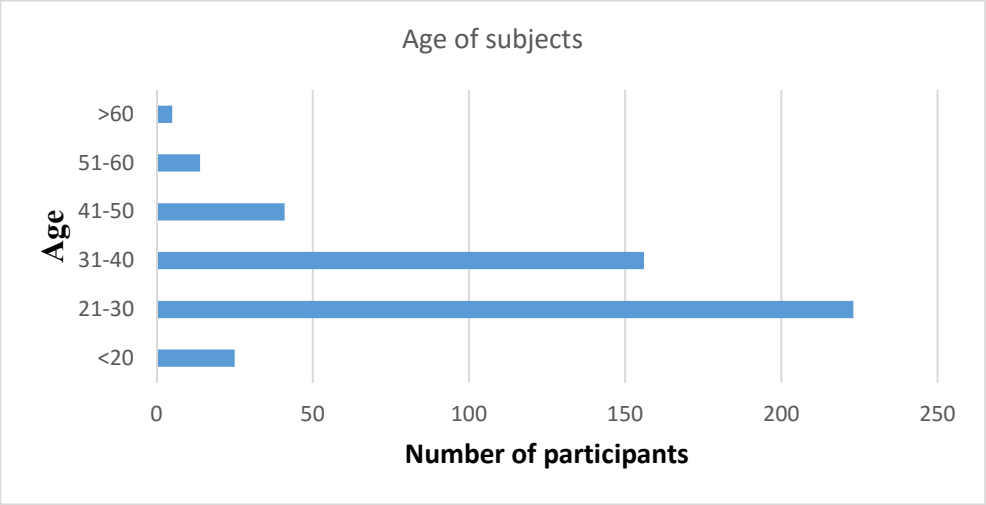

Figure 1: Frequency distribution of participants' age groups

The analysis show that, the majority 223 (48%) were aged between 21 and 30 thus young people were engaged in pesticides handling than older people. Similar findings were reported in Pakistan by Khan *et al.,* (2010) where the majority of

respondents were found to be 30 years and below. Most of the respondents 385 (83%) were male and 79 (17%) were female (Figure 2).

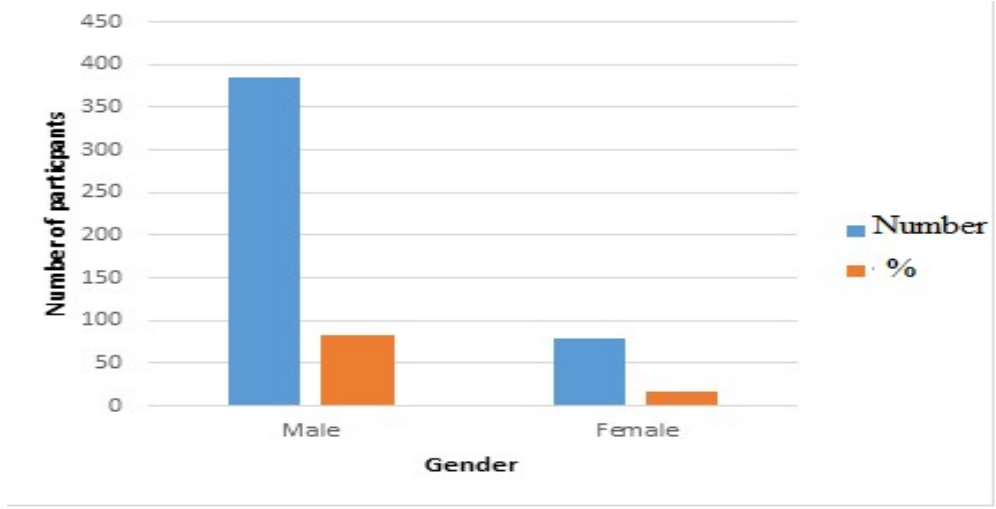

Figure 2: Frequency distribution of participants' gender

These results show similarity to those reported in Kenya by Njogu *et al.,* (2013) showing the majority (62.5%) of the respondents were male whereas the minority (37.5%) was females. Most of them 199 (42.9%) were literate with a college certificate and above, 175 (37.7%) and 90 (19.4%) were secondary and primary school educated respectively (Figure 3).

Further, these results were inconsistent with what was reported in other studies in Kenya, Thailand and Pakistan. These studies reported that majority of participants had primary education (Sheikh *et al.,* 2011; Raksanam *et al.,* 2012; Saowanee *et al.,* 2012; Njogu *et al.,*2013; Toflo *et al.,* 2014). In addition, a study in West Bank reported low educational level among pesticides handlers (Zyoud *et al.,* 2010).

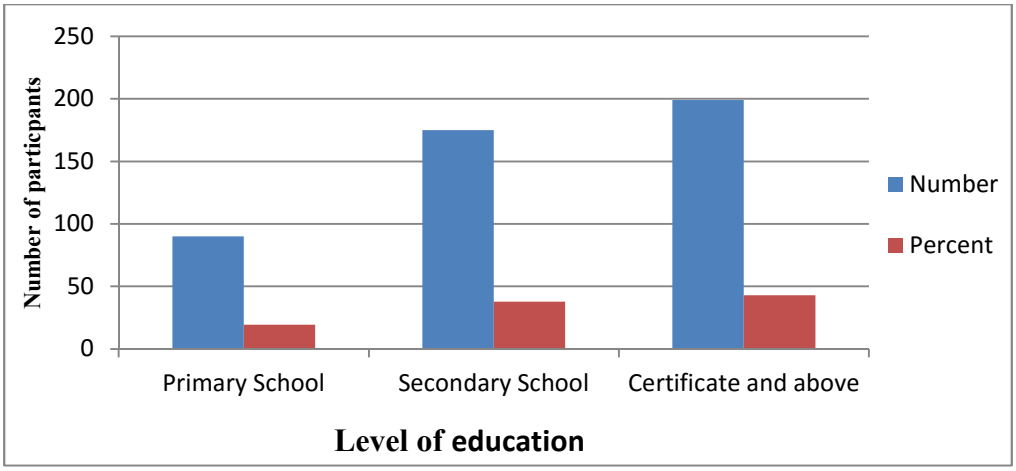

Figure 4: Frequency distribution of level of education of pesticides handlers

In this study, the highest proportion of pesticides handlers 255 (55%) reported handling pesticides for over 24 months and 54 (12%) handled for 18 to 24 months (Table 1). The analysis in Table 1 also show that, the majority 384 (83%) were farm workers while 80 (17%) were stockists. A similar study in Lebanon observed that majority of handlers (89) were agricultural workers whereas the sellers were 29 (Salameh *et al.,* 2003).

Table 1: Demographic features of the pesticide handlers in Kisumu County

Characteristics		**N**	**Percent %**
Age groups	<20	25	5.4
	21-30	223	48.1
	31-40	156	33.6
	41-50	41	8.8
	51-60	14	3.0
	>60	5	1.1
Gender	Male	385	83
	Female	79	17
Level of education	Primary School	90	19.4
	Secondary School	175	37.7
	Certificate and above	199	42.9
Experience	<12 Months	82	17.7
	12-18 Months	73	15.7
	18-24 Months	54	11.6

	> 24 Months	255	55
Type of workplace	Stockists	80	17
	Farmer	384	83

3.2 Awareness on Safe Handling of Pesticides

Table 2 illustrates the awareness of handlers on safe handling of pesticides. Majority 451 (97%) of the participants knew pesticides had negative effects on human health. These results concur with Njogu *et al.,* (2013) who reported that the majority (97.2%) of pesticides handlers knew pesticides have negative impact on human. A similar study in Uganda reported that 92% of farmers knew pesticides have negative effect on their health (Oesterlund *et al.,* 2014). A total of 279 (60%) respondents knew red as the sign for most dangerous pesticides.

These findings were consistent with a study in Ecuador where it was observed that most farmers knew the meaning of colour codes on pesticides labels (Cole *et al.,* 2007). The majority 322 (69%) knew pesticides in dry form can be observed through the skin. Surprisingly 255 (55%) pesticides handlers were not aware whether pesticides in oil are more likely to penetrate skin than pesticides in water. A total of 447 (96%) handlers could read and understand instructions on pesticides labels whereas 352 (76%) were aware of pesticides exposure level. Concerning hygiene, 360 (78%) indicated that washing of hands does not promote movement of pesticides to the body and 447 (96%) indicated that the food they eat can be contaminated by pesticides if hands are not washed. The majority (81%) indicated that, all gloves do not provide same level of protection (Table 2).

Table 2: Knowledge on pesticides handling and routes of exposure in Kisumu County

Knowledge on pesticides		**N**	**Percent %**
Sign for most dangerous pesticide	Blue Colour Coding	36	8
	Red Colour Coding	279	60
	Yellow Colour Coding	50	11
	Green Colour Coding	23	5
	Skull and cross bones	76	16
Whether pesticides have negative effects on health	Yes	451	97
	No	13	3
Reading and understanding instructions on pesticides labels	Yes	447	96
	No	17	4
Awareness on pesticides exposure levels	Yes	352	76
	No	112	24
Whether pesticides in dry form can be absorbed through the skin	Yes	322	69
	No	142	31
Whether pesticides in liquid form can be absorbed through the skin	Yes	413	89
	No	51	11

Whether pesticides in oil are more likely to penetrate skin than pesticides in water	Yes	209	45
	No	255	55
Washing of hands promote movement of pesticides into the body	Yes	104	22
	No	360	78
Whether food that you eat can be tainted by pesticides if no washing of hands after pesticides handling	Yes	447	96
	No	17	4
Instructed about safe pesticides handling methods	Yes	303	65
	No	161	35
All gloves provide same level of protection	Yes	89	19
	No	375	81

3.3 Awareness on Pesticides Exposure Routes

Table 3 show the analysis of handlers' awareness on pesticides exposure routes. Most of handlers had knowledge of pesticides exposure routes where 451 (97%) handlers reported inhalation, 433 (93%) ingestion, 430 (92.7%) contact and 310 (69%) injection.

		N	**Percent**
Exposure can be through inhalation	Yes	451	97
	No	13	3
Exposure can be through contact	Yes	430	93
	No	34	7
Exposure can be through ingestion	Yes	433	93
	No	31	7
Exposure can be through injection	Yes	310	67
	No	154	33

Similarly, in Michigan it was observed that majority of farmworkers were exposed through inhalation (Millard *et al.,* 2004). Since over 90% reported inhalation, ingestion and contact, these show consistency with what was reported in a study in Gaza Strip where most occupational exposure routes were inhalation (93%) followed by skin (88.4%) and ingestion (87.8%) (Yassin *et al.,* 2002). Elsewhere, in Lebanon Salameh *et al.,* (2003) found out that inhalation and dermal were the common route of exposure. The findings also concur with what was observed in Thailand where ingestion and skin as potential pathways (Raksanam *et al.,* 2012). Finally, these results were consistent with what was reported in Kenya among health workers in Agricultural areas whereby ingestion (68%) was reported as the most common route (Ohayo-Mitoko, 1997).

3.4 Awareness on PPE Use

The respondents were asked to indicate the type of PPEs they use while handling pesticides as illustrated in Table 4;

Table 4: Personal Protective Equipment usage among handlers in Kisumu County

PPEs		N	Percent
Use gloves	Yes	394	85
	No	70	15
Use Dust Mask	Yes	298	64
	No	166	36
Use Dust Coat/Apron	Yes	319	69
	No	145	31
Use Respirator	Yes	151	33
	No	313	67
Use hat/Helmet	Yes	134	29
	No	330	71

The findings as indicated on Table 4: show that the most commonly used PPEs were gloves 394 (85%), dust coat/apron 319 (69%) and dust mask 298 (64%). The least used PPEs were respirators 151 (33%) and hat/helmet 134 (29%). The higher percentage of handlers using PPE could be as a result of high level of education and information among handlers in Kisumu County. The findings were consistent with what was reported in Pakistan where it was reported that the decision to use safety measures was determined by the level of awareness and quality of information (Khan et al., 2013). Contrary to the findings of this study, in Philippines it was reported that farmers despite being instructed having the risks of pesticides, they did not wear coveralls (84.25%), mask (77.75%), Gloves (55.5%) and respirators (83.25%) (Leilanie, 2011). There was a slight correspondence between this study and what was reported by Leilanie (2011), on use of respirators where in the present study the majority (67%) did not use respirator. Similarly, in Jamaica, Henry and Feola (2013) observed that none of the handlers used coveralls, respirators and dust masks

3.5 Association between Age, Gender, Education, Experience and Awareness

3.5.1 Association between Age and Awareness on Safe Handling of Pesticides

Table 5 illustrates the association between awareness on safe handling of pesticides and age. Age had influence on having knowledge on pesticides handling at 5% level of significance (p-value <0.05). Majority (86%) of the handlers who were aged between 51 to 60 years were aware of pesticides exposure levels. There was significance association between the age and awareness on pesticides exposure level ($\chi 2 = 24.611$; $p < 0.00$). A study in Pakistan showed that handlers who were aware of the health consequences of pesticide use would choose to use more safety clothing while using pesticides (Khan *et al.,* 2013). Regarding exposure routes, 100% of age group 51 to 60 and 100% of above sixty knew exposure through contact. On the other hand, 100 % who were above sixty and 99% of age group 31 to 40 knew exposure to pesticides could be through ingestion. There was significant association between age and knowledge in exposure through contact

($\chi 2 = 13.757$; $p < 0.02$) and knowledge in exposure through ingestion ($\chi 2 = 15.497$; $p < 0.01$) respectively.

Concerning PPEs use, the majority 100% of those who were over sixty years used dust mask and 80% of the same age group used dust coat/apron when handling pesticides. There was significant association between age and dust mask use ($\chi 2 = 12.122$; $p < 0.03$) and dust coat/apron use (12.789; $p < 0.03$) respectively. This age group lowered their exposure to pesticides significantly by using PPEs when handling pesticides because wearing PPE is widely assumed to protect workers from pesticide exposure (Quandt *et al.,* 2006).

Table 5: Knowledge and practice on safe handling of pesticides based on the age group of handlers in Kisumu County

	Age of subjects						**Pearson Chi-Square**	
	<20 n=25	21-30 n=223	31-40 n=156	41-50 n=41	51-60 n=14	>60 n=5	Chi-Square value	p-value <0.05
Awareness on pesticides exposure levels	20 (80%)	186 (83%)	109 (70%)	21 (51%)	12 (86%)	4 (80%)	24.611	0.00
Exposure can be through contact	20 (80%)	201 (90%)	150 (96%)	40 (98%)	14 (100%)	5 (100%)	13.757	0.02
Exposure can be through ingestion	24 (96%)	198 (89%)	154 (99%)	39 (95%)	13 (93%)	5 (100%)	15.497	0.01
Use dust mask when handling pesticides	12 (48%)	132 (59%)	111 (71%)	29 (70%)	9 (64%)	5 (100%)	12.122	0.03
Use dust coat/apron when handling pesticides	10 (50%)	153 (69%)	116 (74%)	26 (63%)	10 (71%)	4 (80%)	12.789	0.03

3.5.2 Association between Gender and Awareness on Safe Handling of Pesticides

Table 6 explains the association between gender and awareness on safe handling of pesticides. A total of 374 (97%) of men and 73 (92%) of women could read and understand the instructions. On whether pesticides in oil are likely to penetrate

skin than in water, 44 (56%) of women were aware compared to 165 (43%) of men. There was significant association between gender and reading and understanding instruction ($\chi 2 = 4.169$; $p < 0.04$). Participants gender and penetration of pesticides in oil than in water was also significantly associated ($\chi 2 = 4.365$; $p < 0.04$).

Table 6: Knowledge and practice on safe handling of pesticides based on the gender of handlers in Kisumu County

	Gender of subjects				**Pearson Chi-Square**	
	Male (n= 385)		**Female (n = 79)**		**Chi-Square value**	**p. value < 0.05**
	N	**%**	**N**	**%**		
Reading and understanding instructions on pesticides labels	374	97%	73	92%	4.169	0.04
Pesticides in oil are more likely to penetrate skin than pesticides in water	165	43%	44	56%	4.365	0.04

3.5.3 Association between Education and Awareness on Safe Handling of Pesticides

Table 7 illustrates the association between awareness and the handlers' level of education. A total of 194 (99%) participants with certificate and above and 174 (99%) with secondary school education could read and understand instruction on pesticides labels. The difference was significant ($\chi 2 = 47.786$; $p < 0.00$).

Table 7: Knowledge on safe handling of pesticides based on the level of education of handlers in Kisumu County

	Level of education			Pearson Chi-Square	
	Primary n=90	Secondary n=175	Certificate > n=199	Chi-Square value	p. value < 0.05
Can read and understand instructions on labels	76 (84%)	174 (99%)	197 (99%)	44.786[a]	0.00
Pesticides in liquid can be absorbed through skin	74 (82%)	161 (92%)	178 (89%)	5.877a	0.05
Instructed about safe pesticides	47 (52%)	112 (64%)	144 (72%)	11.304a	0.00

handling methods					
Use dust mask when handling pesticides	51 (57%)	104 (59%)	143 (72%)	9.038a	0.01
Use dust coat/apron when handling pesticides	53 (59%)	109 (62%)	157 (79%)	17.009a	0.00

The lower the educational level the lesser one could read and understood instruction on pesticides labels (Toflo *et al.,* 2014). High level of education was associated with reading and better understanding of instruction on pesticides labels in Brazil (Toflo *et al.,* 2014).

The findings of this study are in line with what was observed in Brazil because majority of the participants in the present study were well educated. Brazil handlers had low schooling level hence their exposure to pesticides (Toflo *et al.,* 2014). This is also consistent with what was reported by Khan *et al.,* (2013) where education enhanced awareness regarding health and in that study the more educated farmers reported wearing more safety clothing than farmers with less education. Therefore, lack of education can be associated with failure to understand instruction and poor safety measures among handlers. Participants with secondary school education who represented the majority (92%) responded that pesticides in liquid can be absorbed through skin. Certificate and above (72%) respondents were instructed on pesticides safe handling method compared to 64% who had secondary and 52% with primary education.

There was significant association between the levels of education and absorption of liquid pesticides through the skin ($\chi 2 = 5.877$; $p = 0.05$) and instructed safe handling method ($\chi 2 = 11.304$; $p = 0.00$) respectively. There was also significant association between level of education and PPE use. 72% who had certificate and above used dust masks ($\chi 2 = 9.038$; $p< 0.01$) while 79% used dust coat/apron when handling pesticides compared 62% with secondary and 59% with primary level of education ($\chi 2 = 17.009$; $p< 0.00$). Lack of education among handler could result to higher risk when using pesticides since they are not well instructed about pesticides safe handling methods. The findings were consistent with what was reported by Kumari and Reddy (2013) where they associated education with good handling of pesticides. A similar case was also reported in other studies (Khan *et al.,* 2010; Raksanam *et al.,* 2012; Toflo *et al.,* 2014).

3.5.4 Association between Experience and Awareness on Safe Handling of Pesticides

Table 8 exhibits that the experience has shown significant influence on knowledge of pesticides handlers in which knowledge is positively associated with handlers' experience. The majority (70%) who had worked with pesticides for 18 to 24 months knew sign for most dangerous pesticide compared to those with above 24 months experience (63%), < 12 months (54%) and 12 to 18 months (49%). These differences were significant ($\chi 2 = 20.729$; $p < 0.05$). These results reveal that participants with more experience are more aware of sign for most dangerous pesticides than those with less experience. This could be as a result of them working with pesticides for a long time.

Participants with less than 12 months (90%) experience were aware of pesticides exposure level whereas 78% with 12 to 18 months, 73% with above 24 months and 63% with 18 to 24 months were aware. These differences were significant ($\chi 2 = 15.256$; $p < 0.00$). These findings show that all participants were significantly aware of pesticides exposure levels. These findings were inconsistent with what was reported in a similar study which showed a moderate to low awareness among farm workers towards the fate of pesticide which put handlers at risk when contact is made with these chemicals (Yassin *et al.,* 2002).

The majority (96%) who had experience of more than 24 months knew ingestions as a route of exposure to pesticides. These showed significant difference ($\chi 2 = 11.914$; $p < 0.01$). Participants (73%) with 18 to 24 months and 69% with over 24 months of experience used dust mask when handling pesticides. The majority (74%) with 18 to 24 used dust coats. There was significant association between experience and use of dust mask ($\chi 2 = 13.561$; $p < 0.00$) and use of dust coat ($\chi 2 = 10.434$; $p < 0.02$) respectively.

Table 8: Awareness on safe handling of pesticides based on experience of handlers' in Kisumu County

	Duration of handling pesticides in months				**Pearson Chi-Square**	
	<12	12-18	18-24	> 24	Chi-value	p. value
Sign for most dangerous pesticide	44 (54%)	36 (49%)	38 (70%)	161 (63%)	20.729	0.05
Awareness on pesticides exposure levels	74 (90%)	57 (78%)	34 (63%)	187 (73%)	15.256	0.00
Exposure can be through ingestion	75 (91%)	62 (85%)	51 (94%)	245 (96%)	11.914	0.01
Use dust mask	39 (48%)	45 (62%)	38 (73%)	176	13.561	0.00

when handling pesticides				(69%)		
Use dust coat/apron	46 (56%)	46 (63%)	40 (74%)	187 (73%)	10.434	0.02

4.0 Conclusions

Knowledge on pesticide exposure routes was dependent on age, experience and level of education**.** On the age, majority of the participants were aged between 21 and 30 years which showed that younger people were more involved in pesticides handling in Kisumu County compared to the older. The older pesticides handlers seemed to be more knowledgeable than younger ones. They were more aware on pesticides exposure levels, knew exposure through contact and used PPE while handling pesticides compared to the younger ones. On gender, there was significant association between gender and reading and understanding instruction and penetration of pesticides in oil than in water. Participants who had college certificate and above and those who had secondary certificate could read and understand better than those with primary education. Certificate and above were also more instructed on pesticides safe handling methods and used PPEs than those with secondary and primary education. Regarding experience, participants with over 18 months were more aware on pesticides exposure level than those below 18 months. Those with over 24 months knew ingestion as a route of exposure.

5.0 Recommendations

It is recommended that special pesticide safety and health trainings be introduced to help minimize pesticides risks. Development of legislation to impact knowledge and promote safe handling of pesticides is also important. It is also recommended that handlers be trained on effective PPE use and their provision by employers made mandatory; such approaches are necessary to decrease exposure of handlers to pesticide in Kisumu County. A minimum qualification for those selling pesticides to farmers should be increased to certificate and above and included in the legislations in orders for farmers to receive adequate extension services from qualified stockists since from the study it has been observed that awareness on pesticides handling is associated with high level of education (college certificate and above).

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