EVALUATION OF PRACTICES AND SELF- REPORTED TOXICITY SYMPTOMS OF PESTICIDES HANDLERS: A SURVEY OF KISUMU COUNTY, KENYA

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Abstract
Pesticides use in modern agriculture has significantly increased productivity and quality of yield but has also brought negative effects on human health and the environment**.** Exposures to these chemicals occur through inhalation of vapour, ingestion/oral and dermal/contact**.** Their effects to human differ depending on the degree and duration of exposure**.** This study was conducted to evaluate pesticides handlers' practices and self-reported toxicity symptoms among 80 stockists and 384 farmers. Results indicate that the majority 378 (82%) handlers changed clothing before and after pesticide exposure, 67 (14%) did it occasionally while 19 (4%) never changed their clothes. There was significant association between changing of clothing before and after pesticides exposure and the level of education ($\chi2 = 14.682$; $p < 0.01$) and position at work ($\chi2 = 9.168$; $p < 0.01$) and hours of working ($\chi2 = 10.311$; $p < 0.03$). A total 409 (88%) handlers always had a place to wash hands next to where they store or handle pesticides. There was significant association between participants' age and availability of washing area ($\chi2 = 37.325$; $p < 0.00$).
Skin itching, coughing, sore throat/ throat irritation were significantly associated with skin and respiratory diseases respectively (RR > 1). Skin diseases resulting from itching and respiratory diseases as a result of coughing and throat irritation can be reduced by 63%, 57% and 79% if exposure to pesticides is reduced by use of appropriate PPEs. Handlers should be trained on effective PPE use and their provision by employers made mandatory. In addition, training on alternative pest control methods such as Integrated Pest Management should be promoted to minimize pesticide use and eventually minimize exposure to pesticides.

Key words: Pesticides, practices, toxicity symptoms, diseases, Kisumu, Kenya

1.0 Introduction

Pesticides use 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).

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. It was observed that some farmers mixed water with pesticides using bare hands, neither did they wash their hands with soap after pesticides spraying and some smoked during the time of spraying (Bhattacharjee *et al.,* 2013). It is not known whether pesticides handlers in Kisumu County, Kenya were practicing the same while handling pesticides. Elsewhere, it was observed that products which were repackaged or decanted into secondary containers showed signs of spills due to lack of proper seals and damaged containers (Lekei *et al.,* 2014). It was also observed that attendants lacked appropriate qualification (57.3%), first aid kit (38.6%), repacked pesticides (25.3%), lacked fire-fighting equipment (22.6%), were using unsuitable Personal Protective Equipment (PPE) (14.7%) or no PPE at all (14.6%), handling pesticide containers without proper label (14.6%), sold unregistered pesticides (9.3%), lacked hand-washing facilities (9.3%), and sold expired pesticides (8.0%) (Lekei *et al.,* 2014).
In Tanzania retail workers had problems while selling pesticides in metal containers because the fumes became too strong with the increasing temperature and lack of proper ventilation (Stadlinger *et al.,* 2012).

Other problems were due to decanting or repacking of pesticides into smaller quantities without proper PPEs which led to exposure of the handlers to pesticides risks (Stadlinger *et al.,* 2012). Exposures to pesticides occur through inhalation of vapour, ingestion/oral and dermal/contact (Oesterlund *et al.,* 2014).

Their effects to human differ depending on the degree and duration of exposure; they are classified based on short-term or long-term exposure (Andersson *et al.,* 2014). Short term effects include; coughing, fatigue, burning/stinging/itching eyes, excessive sweating, dizziness, burning nose (Bhattacharjee *et al.,* 2013), headaches, nausea (Njogu *et al.,* 2013), diarrhoea, abdominal pain, vomiting (Andersson *et al.,* 2014), impaired lung functions, skin and nose irritation (Raksanam et *al.,* 2012) while the long term effects include; Asthma (Nalwanga and Ssempebwa, 2011), cancer, reproductive disorders (Njogu *et al.,* 2013), skin diseases, depression, neurological disorders, diabetes, genetic disorders, respiratory diseases and death (Andersson *et al.,* 2014). Strong *et al.,* (2008) observed that showering and changing clothes immediately after work, and washing work clothes separately from household laundry after use reduced occupational pesticides exposure but it is not known whether handlers in Kisumu have safety items and good practices with pesticides. It is also not known whether they experience pesticides related toxicity symptoms.

2.0 Materials and Methods

2.1 Study Design

The study was a cross-sectional survey in nature. Structured questionnaires and observational check lists 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 (Figure 1). The economic activities in Kisumu County are farming, livestock keeping, fishing and small scale trading (KIRA, 2014).

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

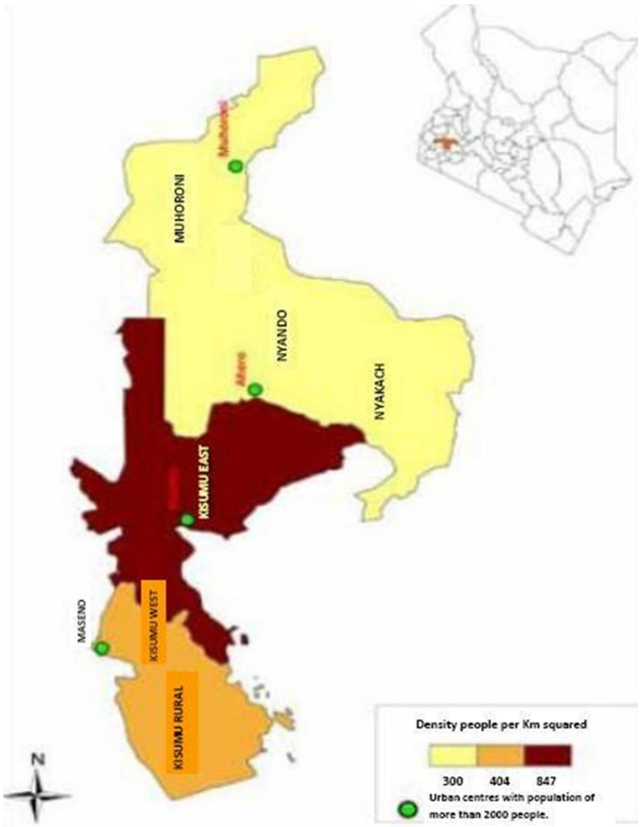

Figure 1: Map of Kisumu County, Kenya

2.4 Research Instruments

A structured survey was used in the study and a questionnaire was administered to the respondents to collect primary data. The other source of primary data was by observational checklist. The questionnaire contained sections which included; practices with pesticides and self-reported toxicity symptoms sections. In relation to practices, participants were asked questions that were answered by either never, sometimes or always.

Regarding self-reported toxicity symptoms subjects were asked to tick against the acute symptoms they had experienced immediately after pesticides handling/spraying and chronic conditions they were diagnosed with or experienced in the duration they handled pesticides. A checklist was used by interviewers during physical inspection of pesticides shops. The interviewer ticked (yes/no) against the safety measures that were present or absent in the selected premises.

2.5 Data Analysis

All data were coded, entered, and then analyzed using the Statistical Package for Social Sciences (SPSS) program. Descriptive results were expressed as frequencies and percentages. Chi-square test ($\chi 2$-test) was used appropriately to test the significant differences or associations between independent and dependent variables. After data collection a contingency two by two table was used to cross tabulate exposure and disease in the present study (Table 1). Kaelin and Bayona (2004) formula ($RR= a(c + d)/c (a + b)$) for calculating relative risk was used to calculate the risk of occurrence of a disease in exposed group to that among non-exposed (control group) and ($AR\% = (Ie - Iu)/Ie) x100$) was used to calculate the percentage, by which the risk of developing a disease can be reduced by elimination or control of the exposure (AR).

Table 1: An example of a contingency two by two table commonly used in epidemiology

	Disease	**No disease**	**Total**
Exposed	a (exposed and diseased)	b (exposed not diseased)	a + b
Unexposed (control group)	c (unexposed but diseased)	d (unexposed not diseased)	c + d
Total	a + c	b + d	a + b + c + d

2.6 Ethical Consideration

Informed consent was sought from pesticide handlers before questionnaires were administered to them and before collections of data by the observational checklist

in the pesticides retail shop. The risks and benefits of the study were explained in the consent form which was signed between the interviewers and participants.

3.0 Results and Discussions

3.1 Demographic Characteristics

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 (Figure 2). Similar findings were reported in Pakistan by Khan *et al.,* (2010) where the majority of respondents were found to be 30 years and below.

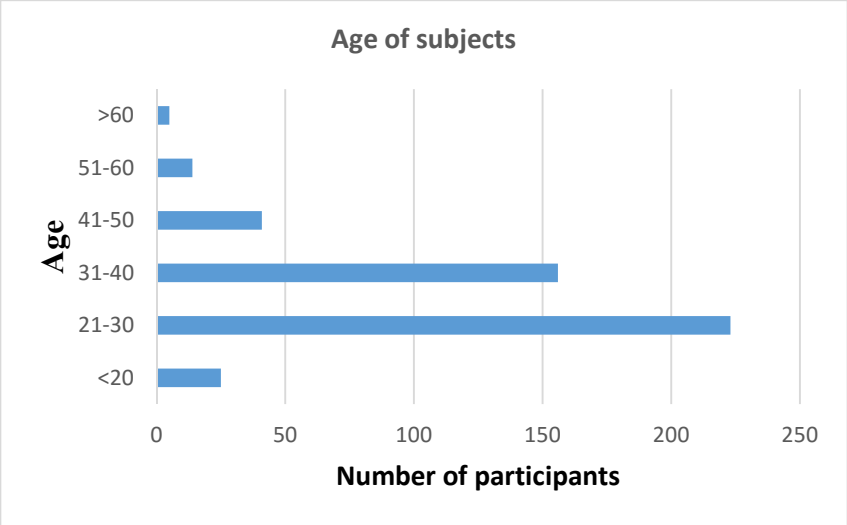

Figure 2: Frequency distribution of participants' age groups

Most of the respondents 385 (83%) were male and 79 (17%) were female (Figure 3). These results show similarity to what was reported in Kenya by Njogu *et al.,* (2013) where the majority (62.5%) of the respondents were male whereas the minority (37.5%) was females.

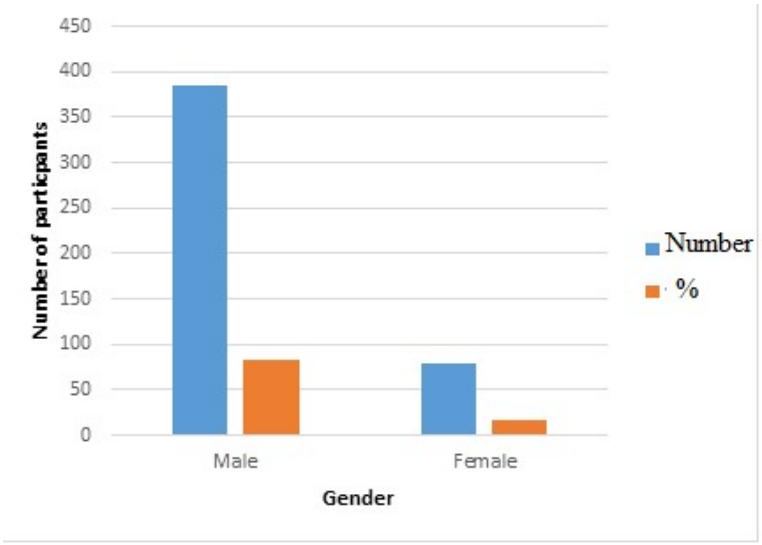

Figure 3: Frequency distribution of participants' gender

Most participants 199 (42.9%) were literate and had a college certificate and above, 175 (37.7%) and 90 (19.4%) were secondary and primary school educated respectively (Figure 4). These results were inconsistent with what was reported in Kenya, Thailand and Pakistan. These studies reported that the 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). A similar study in West Bank also reported low educational level among pesticides handlers (Zyoud *et al.,* 2010).

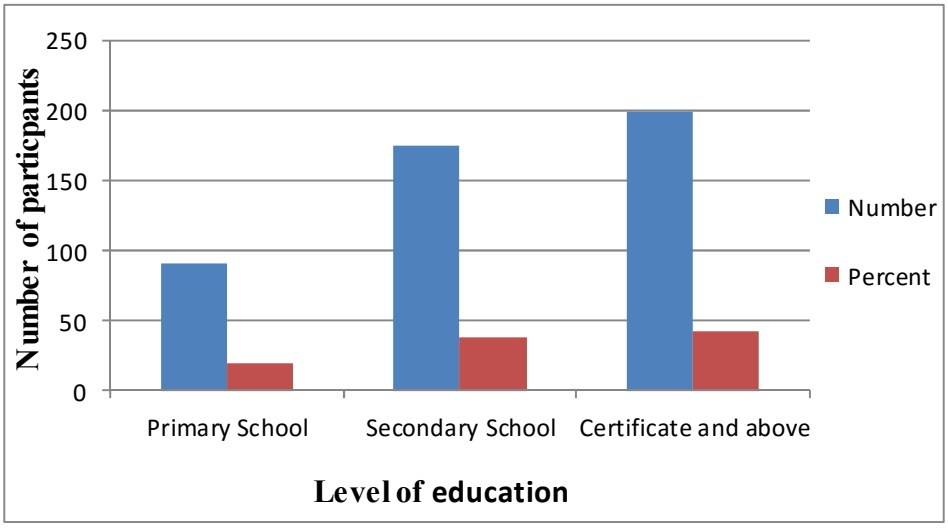

Figure 4: Frequency distribution of level of education of pesticides handlers

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 2). 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 the majority of handlers (89) were agricultural workers whereas the sellers were 29 (Salameh *et al.,* 2003).

Table 2: 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
Position at work	Self-employed	399	86
	Employee	65	14

3.2 Practices of safety measures on pesticides handling

Table 3 explains the handlers' practices with pesticides. A majority of 378 (82%) handlers changed clothing before and after pesticide exposure, 67 (14%) changed occasionally while 19 (4%) never changed completely (Table 3). There was significant association between changing of clothing before and after pesticides exposure and the level of education ($\chi2 = 14.682$; $p < 0.01$), Position at work ($\chi2 = 9.168$; $p < 0.01$) and hours of working ($\chi2 = 10.311$; $p < 0.03$) (Table 3). Change of clothing before and after pesticides handling reduce occupational exposure to pesticides (Strong et al., 2008). These results concurred with Millard et al., (2004) who found out that most workers changed clothing always after pesticides application but were inconsistent with a study in Bahrain whereby majority (95.8%) never changed their clothes after pesticides handling (Al- Haddad and Al-Sayyad, 2013). Elsewhere, a contrary study in Jamaica also reported that a majority of the handlers never changed their clothes and never separated work clothes from home clothes (Henry and Feola, 2013). A total 409 (88%) handlers always had a place to wash hands next to where they store or handle pesticides. There was significant association between participants' age and availability of washing area ($\chi2 = 37.325$; $p < 0.00$). The huge percentage of washing facility was also observed in Philippines where 92% of farmers washed their hands after pesticides handling

(Leilanie, 2011). These was also observed in Michigan where nearly all migrant farmworkers washed hands after handling pesticides before eating (Millard et al., 2004).

Table 3: Pesticide handlers' responses on practices with pesticides in Kisumu County

Practices with pesticides		**Response**	**N**
Percent %			
Change clothing before and after pesticides exposure	Never	19	4
	Sometimes	67	14
	Always	378	82
Have a place to wash hands next to where you store or handle pesticides	Never	27	6
	Sometimes	28	6
	Always	409	88
Shower after handling pesticides	Never	25	5
	Sometimes	68	15
	Always	371	80
Eat or drink while handling pesticides	Never	428	92
	Sometimes	22	5
	Always	14	3
Wash hands after pesticides exposure before eating or drinking	Never	5	1
	Sometimes	11	2
	Always	448	97
Wear PPE when handling pesticides	Never	42	9
	Sometimes	183	39
	Always	239	52
Wear Gloves when cleaning pesticides spills	Never	117	25
	Sometimes	117	25
	Always	230	50
Wear Respirator when handling liquid formulations	Never	286	61.6
	Sometimes	58	12.5
	Always	120	25.9
Wear dust mask when handling dust and powder formulations	Never	160	34.5
	Sometimes	96	20.7
	Always	208	44.8
Chew or smoke tobacco while handling pesticides	Never	448	97
	Sometimes	10	2
	Always	6	1

A total 371 (80%) took showers always after pesticide handling, 68 (15%) showered sometimes while 25 (5%) never had shower after handling pesticides. Toflo et al., (2014) also reported that a similar percentage (80%) always took showers after pesticides handling.

Fortunately 428 (92%) never ate or drank while handling pesticides, 22 (5%) did occasionally while 14 (3%) always ate or drank. There was significant association between not eating or drinking while handling pesticides and age ($\chi 2 = 18.315$; $p < 0.05$), position at work ($\chi 2 = 12.207$; $p < 0.00$) and hour of working with pesticides ($\chi 2 = 18.366$; $p < 0.00$). A contrary practice was reported in Bahrain by Al- Haddad and Al- Sayyad (2013), who observed that the majority ate and drank while handling pesticides and did not shower after handling pesticides. Eating and drinking while handling pesticides could result to accidental ingestion of pesticides into the body. A study in Lebanon disclosed that handlers who avoided eating or drinking when handling pesticides had lowered exposure (Salameh et al., 2003).

From this study 448 (97%) washed their hands before eating or drinking, 11(2%) did it sometimes and 5(1%) never. These results showed similarity with what was reported in Bahrain by Al- Haddad and Al-Sayyad (2013) who established that 87.9% washed their hands after pesticides handling. Contrary to the findings in Bahrain and the present study, Bhattacharjee et al., (2013) reported that 87.5% of pesticides handlers never washed their hands with soap after pesticides application. These led to exposure of the handlers to pesticides.

Concerning safe pesticides handling, 239 (52%) always wore PPE when handling pesticides and 117 (50%) wore gloves always when cleaning pesticides spills. Wearing of PPEs and wearing of gloves were significantly associated with position at work ($\chi 2 = 6.312$; $p < 0.04$) and level of education ($\chi 2 = 23.180$; $p < 0.00$) respectively. Handling of pesticide formulation requires wearing of appropriate personal protection equipment as a precaution against pesticide exposure. Workers who do not wear PPEs are often exposed to pesticides (Khan et al., 2010).

Most of them 286 (62%) never wore respirators when handling liquid formulations, 160 (34%) never wore dust mask when handling dust and powder formulations. There was association between wearing of respirators and position at work ($\chi 2 = 10.409$; $p < 0.01$) (Table 4). Similar practice was reported among handlers in Pakistan which reported that use of protective measures and equipment for safe handling of pesticides was far from being adopted (Khan et al. 2010). On the contrary, Yassin et al., (2002) observed that the highest number wore oral- nasal masks in Gaza Strip. None wearing of respirators and dust mask could lead to the increase of respiratory diseases resulting from inhalation of fumes and dust when handling liquid and dust formulations of pesticides respectively.

Only 6 (1%) reported chewing or smoking tobacco. Similarly, Henry and Feola (2013) in their study reported that only 1 out of 81 farmers smoked during pesticides handling in Jamaica. In Bangladesh, contrary findings by Bhattacharjee *et al.,* (2013) indicated that a higher proportion of 21% of pesticides handlers smoked tobacco while handling pesticides.

Table 4: Association between practices and age, education, position at work and hours of working with pesticides in Kisumu County (p < 0.05)

	Age		Education		Position at work		Hours of work	
	χ2	p	χ2	p	χ2	p	χ2	p
Availability of washing area	37.325	0.00						
Changing clothing before and after exposure			14.682	0.01	9.168	0.01	10.311	0.03
Not eating and drinking while handling pesticides	18.315	0.00			12.207	0.00	18.366	0.00
Wearing of PPEs							6.312	0.04
Wearing of gloves when cleaning spills			23.180	0.00				
Wearing of respirators							10.409	0.01

3.3 Risk Factors for Pesticides Exposure and Practices in Retail Outlets

An observational checklist was used to assess the premises suitability of the 80 pesticides retail outlets in Kisumu County. The majority 71 (89%) of the premises were constructed with good material, 69 (86%) well-constructed shelves and easily accessible, 71 (89%) had smooth floors made of concrete and 65 (81%) sufficient space. Only 14% of the premises had poorly constructed and inaccessible shelves (Plate 1). Workers in these premises lacked dust coat (46%), gloves (42%), dust mask (41%) and safety boot/closed shoes (73%). In additions there was lack of clean running water (34%), inventory of pesticides and their toxicity (68%) and sawdust or sand for cleaning pesticides spills (58%). Lack of PPE and clean running water for washing was also noted in a similar study conducted in Tanzania where it was reported that retailers lacked suitable PPEs (14.7%) or had no PPEs (14.6%) and (52%) lacked hand washing facility which contributed to exposure (Lekei *et al.,* 2014).

Plate 1: Overstocked shelves with insufficient space and not easily accessible

A majority 66% of premises were dirty with a lot of dust and fumes (Plate 2).

Plate 2: Dust and leakages from pesticides on the premises floor

Some stockists arranged their pesticides improperly on shelves (22%) (Plate 3).

Plate 3: Improper arrangement of pesticides in the shelves

Twenty nine (36%) premises that were visited lacked dust bin for pesticides waste disposal. Others 12 (15%) lacked sufficient ventilation and the temperature inside was not conducive. Regarding products safety, 69 (86%) had their product package intact and no single one was opened. This means that only 14% were opening pesticides containers for decanting or reweighing (Plate 4). Similar findings were reported in studies conducted in Tanzania and Zanzibar (Stadlinger *et al.,* 2012; Lekei *et al.,* 2014). Majority of the stockists (88%) had products that were within the stipulated shelf life but 12% had some expired products in their shelves. This was also noted in Tanzania (Lekei *et al.,* 2014).

A majority 66% and 61 % lacked firefighting equipment and first aid kits respectively. This showed similarities with what was reported in Tanzania whereby retailers lacked first aid kit (38.6%) and fire-fighting equipment (22.6%).

Plate 4: Pesticides decanted from their original container into a water bottle

Lack of these items could lead to adverse health effects in pesticides industry because many sellers could be exposed to fumes and dust in some of the poorly ventilated premises. Participants also lacked running water for cleaning the premises and washing or showering. In addition, the handlers lacked suitable PPEs for safe handling of pesticides which could lead to exposure of the retailers to pesticides. Lastly, a majority 54 (68%) lacked inventory of pesticides and their toxicity which made separation of highly toxic from less toxic and prevention of contamination difficult.

Repackaging was associated with spillage of pesticides (Plate 4). This practice could generate a potential for a high risk of exposure for the sellers. The exposures occur as a result of fumes and dust that were observed in most of the shops (66%) due to opening of containers and repacking or decanting of pesticides. This was also considered as a serious problem in a study conducted in Zanzibar (Stadlinger *et al.,* 2012).

3.4 Prevalence of Self- Reported Acute and Chronic Pesticides Toxicity Symptoms

The prevalence of self-reported toxicity symptoms related to pesticide exposure were included in the study questionnaire. The handlers were asked whether they had experienced these signs and symptoms during or immediately after pesticide handling and in the duration they have handled pesticides. Short term and long term toxicity symptoms were reported by some handlers as illustrated below (Table 4 and 5).

Table 4: Self- reported acute symptoms experienced by pesticides handlers in Kisumu County

Symptoms	N	Percent%
Headache	271	58
Burning/stinging/itching eyes	368	79
Blurred vision	85	18
Sore Throat/throat irritation	245	53
Burning, runny or stuffy nose	233	50
Nose Bleeding	32	7
Shortness of breath	192	41
Chest tightness	204	44
Coughing	313	68
Excessive sweating	94	20
Skin Itching	341	74
Dizziness	202	44
Sudden loss of appetite	85	18
Stomach Pain	99	21
Diarrhea	53	11

Table 4 shows some of the acute self- reported symptoms that were recorded in this study. The most prevalent were burning/stinging/itching eyes 368 (79%), skin itching 341 (74%), coughing 313 (68%), headache (58%) and 245 (52%) sore throat. These findings were consistent whit what was observed in other studies (Calvert *et al.,* 2007 Khan *et al.,* 2010; Karunamoorthi and Yirgalem, 2012; Raksanam *et al.,* 2012; Stadlinger *et al.,* 2012; Dey *et al.,* 2013; Oesterlund *et al.,* 2014; Toflo *et al.,* 2014; Yassin *et al.,* 2014).The least self-reported acute symptoms were nose bleeding 32 (7%), Diarrhoea 3 (11%), blurred vision and 85 (18%) sudden loss of appetite reported. A study in Uganda also pointed out blurred vision as one of the symptoms (Oesterlund *et al.,* (2014).

In relation to self-reported chronic symptoms, skin disease 34 (7%) and respiratory disease 25 (5%) prevalence were high. The least were Asthma 15 (3%), neurological disorders 8 (2%), reproductive disorders 8 (2%) and 7 (1.5%) blindness (Table 5).

Table 5: Self- reported chronic medical conditions of pesticide handlers in Kisumu County

Chronic symptoms	N	Percent %
Asthma	15	3.2
Skin Disease	34	7.3
Reproductive disorder	8	1.7
Neurological Disorder	8	1.7
Respiratory Disease	25	5.4
Blindness	7	1.5

In the present study, majority of the handlers were literate, were using appropriate PPEs and had experience, knowledge and good practices with pesticides hence the reason for low prevalence of pesticides related diseases. These diseases could be caused by long-term exposure to pesticides. Similar chronic symptoms were also reported in other studies (Chitra *et al.,* 2004; Dey *et al.,* 2013).

The researchers tested the association between the exposures and diseases using a contingency two by two tables by calculating the RR and AR. A total of 4 participants with skin disease had not experienced skin itching (unexposed but diseased), 30 who had the disease experienced skin itching when handling pesticides (exposed and diseased). Three hundred and eleven (311) experienced skin itching but did not develop skin disease (exposed but not diseased) while 119 had not experienced skin itching and did not report skin disease (unexposed and not diseased). The risk of occurrence of a skin disease among people who experienced skin itching to that among the unexposed (RR= 2.7). These show that skin itching was significantly associated with skin disease (RR>1). These meant that the exposed group was 2.7 times at a higher risk than the non-exposed. The rate (proportion) of a skin disease in exposed individuals that can be attributed to the exposure (AR=63%). Results show that skin disease can be reduced by 63% if exposure can be prevented through proper use of skin protective equipment such as; gloves, dust coats and hat/ helmets when handling pesticides.

Four (4) participants with respiratory disease had not experienced coughing (unexposed but diseased), 21 experienced coughing and had developed respiratory disease (exposed and diseased), 292 experienced coughing but had no respiratory disease (exposed but not diseased) and 147 had not experience coughing and never had respiratory disease. The relative risk of a respiratory disease among those who experienced coughing to that among unexposed (RR=2.3). The attributable risk (AR=57%). The results reveal that coughing is significantly associated with respiratory disease (RR> 1). In addition, the exposed group is 2.3 times at a higher risk than the non-exposed. Respiratory disease can be reduced by 57% if the handlers use dust masks and respirators properly. These could minimize exposure to dusts and fumes originating from solid and liquid formulations of pesticides. These will eventually reduce coughing as a result of pesticides exposure among pesticides handlers in Kisumu County.

In addition, 4 of those with respiratory disease had not experienced sore throat/ throat irritation, 21 experienced and had respiratory disease, 224 handlers experienced sore throat but did not report the disease while 215 had not experienced sore throat and did not report respiratory disease. The relative risk of respiratory disease among those who experienced sore throat/ throat irritation to that among unexposed RR=4.7. The Attributable risk is 79%. Sore throat/throat irritation is strongly associated with respiratory disease (RR>3). Exposed groups

are 4.7 times at a higher risk of developing respiratory disease compared to the unexposed group. Respiratory disease among handlers who experienced sore throat/ throat irritation can be reduced by 79% if they handle liquid, aerosol and dust formulation of pesticides in a well-ventilated area and with respirators and or dust masks. These mean that the use of PPE when handling pesticides helps in reducing exposure of handlers' to pesticides. This was also emphasized in a study conducted in Nepal. In that study it was reported that the use of personal protective equipment could reduce pesticides exposure through skin and inhalation, thereby potentially reducing the acute and chronic health hazards to the handlers (Bhandari, 2014).

Participants (7) who developed blindness experienced burning/stinging/itching eyes when handling pesticides, 361 of them experienced the same but did not develop blindness while 96 of them did not experience itching eyes and did not develop blindness.

The relative risk of people who had blindness to that among unexposed is 0.02. The Attributable risk is 2%. The finding of study revealed that burning, stinging, itching eyes was not associated with blindness (RR<1) but blindness can be reduced by 2% if handlers use face shield and goggles to protect their eyes from pesticides exposures

4.0 Conclusion

Safe handling of pesticides was significantly associated with participants' age, level of education, hours of working with pesticides and positions at work ($p < 0.05$). Skin itching was significantly associated with skin diseases (RR > 1). Skin diseases resulting from itching can be reduced by 63% if exposure to pesticides is reduced by use of appropriate PPEs. Coughing, throat irritation is significantly associated with respiratory diseases (RR>1). Respiratory diseases as a result of coughing and throat irritation can be reduced by 57% and 79% respectively if the handlers use appropriate PPEs.

5.0 Recommendations

It is recommended that special pesticide safety and health trainings be introduced to help minimize pesticides risks. Handlers should not only possess PPEs but wear them properly. 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. In addition, training of handlers on alternative pest control methods such as IPM should be promoted in order to minimize pesticide use and eventually minimize exposure of handlers to pesticides. There is also need for furthers studies to conduct biological testing among these group of workers who reported acute and chronic with the aim of treating them and preventing further illnesses.

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