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Occupational Pesticides Intoxication among Agricultural Workers

Mahmoud Ali Saleh, Hassan El Sayed El far, Omyma Mahmoud Hassan, Marwa Salah El-DienAbdEl-Raouf, Shaima Adel Elsayed Ali

Department of Community, Environmental and Occupational Medicine, Faculty of Medicine, Benha University

Corresponding author: Marwa Salah El-dienAbd-Elraouf, **Mobile:** (+20) 01065063533, **E-Mail:** marwad24@yahoo.com

Abstract

Background: Pesticide intoxication is a public health problem in many developing countries. Approximately 18.2 per 100 000 agricultural workers worldwide have occupational-related pesticide acute and chronic toxicity symptoms.

Objective: This study aimed to investigate the toxic symptoms in pesticide-exposed agricultural workers.

Patients and Method: A cross sectional study was conducted on 390 agricultural workers using an interview questionnaire that consists of socio-demographic and exposure data, safety practices and self-reported toxicity symptoms. Physical examination and investigations were done.

Results: Among the self-reported toxicity symptoms, cough was the most common acute symptom (59%) while skin problems were the most reported chronic symptoms (11.5%). There was a statistically significant difference regarding age between those with & without blurring of vision [(median, 50 and 39 years respectively) $P < .001$], muscle spasm [(median, 49 and 40 years respectively) $P < .001$] and skin problems [(median, 48 & 41 years respectively) $P < 0.007$]. Regarding duration of exposure, there was a statistical significant difference between those with & without blurring of vision [(median, 10 and 50 years respectively) $P < .001$], muscle spasm [(median, 10 and 6 years respectively) $P < .001$] and skin problems [(median, 12 and 6 years respectively) $P < .001$]**.** There was statistical significant negative correlation between serum cholinesterase level and age, duration of pesticides exposure and body mass index.

Conclusions: The most self-reported pesticides toxicity symptom was cough (59%) while walking problems were the least reported one (5.9%). Age and duration of pesticides exposure are significant risk factors for pesticides toxicity.

Keywords: Pesticides, Toxicity, Agricultural workers.

INTRODUCTION

Agricultural sector has a central role in the Egyptian economy, as it accounts for more than 30% of the work force [(1)]. Pesticide intoxication is a well-known public health problem in many developing countries. It is estimated by the World Health Organization (WHO) that approximately 18.2 per 100 000 agricultural workers have occupational-related pesticide poisonings worldwide [(2)]**.** This can be attributed to inappropriate protective measures including inadequate clothing, unsafe handling, storage and disposal practices, drift of spray droplets, poor maintenance of spray equipment [(3)]. Occupational exposure to pesticides can cause acute and chronic poisoning. Acute toxicological symptoms include dizziness, muscle ache, headache and seizures [(4)]**.** In addition, long-term pesticides exposure has been associated with a wide range of chronic manifestations, including impaired neurobehavioral function, respiratory problems, obesity, skin problems and thyroid problems [(5)]**.**

Objective: This study aimed to investigate the toxic symptoms in pesticide-exposed agricultural workers.

SUBJECTS AND METHODS

Study design: This is a cross-sectional study.

Study setting: The Primary Health Care Units in 3 randomly chosen villages in Kafr-Shukr disrict, Qalyubia governorate. Egypt (Kafr Ali Sharafuddin, Berqata and Alshuqur).

Study period: The field work of this study was carried out from first of March 2020 to the end of May 2020.

Target population of the study: Agricultural workers who are fulfilling the following inclusion criteria.

Inclusion criteria: Agricultural workers using pesticides of age group 18-60 years old and accepted to participate in the study.

Exclusion Criteria: Alcoholics, drug abusers and or workers with chronic diseases.

Sampling Design

- Sample size:

The minimal calculated sample size was 384 by using free online program; Open Epi: Open Source Epidemiologic Statistics for Public Health version 3.01 [(6)]. With Confidence Interval 95%, margin of error 5% and study power 80%. The annual incidence rate of pesticides poisoning among agricultural workers was 18.2 per 100000 workers according to **Thundiyil *et al*** [(7)]**.**

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The sample size was adjusted and increased to 390 subjects taking in consideration non-responders and defaulters.

- Sampling type and technique:
The 24 villages of Kafr-Shukr center were listed and 3 were chosen by simple random sampling technique. All agricultural workers using pesticides and attending Primary Health Care Units in these 3 villages and fulfilling specific selection criteria were included in this study. The total sample size was equally distributed between the 3 villages (130 from each village).

Study methods and tools:
Data were collected using interview questionnaire, physical examination and investigation.
An interview questionnaire was adopted by **Kori *et al.*** [3] including the following sections:

(1) A sociodemographic data: It consisted of personal information such as age, educational level, marital status and smoking.

(2) Questions about pesticides exposure: duration of exposure in years and the exposure index of pesticide-exposed farm workers that measured the relative levels of chronic occupational exposure to pesticide, which was calculated as follows:

$$\textbf{Chronic exposure level} = \log_{10}\left(\left(\frac{Y \times D}{age-18}\right)+1\right)$$

Where Y is the number of years of occupational exposure to pesticide and D is the most recent estimate of the number of days of usage of pesticide per year. In this study, Index values from 0.698 to 1.710 were classified as medium chronic exposure and those from 1.711 to 2.757 were classified as high chronic exposure to assess the association between adverse health effects and chronic exposure level [3].

(3) Questions to assess occupational health and safety practices towards pesticides.
(4) Questions about self-reported toxicity symptoms including acute symptoms (headache, blurred vision, dyspnea, cough, excessive sweating, excessive salivation, vomiting, diarrhea and muscle spasm) and chronic symptoms (joint pain, skin problems, walking problems and cardiac problems).

General and systemic examination: pulse, blood pressure, weight, height and chest auscultation for wheeze.

Investigation: 5 ml venous blood samples were collected from each participant by a qualified nurse under complete aseptic condition in a dry tube for the measurement of serum pseudocholinesterase enzyme level.
Administrative and Ethical design:

- An official permission was obtained from the Health Administration in Kafr-Shukr to conduct this study.
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- **Ethical consideration**

-An approval from Research Ethics Committee in Benha Faculty of Medicine was obtained (no.: MS 24-10-2019).
-An informed written consents were obtained from all participants. It included data about aim of the work, study design, site, time, subject and methods and confidentiality.

Data management and statistical analysis:-
The collected data were recorded and statistically analyzed by computer using SPSS version 22.0 for windows (SPSS Inc., Chicago, IL, USA). The normality of distribution for the analyzed variables was tested using Kolmogorov-Smirnov test. The collected data were summarized in terms of mean ± standard deviation (SD) or median and range (minimum-maximum) for quantitative data when it was appropriate and as number and percentage for qualitative data. Comparisons between the different study groups were carried out using the Chi-square ($\chi 2$) and Fisher's Exact Test (FET) to compare qualitative data when appropriate.
Mann-Whitney test (z) was used to compare median, while student t test was used to compare means of two groups of quantitative data when it was appropriate. Correlation analysis was done to determine the association between choline esterase level and other variables using spearman correlation coefficient (rs). All tests were two sided. The accepted level of significance in this work was ($p \leq 0.05$).

Results:

Table (1): socio-demographic and exposure characteristics among studied population

Socio-demographic and exposure characteristic		N. (n= 390)	% (100.0)
Age (years)	Median (min. – max.)	48 (19 - 59)	
Educational level	Illiterate	76	19.5
	Primary	48	12.3
	Preparatory	96	24.6
	Diplom	144	36.9
	University	26	6.7
Marital status	Single	88	22.6
	Married	272	69.7
	Widow	22	5.6
	Divorced	8	2.1
BMI	Median (min. – max.)	25.77 (21.22 – 34.19)	
Smoking	Smoker	270	69.2
	Non smoker	120	30.8
Duration of pesticides exposure (year)	Median (min. – max.)	8 (2 – 25)	
Chronic pesticides exposure level	Median (min. – max.)	1.72 (1.04 – 2.78)	
	Medium	194	49.7
	High	196	50.3
Cholinesterase level (U/L)	Median (min. – max.)	4250 (3452 - 6523)	
	< 4000	96	24.6
	4000 — 5000	166	42.6
	5000 — 6000	94	24.1
	> 6000	34	8.7

Results of this study showed that the median age of the study participants was 48 years. Regarding educational level, only 6.7% of them belonged to university education. Majority of the participants (69.7%) were married. The median body mass index (BMI) of the farm workers was 25.77 ranged from 21.22 to 34.19. It was noticed that most of them (69.2%) were smokers. The median duration of pesticides exposure among the studied population was 8 years ranged from 2 years to 25 years. Regarding the chronic pesticides exposure level, more than half of the participants (50.3%) belonged to the high exposure level, with 1.72 median value and ranged from 1.04 to 2.78. The median cholinesterase level was 4250U/L, with 3452U/L as minimum level and 6523U/L as the maximum level. (Table 1).

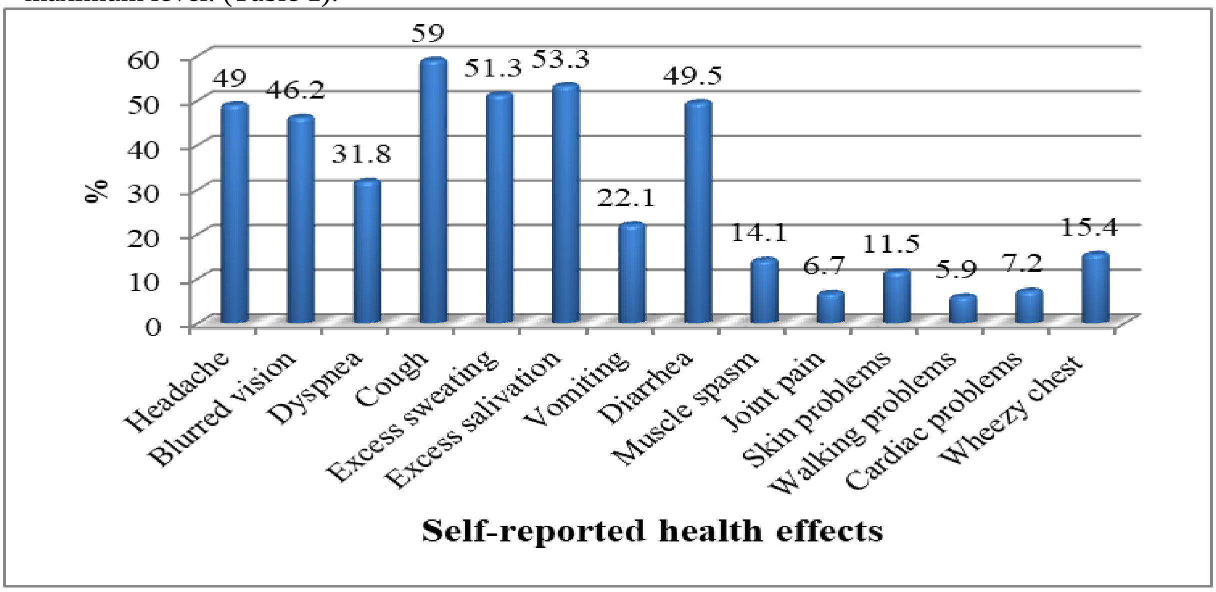

Figure (1): Frequency distribution of self-reported health effects among studied population.

Among the self-reported acute toxicity symptoms, cough was the most common (59%) followed by excess salivation (53.3%), excess sweating (51.3%), diarrhea (49.5%), headache (49%), blurred vision (46.2%), dyspnea (31.8%), vomiting (22%) and muscle spasm (14.1%). Chronic symptoms included skin problems (11.5%), cardiac problems (7.2%), joint problem (6.7%) and walking problem (5.9%). Only 15.4% of farm workers had wheezy chest on auscultation, while the majority (84.6%) had free chest (Figure 1).

Table (2): Relation between blurring of vision and some risk factors among studied population

Some risk factors			Blurring of vision Yes (n=180)	Blurring of vision No (n=210)	Test of significance	*P* value
Age (years)		Median (min. – max.)	50 (22 - 59)	39 (19 - 55)	$Z^* = 7.76$	.000
Smoking		Smoker	121 (67.2%)	149 (71%)	$\chi^{2\,**} = 0.63$	0.426
		Nonsmoker	59 (32.8%)	61 (29%)		
BMI		Median (min. – max.)	26.3 (22.2 – 34.2)	24.5 (21.2 – 27.8)	$Z^* = 7.97$	.000
Duration of exposure (years)		Median (min. – max.)	10 (4 - 25)	5 (2 - 20)	$Z^* = 8.00$	.000
Chronic pesticides exposure level		Median (min. – max.)	1.81 (1.04 – 2.30)	1.59 (1.05 – 2.78)	$Z^* = 2.42$	.016
		Medium	66 (36.7%)	128 (61%)	$\chi^{2\,**} = 22.87$	.000
		High	114 (63.3%)	82 (39%)		
Pesticide concentration applied		Recommended	102 (56.7%)	120 (57.1%)	$\chi^{2\,**} = 23.52$	.000
		Less than recommended	14 (7.8%)	18 (8.6%)		
		More than recommended	18 (10%)	0 (0%)		
		Not committed	46 (25.6%)	72 (34.3%)		
Cholinesterase level (U/L)		Median	4235.5	4325	$Z^* = 1.57$	0.116
Use of protective clothes		Yes	98 (54.4%)	96 (45.7%)	$\chi^{2\,**} = 2.96$	.086
		No	82 (45.6%)	114 (54.3%)		
Re-entry period commitment		Yes	118 (65.6%)	124 (59%)	$\chi^{2\,**} = 1.74$	0.187
		No	62 (34.4%)	86 (41%)		
Practices during spraying	**Spray with the wind direction**	Yes	128 (71.1%)	166 (79%)	$\chi^{2\,**} = 3.29$	.070
		No	52 (28.9%)	44 (21%)		
	Smoking while mixing or spraying	Yes	123 (68.3%)	133 (63.3%)	$\chi^{2\,**} = 1.07$	0.300
		No	57 (31.7%)	77 (36.7%)		
	Blowing by mouth in blocked nozzle	Yes	12 (6.7%)	0 (0%)	$\chi^{2\,**} = 14.44$	.000
		No	168 (93.3%)	210 (100%)		
	Showering immediately after mixing or spraying	Yes	58 (32.2%)	116 (55.2%)	$\chi^{2\,**} = 20.78$	.000
		No	122 (67.8%)	94 (44.8%)		
	Washing work clothes separately	Yes	86 (47.8%)	98 (46.7%)	$\chi^{2\,**} = 0.05$	0.827
		No	94 (52.2%)	112 (53.3%)		

Z^* = Z for Mann-Whitney test $\quad$ $x^{2\,**}$ = Chi-square test

As regards blurring of vision (one of acute toxicity symptoms), there were statistically significant differences between those with and without blurring of vision in relation to age [(median, 50 and 39 years respectively) P < .001], BMI [(median, 26.3 & 24.5 respectively) P < .001], duration of pesticides exposure [(median, 10 and 50 years respectively) P < .001] and chronic exposure level (median, 1.81 & 1.59 respectively) P < .05]. There was a highly statistically significant association between blurring of vision and concentration of pesticides applied (P < .001). There was a highly statistically significant association between blurring of vision and blowing by mouth in blocked nozzle (P = .000) and showering immediately after spraying (P = .000) (Table 2).

Table (3): Relation between muscle spasm and some risk factors among studied population

Some risk factors			Muscle spasm Yes (n=55)	Muscle spasm No (n=335)	Test of significance	*P* value
Age (years)		Median (min. – max.)	49 (20 - 58)	40 (19 - 59)	$Z^{*} = 3.63$	.000
Smoking		Smoker	44 (80%)	226 (67.5%)	$\chi^{2\,**} = 3.49$	.062
		Nonsmoker	11 (20%)	109 (32.5%)		
BMI		Median (min. – max.)	26.3 (21.2 – 31.9)	25.7 (21.9 – 34.2)	$Z^{*} = 2.30$	.022
Duration of exposure (years)		Median (min. – max.)	10 (2 – 20)	6 (2 – 25)	$Z^{*} = 3.68$	.000
Chronic pesticides exposure level		Median (min. – max.)	1.79 (1.10 – 2.31)	1.71 (1.04 – 2.78)	$Z^{*} = 0.64$	0.522
		Medium	26 (47.3%)	168 (50.1%)	$\chi^{2\,**} = 0.16$	0.693
		High	29 (52.7%)	167 (49.9%)		
Pesticide concentration applied		Recommended	16 (29.1%)	206 (61.5%)	$FET^{***}=23.09$	.000
		Less than recommended	9 (16.4%)	23 (6.9%)		
		More than recommended	6 (10.9%)	12 (3.6%)		
		Not committed	24 (43.6%)	94 (28.1%)		
Cholinesterase level (U/L)		Median	4250	4325	$Z^{*} = 2.30$	.022
Use of protective clothes		Yes	13 (23.6%)	181 (54%)	$\chi^{2**} = 17.46$	.000
		No	42 (76.4%)	154 (46%)		
Re-entry period commitment		Yes	25 (45.5%)	217 (64.8%)	$\chi^{2**} = 7.49$	.006
		No	30 (54.5%)	118 (35.2%)		
Practices during spraying	**Spray with the wind direction**	Yes	36 (65.5%)	258 (77%)	$\chi^{2**} = 3.40$	.065
		No	19 (34.5%)	77 (23%)		
	Smoking while mixing or spraying	Yes	43 (78.2%)	213 (63.6%)	$\chi^{2**} = 4.47$	.035
		No	12 (21.8%)	122 (36.4%)		
	Blowing by mouth in blocked nozzle	Yes	8 (14.5%)	4 (1.2%)	FET^{****}	.000
		No	47 (85.5%)	331 (98.8%)		
	Showering immediately after mixing or spraying	Yes	11 (20%)	163 (48.7%)	$\chi^{2**} = 15.70$	.000
		No	44 (80%)	172 (51.3%)		
	Washing work clothes separately	Yes	23 (41.8%)	161 (48.1%)	$\chi^{2**} = 0.74$	0.390
		No	32 (58.2%)	174 (51.9%)		

Z^{*} = Z for Mann-Whitney test $x^{2\,**}$ = Chi-square test FET^{****} = Fisher's Exact Test

There were statistically significant differences between those farmers with and without muscle spasm as one of acute toxicity symptoms regarding age [(median, 49 and 40 years respectively) P < .001], BMI (median, 26.3 & 25.7 respectively) P < .05], duration of exposure (median, 10 and 6 years respectively) P < .001] and cholinesterase level [(median, 4250 & 4325 U/L respectively) P < .05]. Regarding pesticides concentration applied, there was a highly statistically significant association between it and presence or absence of muscle spasm (P < .001). There was a highly statistically significant association between suffering or not suffering from muscle spasm and use of protective clothes (P < .001). There were also a statistically significant associations with some practices as; re-entry period commitment, smoking while spraying, blowing by mouth in blocked nozzle and having a shower immediately after spraying (P < .05), (P < .05), (P < .001) and (P < .001) respectively (Table 3).

Table (4): Relation between skin problems and some risk factors among studied population

Some risk factors			Skin problems Yes (n=45)	Skin problems No (n=345)	Test of significance	*P* value
Age (years)		Median (min. – max.)	48 (30 - 58)	41 (19 - 59)	$Z^{*} = 2.68$	.007
Smoking		Smoker	42 (93.3%)	228 (66.1%)	$\chi^{2**} = 13.87$	.000
		Nonsmoker	3 (6.7%)	117 (33.9%)		
BMI		Median (min. – max.)	24.8 (21.9 – 31.9)	25.8 (21.2 – 34.2)	$Z^{*} = 0.19$	0.852
Duration of exposure (years)		Median (min. – max.)	12 (4 - 20)	6 (2 - 25)	$Z^{*} = 3.66$	.000
Chronic pesticides exposure level		Median (min. – max.)	1.79 (1.04 – 2.10)	1.71 (1.04 – 2.78)	$Z^{*} = 0.60$	0.548
		Medium	21 (46.7%)	173 (50.1%)	$\chi^{2**} = 0.19$	0.661
		High	24 (53.3%)	172 (49.9%)		
Pesticide concentration applied		Recommended	30 (66.7%)	192 (55.7%)	$FET^{***} = 8.41$	.030
		Less than recommended	0 (0%)	32 (9.3%)		
		More than recommended	4 (8.9%)	14 (4.1%)		
		Not committed	11 (24.4%)	107 (31%)		
Cholinesterase level (U/L)		Median	4523	4250	$Z^{*} = 0.41$	0.684
Use of protective clothes		Yes	17 (37.8%)	177 (51.3%)	$\chi^{2**} = 2.913$	0.088
		No	28 (62.2%)	168 (48.7%)		
Re-entry period commitment		Yes	23 (51.1%)	219 (63.5%)	$\chi^{2**} = 2.59$	0.108
		No	22 (48.9%)	126 (36.5%)		
Practices during spraying	**Spray with the wind direction**	Yes	38 (84.4%)	256 (74.2%)	$\chi^{2**} = 2.25$	0.134
		No	7 (15.6%)	89 (25.8%)		
	Smoking while mixing or spraying	Yes	40 (88.9%)	216 (62.6%)	$\chi^{2**} = 12.19$	.000
		No	5 (11.1%)	129 (37.4%)		
	Blowing by mouth in blocked nozzle	Yes	1 (2.2%)	11 (3.2%)	FET^{****}	1.00
		No	44 (97.8%)	334 (96.8%)		
	Showering immediately after mixing or spraying	Yes	12 (26.7%)	162 (47%)	$\chi^{2**} = 6.63$	.010
		No	33 (73.3%)	183 (53%)		
	Washing work clothes separately	Yes	16 (35.6%)	168 (48.7%)	$\chi^{2**} = 2.76$	0.097
		No	29 (64.4%)	177 (51.3%)		

Z^{*} = Z for Mann-Whitney test $x^{2\,**}$ = Chi-square test FET^{****} = Fisher's Exact Test

As regards chronic health effects of pesticides exposure, there was a statistically significant differences between those with and without skin problems concerning age [(median, 48 & 41 years respectively) P = .007] and duration of pesticides exposure [(median, 12 and 6 years respectively) P = .000]. Skin problems occurrence showed a highly statistically significant association with smoking (P = .000). There were statistically significant associations between those with and without skin problems regarding smoking while spraying (P < .001) and showering immediately after spraying (P < .05) (Table 4)

Table (5): Correlation between cholinesterase level and age, duration of exposure, chronic exposure level and BMI among studied population.

Parameter	Cholinesterase level (U/L)	
	rs*	*P* value
Age (years)	- 0.527	.000
Duration of pesticides exposure (years)	-0.533	.000
Chronic pesticides exposure level	0.065	0.201
BMI	- 0.155	.002

rs* = spearman correlation coefficient

Correlation analysis showed that there were statistically significant negative correlations between cholinesterase level and age (rs = - 0.527, P < .001), duration of exposure (rs =-0.533, P < .001) and body mass index ((rs = -0.155, P < 0.05) (Table 5).

DISCUSSION

Hazards of pesticide exposure became a growing concern globally. The purpose of this study was to assess the effect of exposure to pesticides on health of agricultural workers in Kafr Shukr District, Qalyubia Governorate.

This study revealed that the median age of the study participants was 48 years old. Only 6.7% of the participants belonged to university education. The majority of them (69.7%) were married. These results are supported by a cross sectional study, which was conducted on 240 farmers from Ghana. The average age of the farmers was 52 years old and minority of them (3.3% had university education) **[8]**. In this study the median duration of exposure to pesticides was 8 years with a range from 2 to 25 years and the median chronic exposure level was 1.72 which showed a high chronic exposure among the participants. This is similar to **Kori *et al.*** **[3]** who conducted a cross-sectional study among 248 male farm workers from the district Sagar, India. The mean value of chronic exposure index was 1.710 indicating also a high chronic exposure to hazardous pesticides.

In the present study, the self reported symptoms of pesticides toxicity by agricultural workers were cough as the most prevalent symptom (59%) followed by headache (49%), blurred vision (46.2%), dyspnea (31.8%), vomiting (22%), diarrhea (49.5%), excess sweating (51.3%), excess salivation (53.3%) and muscle spasm (14.1%). This is supported by **Jensen *et al.*** **[9]** who conducted a cross-sectional study upon 89 pesticides sprayers in Cambodia in which similar acute symptoms were reported by respondent as headache (55.1%), blurring of vision (25.8%), dyspnea (12.4%), cough (5.6%), excess sweating (14.6%), salivation (6.7%) and muscle spasm (22.5%). The difference in incidence of toxicity symptoms could be attributed to variation in the type of used pesticide**.**

There was a statistically significant difference between those with & without some toxicity symptoms as regards age including blurring of vision [(median, 50 and 39 years respectively) P < .001], muscle spasm [(median, 49 and 40 years respectively) P < .001] and skin problems [(median, 48 & 41 years respectively) P < 0.05]. This is similar to **Kori *et al.*** **[3]** where the adverse health effects including headache and muscle pain (71.3%) were found to be more prominent in farmers who belonged to ≥ 46-years old age group.

There was a statistical significant difference between those with & without pesticides toxicity symptoms regarding duration of exposure such as blurring of vision [(median, 10 and 50 years respectively) P < .001] (Table 2), muscle spasm [(median, 10 and 6 years respectively) P< .001] (Table 3) and skin problems [(median, 12 and 6 years respectively) P < .001] (Table 4). This is similar to a study conducted in Uganda reported that increased duration of exposure is associated with a high prevalence of acute and chronic pesticide-induced symptoms **[10]**.

In this study, there was a significant difference between those farmers with and without muscle spasm regarding serum cholinesterase level [(median, 4250 & 4325 U/L respectively) P < .05 (Table 3)]. **Jintana *et al.*** **[11]** also found an association between increased pesticides toxicity symptoms prevalence with decreased serum cholinesterase level**.**

The present study revealed that smoking during pesticide mixing or spraying significantly was associated with increased risk of muscle spasm and skin problems when compared to non-smoker individuals. These results are supported by the results of a cross-sectional study among 128 farm workers in two rural areas in northern Tanzania **[12]**. This could be attributed to more frequent hand to mouth contact.

Mouth blowing to unblock the nozzle was significantly associated with a higher risk of reporting acute pesticide poisoning as blurring of vision [P < 0.001 (Table 2)] and muscle spasm [P < 0.001 (Table 3)]. This is supported by the results of **Oesterlund *et al.*** **[10]**, which showed a significant increased risk of pesticide poisoning symptoms reported among those farmers who stated blowing by mouth in blocked nozzle**.**

Timing of shower after pesticides spraying was significantly associated with blurring of vision (P < 0.001), muscle spasm (P < 0.001) and skin problems

(P < 0.05). The practice of taking a shower long after spraying facilitates the intra-dermal penetration of the pesticides via prolonged contact between the skin and clothes. It is also a risk factor of poisoning for the family at home [(13)]. The present study revealed that there was a statistically significant difference between those farmers with and without some toxicity symptoms regarding body mass index as, blurring of vision [(median, 26.3 & 24.5 respectively) P < .001] (Table 2) and muscle spasm [(median, 26.3 & 25.7 respectively) P < .05] (Table 3). Also there was a statistically significant negative correlation between BMI and level of serum cholinesterase (r = -0.155, P = .002) (table 5). This could be attributed to storing of lipophilic pesticides in fat tissue as organophosphates that have an affinity for adipose tissue and are therefore predicted to have a large volume of distribution. Adipose tissue gradually accumulates the highest concentrations of an organophosphate with later slowly release to the vascular compartment. Therefore, the effects of organophosphates are longer lasting in obese patients [(14)].

There was a statistically significant negative correlation between serum cholinesterase level and duration of exposure [(r = -0.533, P < .001)] (table 5). Similarly, a longitudinal study was conducted on a cohort of 280 individuals (189 agriculture workers and 91 healthy control subjects) from Almeria coastline, Spain to evaluate potential effects of pesticide exposure. They found that there was a significant difference in cholinesterase level between high versus low pesticides exposure periods [(15)].

CONCLUSION

It was noticed that the most prevalent self-reported pesticides toxicity symptom was cough (59%) while walking problems was the least reported one (5.9%). some risk factors such as; age, duration of pesticides exposure, body mass index, smoking and risky behaviors such as; not considering wind direction, blowing by mouth in blocked nozzle of sprayer and not showering immediately after pesticides spraying were associated with pesticides toxicity symptoms. There was statistical significant negative correlation between serum cholinesterase level and age, duration of pesticides exposure and body mass index.

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