The Effect of Safety Measure Educational Guideline on Knowledge, Practice and Adverse Health Outcomes among Pesticide Workers

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Abstract

Background: Pesticides are chemicals that are used to kill or control pests which include insects and rodents, in addition to a virus, bacteria, fungi, and other organisms. They play a key role in the protection, prevention, responding to outbreaks, and control of infectious diseases. The continuous exposure of the workers to pesticides leads to adverse health outcome due to that the workers do not apply safety measure guideline. **Aim**: of this study was to evaluate the effect of safety measure educational guideline on knowledge, practice and adverse health outcomes among pesticide workers. **Subjects and methods: Design:** A quasi-experimental design (one group pre/posttest) was used for the conduction of this study. **Setting:** The study was conducted at all sections of disease vector control of the General Department of Vector Control, in the Directorate of Health Affairs, at Cairo Governorate. **The sample:** A convenient sample from (120) pesticide workers. **Tools of data collection:** The study included three tools: A structured interview questionnaire, an observation checklist (pre/post-tests) and a self-reported health assessment sheet of adverse health outcomes of pesticide workers. **Results:** All of the pesticide workers were male with a mean age33.2 ± 4.7 and less than two third are married. The study denoted that there were poor total knowledge and inadequate total practice score pre educational guideline and highly significant (p=0.000) improvements of total score of workers knowledge and practice at the post-test. **Conclusion:** The educational guideline had a positive effect on pesticide workers knowledge and practice. In addition , a significant reduction was observed in posttest regarding adverse health outcomes. **Recommendations:** Periodic safety measure educational guideline for all workers exposed to pesticides with continuous use of personal protective equipment and following safety instructions.

Keywords: Pesticide workers, safety measure, educational guideline, adverse health outcomes

Introduction:

Pesticides is any substance, or mixture of substances of chemical or biological ingredients intended for repelling, destroying or controlling any pest. Pesticides are used to protect human health or the environment from illnesses that can be caused by vector-borne disease **(WHO, 2015).** Evaluation of impact of pesticides on human health is not an easy or accurate process because of differences in the duration and levels of exposure, the types of pesticides used (regarding toxicity and persistence**) (Kachaiyaphum et al., 2018).**

Pesticides' workers who mix, use, store, apply and dispose of pesticides are normally considered to be the group who will receive the greatest occupational hazards' exposure that occurs because of the nature of their work. They are therefore at the highest risk for possible acute intoxication of pesticides **(Sarwar,2012**). Pesticides may be used for preventing other vector-borne diseases but its toxicity by design kills, reduces or repels insects, fungi or other organisms that can threaten public health and the economy and raise the potential for human toxicity, leading to an adverse health effect **(Sarwar & Salman, 2015).**

Epidemiological research represents the most direct evidence of an association between adverse health outcomes and its relation to toxicity of pesticides 'exposure **(Groot & Van't Hooft, 2016).** High acute human toxicity refers to product properties that can cause immediate health effects. Pesticides with high acute toxicity can affect people who are preparing,

mixing or using pesticides. Other handling during which such pesticides can pose risk include storage, cleaning and storage of application equipment, disposal of empty containers and contaminated materials such as gloves **(WHO, 2016).**

Several previous studies focused on providing continuing education on using pesticide safety equipment and protection standards for workers in order to mitigate adverse health outcomes because the workers were at the highest risk of occupational hazards of pesticides; owing to their poor knowledge of the side effects of pesticide exposure, workers rarely follow safety measure guideline while dealing with pesticides **(Ejaz et al., 2016).**

Many studies assess occupational exposure hazards of pesticides on pesticides' workers posing both acute risks, including neurologic, allergic, respiratory risks and chronic hazards, which are considerably less well defined. The chronic effects of concern include developmental toxicity, endocrine disruption, carcinogenicity, immune system damage, headache, excessive salivation, lacrimation, nausea, diarrhea, respiratory depression, seizures, and loss of consciousness **(Sarwar, 2015a).**

However, more research on higher-order controls to reduce pesticide exposure, understand the reasons for the less and bad utilization of personal protection equipment (PPE) including inadequate clothing, respirators 'serve, skin protection, eye protection, footwear and other defects in spray equipment, or other reasons, and identify effective training methods is needed for facing adverse health outcome (**Yassin, 2018**). Moreover, the **WHO (2016),** recommended the promotion of less toxic pesticides, environmental friendly, least accumulation, and provide protective equipment to the pesticide workers in developing countries. However, many pesticides used in these countries come under the category of extremely or highly hazardous and that they lead to adverse health problems.

Communities today are generally exposed, on a permanent basis, to doses of pesticides and other chemical substances for eradicate pest; pesticides' workers are group of workers who could greatly benefit from community health nursing services through providing direct care, educating about occupational hazards and safety measures. Community health nurse can have a major impact on how to protect the pesticides' workers from toxicity of pesticides' exposure and decrease adverse health outcome of pesticides **(Judith and Cherie, 2012).**

Significance of the study:

Pesticides play a role of eradicate insects. Most countries in the African Region lack a national pesticide laboratory and adequate capacity for pesticide analysis (**Sarwar, 2015b)**. Exposure of workers increases in the case of not paying attention to use the safety measure intervention (personal protective equipment and safety instructions of practices).Inexpensive pesticides' chemicals are used intensively in developing countries, which make up about 20% of world pesticide usage. Yet, they suffer 99% of deaths from pesticide poisoning **(Sarwar, 2013).** Pesticides' workers are at a much greater risk of health problems than others. Pesticide poisoning is a major health problem globally. Estimates that between 1 and 5 million cases of acute pesticide poisoning occur annually, largely in underdeveloped nations, where pesticide education, monitoring, and safety equipment is either limited or unavailable **(WHO, 2013).** In Egypt, there are 108 types of pesticides, 39 kinds of herbicides, 30 types of fungicides, and 6 types of rodenticides. It is estimated that global expenditure on pesticides increased significantly from 2018 to 2022**.** Weak framework on legislative, illiteracy and lack of training facilities are the main reasons for pesticide adverse health effect which causes severe threats to man and environment **(Farahat et al., 2016).**

Aim of the Study

This study aimed to evaluate the effect of safety measure educational guideline on knowledge, practice and adverse health outcome among pesticide workers through**:**

1- Assessing the knowledge, practice and adverse health outcomes of the pesticide workers regarding safety measure guideline.

2- Developing and implementing a safety measure educational guideline according to pesticide workers' needs.

3- Evaluate the effect of the safety measure educational guideline on pesticide workers' knowledge, practice and adverse health outcomes.

Hypotheses:

- Pesticide workers who are exposed to safety measure educational guideline will exhibit an improved knowledge compared to their pre education guideline level.
- Pesticide workers who are exposed to safety measure educational guideline, will exhibit an improved safety practice compared to their pre education guideline level.
- Pesticide workers who are exposed to safety measure educational guideline, will exhibit improved adverse health outcomes compared to their pre education guideline level.

Subjects and Methods

Research design: A quasi-experimental design (one group pre/posttest) was utilized to achieve the aim of the study.

Setting: The current study was conducted at all sections of disease vector control of the General Department of Vector Control, in the Directorate of Health Affairs, at Cairo Governorate which includes 38 medical districts and each medical area contains a section for disease vector control. The reason of selection Cairo Governorate is that it is a big city containing the large number of pesticide workers.

Sampling: A convenient sample of (120) pesticide workers was used in this study. The total number of pesticide workers was 120 from a total of 133 workers; they were working in all departments of disease vector control in different medical regions that follow the General Department for Disease Vector Control.

Tools of the study: three tools were used in the present study.

Tool I: A structured interview questionnaire, it was constructed by the researchers. based on literature review, and guided by **Mustapha et al.(2017).** It was written in simple, clear Arabic language and included three parts:

Part 1: To assessing the socio-demographic characteristics which include gender, age, level of education, marital status, family income, years of pesticide exposure, source of knowledge about pesticide use, and daily working hours. This took about 10 minutes to completed.

Part 2: To assessing Pesticide worker's knowledge It included simple twelve questions (nine questions were close ended and three questions were multiple choice) regarding the characteristics of pesticides such as; types of pesticides, effects of pesticides on health and the environment, different types of route of pesticides (inhalation, skin and mouth), pesticides' application (storage of pesticides product, pesticides' place and disposal of empty pesticide containers) (pre/post-tests). This took about 20–30 minutes be completed. **Scoring system:** Eleven questions were used to test pesticide worker's knowledge about characteristics of pesticides, with a total of 22 points, a correct complete answer was scored (2) and a correct incomplete answer was scored (1), while the wrong answer was given (0), according to the workers' answers, his knowledge score was categorized into (Good knowledge) ≥ 75%, (Average knowledge) ≥ 50% - < 75% and (Poor knowledge) < 50%.

Tool II: An observation checklist was developed by the researchers and guided by **Wayne (2018), and Kendra (2018).** To assess worker safety measures' practices of pesticides. It was written in simple, clear Arabic language, twelve close ended questions. and constituted of two parts:

Part 1: Worker practices toward the use of safety measure during mixing and spraying pesticides such as; wearing an eyeglass, wearing special gloves, wearing special clothes for mixing pesticides, wearing a

special face mask, clothing facilitate on work site and wearing footwear.

Part 2: Workers practices regarding healthy practices such as; eating during the application, smoking during the application, steps of hand washing before and after application, separating clothes when washing, reading labels on pesticide containers and following the product label.

Scoring system: For assessment of worker practices this part was designed to be answered by the item correctly performed scored as (1) or incorrectly performed scored as (0). The scores were totaled and converted into a percentage score. The worker's practice was considered adequate: if the percent score was ≥ 60%, while it was considered inadequate, if the percent score was less than 60%.

Tool III: Self-reported health assessment sheet of adverse health outcomes of pesticides among workers. Designed by researchers, and guided by **Alam, A. (2016).** It included questions related to physical and psychological problems. The physical health problems, assessed according to the body systems, included five systems as following; the respiratory disorders, neuromuscular disorders, skin disorders, gastrointestinal disorders and eye condition. The psychological health problems included the following disorders; stress; anxiety, and depressed mood.

Methodology

Administrative phase: An official approval letter was assumed from the Dean of Faculty of Nursing, El-Fayoum University, to the Disease Vector Control Department in the Directorate of Health Affairs. This letter includes the aim of the study and requesting a permission for the researchers to carry out the study.

Pilot study: A pilot study was conducted before starting data collection on 13(10%) pesticide workers to test the content clarity, the feasibility and the time needed to fill in the tools as a pre-test. According to the pilot study result, some modifications were done. So, the pilot study sample was excluded from the main study sample.

Reliability: Reliability coefficients were calculated for the questionnaire items. The coefficient alpha was for knowledge 76.00 %, and for the observation checklist, it was 88.0%.

Validity of the tools: Content validity was done through three experts from Faculty Members of Community Health Nursing Department and three experts from Faculty Members of Community Health Medicine Department to ascertain relevance and completeness.

Ethical Considerations: Each pesticide worker was informed about the purpose and benefits of the study, then an oral consent was obtained before starting the data collection. Strict confidentiality was ensured throughout the study process. The study subjects were assured that all data will be used only for research purpose and workers were informed about the rights to refuse or withdraw at any stage of the study with no consequences.

Fieldwork

The field work was carried out over a period of 11 months from beginning of January 2018 to the end of November 2018. The previously mentioned settings were visited by the researchers two days/week (Saturdays &Thursdays) from 10.00 am to 12.00 moon. Safety measure educational guideline it included 5 phases:-

Phase (1): Preparatory Phase

Reviewing of current, past, local and international literature related to the research title was done. The tool questionnaire was designed to assess pesticide worker's knowledge, practice and adverse health outcomes before and after implementation of a safety measure educational guideline.

Phase (2): Assessment phase (pretest)

In this stage, the researchers assessed the actual educational needs by using the pre-constructed tools; the researchers interviewed each worker working in the Disease Vector Control Department throughout using tools of data collection, in the period from the beginning of January 2018 to the end of February 2018.

Phase (3): Planning phase

Developing the safety measure educational guideline according to a **general objective** to enhance the workers' knowledge, practice and reduce pesticide adverse health outcome. And **specific objectives** of the safety measure educational guideline. By the end of the educational guideline each, worker will be able to define: types of pesticide products, effect of pesticide on human health, route of pesticide entry into body by inhalation, route entry into body by skin, read, understand and follow pesticide labels, concentration of pesticides , storage, preparation and disposal of empty pesticide containers, as well training pesticide workers' practice of using the personal protective equipment (PPE) and safety instruction practice during pesticide mixing and application, and adverse health outcomes related to continuous exposure of workers to pesticides.

- In this phase, the researchers analyzed the pre-test, then tailored the safety measure educational guideline to the needs of each worker. There were commonality among workers 'needs from the safety measure educational guideline; as there was lack of knowledge in almost all items and need for improvement of their knowledge and practice regarding pesticide uses that will decrease adverse health outcomes of workers.

Phase (4): Program implementation

The safety measure educational guideline was carried out at the Disease Vector Control Department in the Directorate of Health Affairs.The subjects were divided into small groups (12 groups), each group consists of 10 workers. The program was conducted through six sessions; each group obtained the six sessions through 3 weeks (2 sessions /week), each session took 40 minutes. The total allocated time for achieving the program objectives for the twelve groups was 48 hours (12 groups × 4 hours). Each session started by a summary about what was given through the previous sessions and the objectives of the new one taking into consideration using simple and clear language. Teaching methods and media used included lectures, open discussions, and brain storming as well as role play. Suitable teaching aids, prepared especially for the safety instruction program were used such as: printed materials, pictures, and power point presentations. The duration of program implementation was nine months (from beginning of March 2018 to the end of November 2018). At the end of the safety instruction implementation an program immediate post-test was done.

Phase (5): Evaluation (post-test)

After implementation of the program a post-test was done to evaluate the effect of the safety measure educational guideline by using the same tools which were used in the pretest.

Statistical Design:

Statistical presentation and analysis of the present study were conducted, using the mean, standard deviation, paired t-test, Analysis of variance [ANOVA], Linear Correlation Coefficient [r] and chi-square tests by (IBM computer using the statistical package for social science (SPSS), Version 20.0, Statistics for Windows. ANOVA test was used for comparison among different times in the same group in quantitative data. Fisher's exact test and Yates' corrected Chi-square were computed for 2x2 tables. Linear Correlation coefficient was used for detection of correlation between two quantitative variables in one group. Significance of results was evaluated as follows: >0.05 Not significant(NS), <0.05* Significant (S), and <0.001** Highly significant(HS).

Result:

Table (1): Shows the studied pesticide workers' characteristics. All of the workers (100.0%) were male, the highest percentage of workers' age ranged between 21 – 40 (56.7%) with a mean age 33.2 ± 4.7years, 63.3%, of them were illiterate and 20% can read and write. 63.3% of them were married and 66.6% of them had insufficient income, for 54.2% of pesticide workers' exposure to pesticides ranged between 5-10 years, and for all of them (100.0%),the source of knowledge about pesticide was by experience, and for 62,5% the daily working hours were ≥ 6 hours.

Table (1): Frequency and Percentage Distribution of Pesticide Workers' Socio-demographic Characteristics (n=120)

Characteristics	No.	%
Gender		
Male	120	100.0
Age (years)		
≤ 20	32	26.7
21-40	68	56.7
> 40	20	16.6
Mean ± SD	33.2 ± 4.7	
Educational level		
Illiterate	76	63.3
Read and write	24	20.0
Basic education	20	16.7
Marital status		
Single	33	27.5
Married	76	63.3
Divorced	4	3.3
Widower	7	5.8
Family income		
Sufficient	25	20.7
Insufficient	80	66.6
Sufficient and saved	15	12.7
Years of pesticide exposure(years)		
<5	28	23.3
5-10	65	54.2
>10	27	22.5
Source of knowledge about pesticide use		
By experience	120	100.0
Daily working hours (hours)		
≤6	45	37.5
> 6	75	62.5

Table (2) Reveals a highly statistically significant difference between the pesticide workers 'knowledge pre/post educational guidelines (t= 39.145, $p < 0.001$), whereas mean of the pesticide workers 'knowledge score in posttest was higher than pretest (13.77±1.8 & 5.6±1.44) respectively.

Table (2): Comparison of Pesticides Workers' Knowledge between Pre and Post Implementation of Safety Measure Education Guideline about Pesticides (n=120)

Knowledge	Pre-education program						Post –education program					
	Complete		Incomplete		Incorrect		Complete		Incomplete		Incorrect	
	No	%	No	%	No	%	No	%	No	%	No	%
Definition of pesticides	2	1.7	67	55.8	51	42.5	74	61.7	36	30.0	10	8.3
Types of pesticides	11	9.2	43	35.8	66	55.0	83	69.2	25	20.8	12	10.0
Effect of Pesticides on the health	1	0.8	66	55.0	53	44.2	92	76.7	24	20.0	4	3.3
Effect of Pesticides on the environment	0	0.0	65	54.2	55	45.8	74	61.7	34	28.3	12	10.0
Route of pesticide entry into body by inhalation	16	13.3	75	62.5	29	24.2	76	63.3	42	35.0	2	1.7
Route of pesticide entry into body by skin	17	14.5	64	53.0	39	32.5	72	60.0	39	32.5	9	7.5
Route of pesticide entry into body by mouth	3	2.5	31	25.8	86	71.7	92	76.6	17	14.2	11	9.2
Understand and follow pesticide labels	1	0.8	75	62.5	44	36.7	80	66.7	36	30.0	4	3.3
Pesticide concentration applied	12	10.0	27	22.5	81	67.5	88	73.3	21	17.5	11	9.2
Mean±SD	5.6±1.44						13.77±1.8					
t (P-value)	39.145 (<0.001**)											

**Highly significant at p < 0.001

Table (3): Reveals a highly statistically significant difference between the pesticide workers 'knowledge about application of pesticides pre/post educational guideline (t= 38.615, *p* < 0.001),whereas the mean of the pesticide workers 'knowledge score about application of pesticides in posttest was higher than pretest (14.19±1.86 & 5.73±1.52) respectively.

Table (3): Comparison of Pesticides Workers' knowledge of Application Pesticides between Pre and Post Implementation of Safety measure Education Guideline (n=120).

Knowledge	Pre-education program						post –education program					
	Complete		Incomplete		Incorrect		Complete		Incomplete		Incorrect	
	No	%	No	%	No	%	No	%	No	%	No	%
Storage of pesticide products												
At any place	7	5.8	26	21.7	87	72.5	77	64.2	38	31.7	5	4.2
Specific store	5	4.2	35	29.2	80	66.7	85	70.8	32	26.7	3	2.5
Pesticide preparation places												
Open place	3	2.5	31	25.8	86	71.7	90	75.0	28	23.3	2	1.7
Special room	4	3.3	30	25.0	86	71.7	85	70.8	35	29.2	0	0.0
At any place	3	2.5	36	30.0	81	67.5	79	65.8	40	33.3	1	0.8
Disposal of empty pesticide containers												
Burning	3	2.5	42	35.0	75	62.5	72	60.0	47	39.2	1	0.8
Burying	2	1.7	34	28.3	84	70.0	76	63.3	42	35.0	2	1.7
Washing and reusing at home	5	4.2	28	23.3	87	72.5	72	60.0	48	40.0	0	0.0
Reuse for storage of other pesticides	10	8.3	26	21.7	84	70.0	87	72.5	30	25.0	3	2.5
Mean±SD	5.73±1.52						14.19±1.86					
t (P-value)	38.615 (<0.001**)											

**Highly Significant at p < 0.001

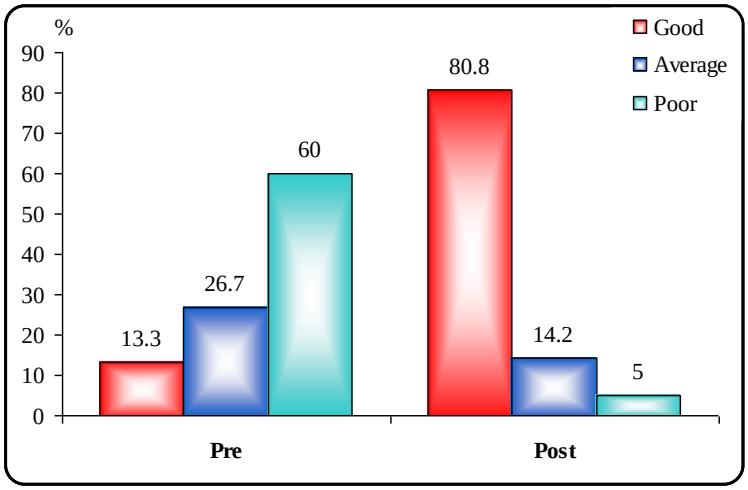

Figure (1): Total Workers' Knowledge score on Pesticides

Figure (1): Clarifies that 80.8% of workers had good total knowledge score in posttest compared to pretest (13.3%) and 5% of workers posttest had poor total knowledge score compared to pretest(60%).

Table (4): Reveals a statistically significant difference between the pesticide workers practice level about the use of personal protective equipment when mixing and spraying pesticide items pre/post educational guideline (t= 24.075 , p < 0.001), whereas mean of the pesticide workers 'practice score in posttest was higher than pretest (3.78±0.72 & 1.32±0.86) respectively.

Table (4): Comparison of Pesticides Workers' Practice of Using the Personal Protective Equipment (Pre/ Posttest) (n=120).

Personal protective equipment practice	Pre-education program				Post –education program			
	Correct		Incorrect		Correct		Incorrect	
	No	%	No	%	No	%	No	%
Wear an eye glass	11	9.2	109	90.8	94	78.3	26	21.7
Wear special gloves	2	1.7	118	98.3	95	79.2	25	20.8
Wear a special clothes	12	10	108	90	97	80.8	23	19.2
Wear a special face mask	0	0	120	100	92	76.7	28	23.3
Clothing facilitates on work site	8	6.7	112	93.3	88	73.3	32	26.7
Wear foot wear	10	8.3	110	91.7	86	71.7	34	28.3
Mean±SD	1.32±0.86				3.78±0.72			
t (P-value)	24.075 (<0.001**)							

**Highly Significant at p < 0.001

Table (5): Reveals a highly statistically significant difference between the pesticide workers about safety instruction practice pre/post educational guideline (t= 22.033, p < 0.001), whereas mean of the pesticide workers 'practice score in posttest was higher than pretest (3.83±0.74 & 1.48±0.91) respectively.

Table (5): Comparison of Pesticides Workers' Safety Instruction Practice (Pre/ Posttest) (n=120).

Safety instruction practice	Pre-education program				Post –education program			
	Correct		Incorrect		Correct		Incorrect	
	No	%	No	%	No	%	No	%
Eating during application	16	13.3	104	86.7	87	72.5	33	27.5
Smoking during application	13	10.8	107	89.2	95	79.2	25	20.8
Hand washing before and after application	2	1.7	118	98.3	92	76.7	28	23.3
Separates clothes when washing	6	5	114	95	102	85.0	18	15.0
Read labels on pesticide containers	1	0.8	119	99.2	98	81.7	22	18.3
Follows the product label	10	8.3	110	91.7	86	71.7	34	28.3
Mean±SD	1.48±0.91				3.83±0.74			
t (P-value)	22.033 (<0.001**)							

**Highly Significant at p < 0.001

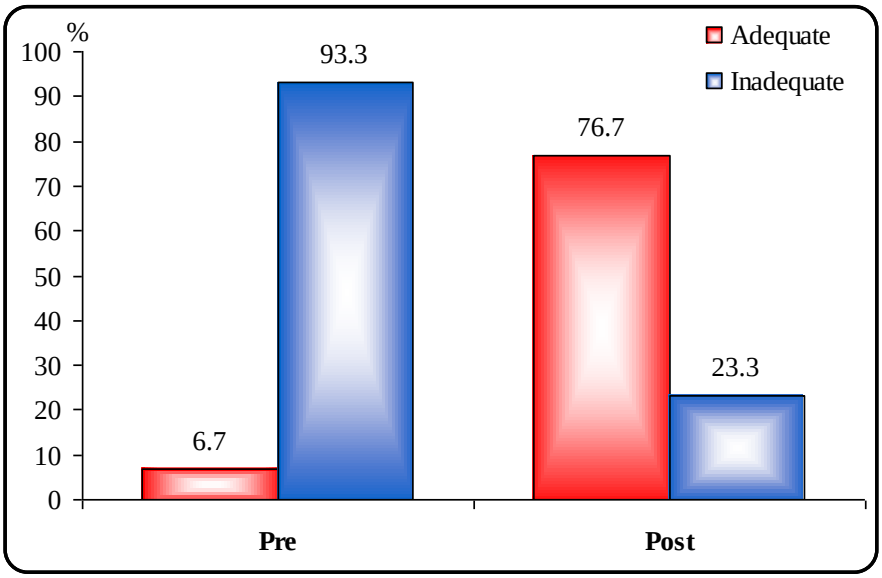

Figure (2): Percentage Distribution of Pesticide Workers' Total Practice Score of Pesticide Use (n=120).

Figure (2): Illustrates that 76.7% of workers had adequate practice score in posttest compared to pretest(6.7%) and 23.3% of workers at posttest had inadequate practice score compared to pretest(93.3%).

Table (6): Reveals a statistically significant difference between the pesticide workers adverse health outcomes (physical and psychological problems) pre/post educational guideline .

Table (6): Comparison of Adverse Health Outcomes of Pesticide Use among the Pesticide Workers Pre and Post Implementation of the Safety Measure Educational Guideline (n=120).

Adverse health outcome	Pre safety measure education guideline		Post safety measure education guideline		Chi-square	
	No	%	No	%	X^2	P-value
A)Physical health problems						
1-Respiratory disorders						
Cough	90	75.0	60	50.0	16.000	<0.001**
Excessive salivation	70	58.3	40	33.3	15.105	<0.001**
Dyspnea	35	29.1	20	16.6	5.307	0.021*
2- Neuromuscular disorders						
Muscle ache	100	83.3	60	50.0	30.000	<0.001**
Headache	80	66.6	60	50.0	6.857	0.009*
Dizziness	65	54.1	35	29.2	15.429	<0.001**
3- Skin disorders						
Skin redness	60	50.0	25	20.8	22.315	<0.001**
Allergic reaction	40	33.3	23	19.6	6.220	0.013*
4- Gastrointestinal disorders						
Vomiting	56	46.6	40	33.3	4.444	0.035*
Nausea	50	41.6	32	26.6	6.002	0.014*
Diarrhea	60	50.0	30	25.0	16.000	<0.001**
Altered taste	74	61.6	55	45.8	6.051	0.014*
Altered smell	75	62.5	60	50.0	15.000	<0.001**
5- Eye condition						
Eye redness	75	62.5	55	45.8	6.713	0.010*
B) Psychological health problems						
Stress	55	45.8	25	20.8	16.875	<0.001**
Anxiety	45	37.5	20	16.6	13.187	<0.001**
Depressed mood	110	91.6	70	58.3	35.556	<0.001**

(*) Statistically significant at $p \leq 0.05$ & (**) highly statistically significant at $P \leq 0.001$

Table (7): Shows that there were highly statistically significant correlations between total knowledge score about pesticide use and age, and level of education ($p < 0.001$**). As well statistically significant correlations were found between total knowledge score about pesticide use and family income and years of pesticide exposure ($p < 0.05$*) about safety measure educational guideline.

Table (7): Correlation between Demographic Characteristics of Pesticide Workers and Total Knowledge Score about Pre & Post Safety Measure Educational Guideline (n =120).

Demographic characteristics	Total knowledge score							
	Pre		ANOVA		Post		ANOVA	
	Mean	±SD	f	P-value	Mean	±SD	f	P-value
Age (years)								
≤ 20	4.59	1.36	7.523	<0.001**	13.44	1.48	9.166	<0.001**
21-40	5.34	1.27			13.90	1.36		
> 40	5.90	0.79			15.05	0.94		
Educational level								
Illiterate	5.01	1.39	4.097	0.019*	13.76	1.43	7.728	<0.001**
Read and write	5.38	1.13			13.71	1.37		
Basic education	5.90	0.79			15.05	0.94		
Family income								
Sufficient	5.29	1.28	6.187	0.003*	13.60	1.50	5.907	0.004*
Insufficient	4.60	1.29			13.88	1.38		
Sufficient and saved	6.00	0.85			15.07	1.03		
Years of pesticide exposure (years)								
<5	4.46	1.29	7.669	<0.001**	13.46	1.48	5.463	0.005*
5-10	5.38	1.28			13.89	1.32		
>10	5.67	1.00			14.67	1.39		

(*) Statistically significant at $p \leq 0.05$ &(**) Highly statistically significant at $P \leq 0.001$

Table (8): Shows that there were highly statistically significant correlations between total practice score and age and level of education (p<0.001). While statistically significant correlation were detected between practice score and family income and years of pesticide exposure (p< 0.005) about safety measure educational guideline.

Table (8): Correlation between Demographic Characteristics of Workers and Total Practice Score about Pre & Post Safety Measure Educational Guideline (n =120).

Demographic characteristics	Total practice score							
	Pre		ANOVA		Post		ANOVA	
	Mean	±SD	f	P-value	Mean	±SD	f	P-value
Age (years)								
≤ 20	1.22	0.49	34.966	<0.001**	3.53	0.67	10.688	<0.001**
21-40	1.38	0.65			3.69	0.60		
> 40	2.55	0.60			4.35	0.75		
Educational level								
Illiterate	1.32	0.57	33.839	<0.001**	3.64	0.65	9.921	<0.001**
Read and write	1.38	0.71			3.63	0.58		
Basic education	2.55	0.60			4.35	0.75		
Family income								
Sufficient	1.16	0.47	26.406	<0.001**	3.76	0.66	3.793	0.025*
Insufficient	1.45	0.67			3.52	0.71		
Sufficient and saved	2.60	0.63			4.13	0.74		
Years of pesticide exposure (years)								
<5	1.18	0.48	23.062	<0.001**	3.54	0.69	6.468	0.002*
5-10	1.38	0.60			3.69	0.61		
>10	2.26	0.86			4.15	0.77		

(*) Statistically significant at p ≤ 0.05 &(**) Highly statistically significant at P≤0.001

Table (9): Shows that highly statistically significant correlation was detected between total knowledge score of pesticide workers and improvement in their total practice score pre/post educational guideline (r = 0.457, p < 0.001**) and (r =0.602, p < 0.001**) respectively.

Table (9): Correlation between Pesticide Workers' Total Knowledge and Practice Pre /Post Safety Measure Educational Guideline (n = 120).

Items	Total Knowledge score of Pesticides			
	Pre educational guideline		Post educational guideline	
	r	P value	r	P value
Total practice score	**0.457**	**<0.001****	**0.602**	**<0.001****

(*) statistically significant & (**) high statistically significant P≤0.001

Discussion:

Workers are not adequately informed about the risks associated with exposure to pesticides as they had insufficient training in handling pesticides leading to many health risks. In Egyptian community, workers should be informed about safety measures to prevent and protect themselves from pesticide hazards because they are the main force of human resources needed to deal with pesticides. The present study aimed to evaluate the effect of safety measure educational guideline on knowledge, practice and adverse health outcomes among pesticide workers. Concerning pesticide workers socio-demographic characteristics, all of the workers were male, the highest percentage of workers' age ranged between 21 – 40

years representing more than half of them with a mean age of 33.2 ± 4.7. years. From the researchers 'point of view, the men are hard workers with physical strength to carry the pesticides 'machine gun. This finding is supported, in Egypt, by **Neghab et al., (2015),** who conducted study about respiratory toxicity of raw materials used in pesticide production, which showed that the mean age of their studied sample was 31.3 ± 4.2 years. However this result is in disagreement with that of the study carried out **Mostaghaci and Jalil (2017),** on the effect of work place on the health of workers, in Iran, who found that the mean age of workers was 20.50±7.34 years.

Regarding the educational level, the present study result showed that approximately two-thirds of workers are illiterate and one fifth don't read and write that lead to poor knowledge about hazards of pesticides and they don't apply correct safety measure, while a the minority of the study sample had high education. From the researcher's point of view, illiteracy leads to inability to read and understand meaning of the labels of pesticides especially the label may be written by English language. This finding was supported by **Mustapha et al., (2017),** who conducted a study about " Pesticide knowledge and safety practices among farm workers", in Kuwait, which showed that 70% of the farmers did not read or follow instructions on pesticide labels.

According to the marital status, less than two-third of the study sample were married. The current study findings can be interpreted as the pesticides' effect on sexual ability and longtime exposure lead to impotence which agreed with **Soliman et al ., (2008).** Who in a study, on erectile dysfunction in workers chronically exposed to pesticide and organic solvents in Damietta governorate, men who consulted for erectile disorders, exposure to pesticides or solvents is associated with an increased risk of having an abnormal nocturnal erectile pattern. Also, these results came in agreement with those of **Mostaghaci, and Jalil, (2017)** where the years of pesticides used mean was 7.94+4.46 years. Concerning of daily working hours, the present study finding showed that less than two-third of workers worked 6 hours or more, while regarding years of exposure to pesticides were for about more than half of them were exposed to pesticides for 5 -10 years. These indicate that the workers under study were exposed to high risk of pesticides hazards. This finding was supported by that **Mustapha et al., (2017),** which reported that, slightly more than half of their sample had 5- ≥ 10 years' work experience and the daily working hours were more than 6 hours.

Considering the studied sample knowledge about definition, the types of pesticides, effect of pesticides on the health and environment, route of pesticide entry into body by inhalation, skin and mouth, understand and follow pesticide labels and pesticide concentration applied, this study results showed that the majority of pesticides' workers had incomplete answers. This means that they had poor knowledge

before implementing the safety measure educational guideline. These findings were in agreement with those of the study conducted by **Mustapha et al., (2017),** that the farmers' lack of knowledge of pesticides about the types of pesticides, effect of pesticides on the health and environment , route of pesticide entry into body by inhalation, skin and mouth, understand.

The current study finding emphasized that the majority of workers had poor knowledge about application of pesticides, the present study found that the majority of workers had poor knowledge related to storage of a pesticide product, pesticide preparation place, disposal of empty pesticide containers. The main causes of poor knowledge of the majority of workers were that they cannot read and write and adding to that the instructions of pesticides might be written by English language. In agreement with these study findings, **Rios-Gonzalez, et al., (2018)**, who conducted a study about " Health and safety of pesticide applicators in a high income agricultural setting: A knowledge, attitude, practice, and toxicity study from North-Eastern Italy" stated that the farmers had poor knowledge and understanding of safe knowledge in pesticides use and the improper storage and disposal of pesticides. Even when able to read, some respondents in this study acknowledged that they were reluctant to read pesticide labels because of their experience with pesticide use. These findings were in agreement with those of the study conducted by **Keifer (2016),** about "Effectiveness of interventions in reducing pesticide overexposure and poisonings " in Iran, who found that participation in training programs leads to increased levels of knowledge about health effect on handling pesticides. The investigator point of view, these training programs may lead to improve environmental contamination and decrease risk on human health.

Comparison of the workers' total knowledge of pesticides results of this study revealed that they had higher good knowledge in posttest compared to pretest indicating of that the safety measure educational guideline was effective. This finding was supported by **Mustapha et al., (2017),** the result of this study illustrates also that there was statistically significant improvement in mean knowledge scores of the pesticides workers in post educational guideline. This result is in line with that of **Abdel Monem et al., (2018),** in a study entitled: "Exposure of pesticide workers to leaded hazards in Gaza strip" which emphasized that the workers have wrong answer of knowledge pre educational program which improved after program and follow up. These findings justified the first research hypothesis.

This study result showed inadequate pesticide workers' practice before implementing the safety measure educational guideline. Concerning the protective equipment used by workers, the present study revealed that the majority of pesticide workers failed to wear complete personal protective equipment (PPE) as wears an eye glass, special gloves, special clothes, face mask, clothing facilitates on work site

and foot wear, when mixing and spraying pesticide items. These findings were in agreement with those of the study conducted by **Rocha et al. (2018),** who reported that the workers were not using PPE during the work due to the lack of knowledge about the importance of personal protective equipment to reduce the pesticide hazards.

The current study revealed that, a minority use all the recommended equipment and follow safety instructions. The investigators view that the main reason mentioned for not using PPE was the discomfort under hot and humid conditions, as the environment, in Egypt is characterized by high ambient temperatures, with summer temperatures exceeding 40C. For that the workers considered PPE to be uncomfortable during work. Regarding following safety instructions during application of pesticides, the present study showed that the minority of pesticide workers follow safety measures instructions as eating, Smoking, Hand washing before and after application, separating clothes when washing, reading labels on pesticide containers and Following the product label. These results were disagreement with those of the study conducted by **Mustapha et al., (2017),** in Kuwait, which concluded that the minority of farmers had some worrying practices about follow safety instruction practice as showering, .hand washing ,special clothes , smoking, eating or drinking while handling pesticides are considered good practices to reduce occupational pesticide exposure. These findings were also in accordance with those of the study conducted by **Litchfield (2015),** entitled "Acute pesticide poisoning in agricultural workers in less developed countries" who reported that the workers were not following safety instructions.

The result of this study indicates that there was a statistically significant improvement in mean practice scores of the pesticides workers in post educational guideline. This findings is congruent with that of the study conducted by **Rocha et al., (2018),** who reported highly improvement in the level of the workers 'practice after implementing the program. This has been detected by the presence of significant differences between results of before and after application the safety measure educational program. These findings are approved the second research hypothesis.

Considering to adverse health outcomes among pesticide workers, the current study result showed that the physical health problems' pesticide workers reported that the majority of problems at respiratory disorder were cough and excessive salivation, the majority of problems at neuromuscular disorder were muscle ache and headache, half of them reported skin redness, and two third of them reported altered test and altered smell as problems at gastrointestinal disorder, three quarter of them showed eye redness.

As regards psychological health problems, the majority of pesticide workers reported depressed mood pre educational guideline. However, post educational guideline, the adverse

health outcomes decreased because the pesticide works followed safety measures educational guideline. This finding was supported by **Ansam et al., (2010), ,** who conducted a study about: "Knowledge and practices of Pesticide use among Farm workers in the West Bank " in Palestine, they found that , the three quarters of the farmers reported at least one symptom of acute pesticide poisoning in the previous year immediately after applying or handling pesticides, while a quarter the respondents did not ascribe any health problems encountered to pesticide exposure. The most frequently reported symptoms were headaches, skin irritation, nausea, itchy eyes ,dizziness ,fatigue and coughing. The researchers highlighted that pesticide residues are found in air ,on surfaces and during application of pesticides they enter the body through inhalation, skin and mouth. This pesticide contamination poses significant risks to the environment and increases adverse health outcomes on workers. The results of the current study disagreed with those of the study carried out by **Mustapha et al., (2017),** in Kuwait, as they found that there were not specific risk, and in some of the cases these symptoms might have been due to causes other than exposure to pesticides, such as long exposure to the sun, especially if no head protection is worn. Nevertheless, the symptoms reported by respondents occurred immediately after applying or handling pesticides and the frequency of occurrence is a great cause of concern. These findings are supporting the third research hypothesis.

Regarding the relation between socio - demographic characteristics and pesticide workers' total knowledge, this study result showed that there were highly statistically significant correlations between total knowledge score about pesticide use and age, level of education. statistically significant Correlation between total knowledge about pesticide use and family income and years of pesticide exposure. This finding was in line with those of the study conducted by **Jaga and Dharmani (2017),** about "Sources of exposure to and public health implications of organophosphate pesticides." ,in Kuwait ,who clarified that there were highly statistically significant differences between participants' characteristics as age, educational level and years of experience and their knowledge.

Considering the relation between socio - demographic characteristics and pesticide workers' practice, this study result found that a total adequate practice score was highly statistically significant correlated between total practice score and age, and level of education. As well statistically significant correlations between total practice score and family income and years of pesticide exposure. This study results agreed with that of the study conducted in **2017, by Arezes and Miguel,** on "The role of risk perception among workers in Scotland" and found that there were statistically significant differences between the workers' practice and their age, years of pesticide use. As well, these results were in agreement with those of **Abou El-magd et al., (2017),** on assessment

of exposure to pesticide hazards of workers in Zigzag City, Egypt and found a statistically significant high prevalence of workers' practice regarding the use of personal protective equipment and level of education.

Investigating the relation between total pesticide workers' knowledge score and their total practice score regarding safety measures educational program ,the current study results found that there was a strong positive correlation between total score knowledge and total score practice of workers about safety measures educational guideline with a statistically significant difference. This finding according to the researchers, this might be due to the application of an accurate safety measure educational guideline which led to improve workers' knowledge that reflected on their practice of the importance of using personal protective equipment and following safety instructions. After the application of safety measure educational guideline the workers 'practice were not in direct contact with pesticides which it lead to decrease adverse health outcomes reported by workers before the educational guideline. These findings were in agreement with those of the study conducted by **Karunamoorthi et al., (2017),** in a study entitled: " Knowledge and practices of farmers with reference to pesticide management", which revealed that there was a highly significant difference between farmers' level of practice and their knowledge regarding safety measures.

Conclusion:

On the light of the main study results, and research hypotheses, the study was concluded that:

Concerning, knowledge of pesticide workers about characteristics of pesticides, the post test showed higher improvement compared to the pretest. Regarding, the practice of pesticides workers about using personal protective equipment and following safety instructions during application of pesticides, the post test showed higher improvement compared to the pretest. Concerning the adverse health outcomes related to direct and indirect exposure to pesticides after applying safety measure educational guideline the posttest revealed decrease in the adverse health outcomes reported by workers. As well there was a statistically significant correlation between the total knowledge and practice of the pesticide workers throughout the post test of the educational guideline.

Recommendations:

Based on the results of the present study, the following recommendations can be suggested:

- Continuous safety instruction programs for workers to minimize adverse health effects regarding pesticide use.
- Optimization of pesticide handling strictly according to the regulations and keeping with the precautionary principle.
- Educating of the public about effective vector management

- Training people in application methods was an effective strategy to reduce the health risks associated with pesticides.
- Further researches are recommended to investigate sustainable preventive strategies about safety pesticide used and health hazards in workers in workplace.

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