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Effect of Evidence-Based Health Education Program for Controlling Pesticides Hazards at Farms on practice of farm-workers

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Abstract: **Unsafe use pesticide in agricultural sector often has been associated with several concerns. For safety of farm-workers, health educator are responsible for training them in the safe use of pesticides. Combining evidence-based interventions into health education programs is generally more cost-effective than implementing a single intervention into the health care system. Aim: The aim of this study was to assess the effect of Evidence-Based Health Education Program for Controlling Pesticides Hazards at Farms on practice of farm-workers. Setting: The study was carried out at El-Mansoura district. The included villages were Shoha, Beddin and Al-Malha. Design: Quasi-experimental research design was utilized throughout this study. Sample: two types of sample were used; village sample's and farm-workers' sample. Only (3) villages at El-Mansoura district agreed to participate in the study. Sample size of farm-workers was 158 (n=158) selected from included villages. Tools: 1) Demographic and occupational structured interview sheet 2) Farm workers' practice in handling pesticides observation checklist pre and immediately post application of evidence-based health education program 3) Farm-workers' feedback structured interview after application of health education program. Results: The study revealed that there was significant improvement in farm-workers' practices, where the mean of total practice score of them had significantly improved from 78.43±12.86 pre application of program to 118.23±7.24 immediately post application of program. Conclusion: It can be concluded that application of evidence-based health education program for controlling pesticides hazards at farms would be a safe and custom-made intervention that ensures the preferred health outcomes. The application of developed evidence-based health education program resulted in improvement in farm-workers practice to control pesticides exposure and hazards at farms. Recommendation: Dissemination of evidence-based health education program for controlling pesticides hazards at farms by the professional health educator in different settings.**

Keywords**: evidence-based health education program, farm-workers, practice, safe pesticide handling.**

1. INTRODUCTION

The use of chemicals in modern agriculture (agrochemicals) has significantly increased. Agriculture is the largest consumer of pesticides to chemically control various pests **[1]**. Pesticides are "Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest **[2,3]**. Pesticides are widely used to ensure an adequate food supply as well as to protect the human health and safety from unwanted pests **[4]**. Pesticides are economic, labor-saving, and efficient tool of pest management in most sectors of the agricultural production **[3,5]**. Egypt consumed about 10600 metric ton of pesticides during 2016 which represent 0.2% of the global consumption **[5].**

Nearly 28% of the Egyptian workforce is employed in agriculture **[6]**. Exposure to pesticides typically occurs among two types of agricultural workers who are pesticide applicators (pesticide sprayers or handlers) and farmers **[7].**

Exposure to pesticides among agricultural workers can happen through four major routes. Pesticides enter the body dermally through the skin, ocularly through the eyes, orally through the mouth and digestive system or by inhalation through the nose and respiratory system **[8,9]**.

Dermal exposure may occur as a result of splashes and drifts when mixing or disposing of pesticides. It may also result from contact with pesticide residues on treated surfaces or contaminated equipment during cleaning or repair **[10,11].** Ocular exposure occurs easily by splashing pesticides in eyes and drift exposure. Adding, it may occur by rubbing eyes or forehead with contaminated gloves or hands with pesticides **[12].** Pesticides can enter the body through the mouth due to carelessness as smoking or eating without washing hands after using a pesticide. Adding, they may be swallowed accidently, if they are improperly stored in food containers **[13].** Inhalation of pesticides can occur during the mixing of wettable powders or, dusts while applying them without protective equipment **[14].**

The agriculture sector in Egypt is dominated by small farms which use traditional practices which do not comply with internationally recognized standards **[15].** In Egypt, unsafe use of pesticides is the major factor of pesticide poisoning. Elements of unsafe use of pesticides includes lack of training on safety measures, risky pesticide storage and transportation, improper maintenance of spraying equipment and lack of the use of personal protective equipment during handling of pesticides **[16, 17]**. Among Egyptian farmers, lack of following safety measures has many reasons namely illiteracy, unavailable protective devices, and the neglection of legislation regulating pesticide use **[18,19].**

Unsafe use pesticide in agricultural sector often has been associated with several concerns including number of human poisoning events, environmental contamination and other living organisms' hazards **[20,21,22,23,24,25].** Pesticide poisoning is a major worldwide public health issue and accounts for nearly 300,000 deaths worldwide every year **[26].** The pesticides harm could be acute or chronic in nature **[27].** The symptoms of acute pesticide poisoning can range from skin irritation to coma or even death **[28].** The chronic pesticide affects occur from repeated small doses over a period of time as asthma, allergies, brain damage and cancers **[28,29].**

Adding, about 99.9% of the used pesticides move into the environment. So, pesticides can contaminate water, soil, and atmosphere and adversely affect ecosystems and public health **[30, 31].**

There are certain personal measures which must always be followed wherever and whenever pesticides are used in order to minimize their personal exposure during handling and application **[2]**. Compliance with standard precautionary measures will safeguard the health of the general public. The ministries of health, agriculture, environment, and education should work together to educate and prevent undue exposure and treat affected persons due to pesticides exposure **[32,33].**

To protect the health and safety of farmers and handlers, heath educators are responsible for training them in the safe use of pesticides. Education and training are essential components of a comprehensive effort to enhance the safety and health of agricultural workplaces **[34].** In health education, evidence-based health education intervention or practice is "the process of systematically finding, appraising and using qualitative and quantitative research findings as the basis for decisions in the practice of health education" **[35,36].** Combining evidence-based interventions into health education programs is generally more cost-effective than implementing a single intervention into the health care system **[37].**

AIM OF THE STUDY:

The aim of this study was to assess the effect of Evidence-Based Health Education Program for Controlling Pesticides Hazards at Farms on practice of farm-workers

2. SUBJECT AND METHODS

1. Research design

Quasi-experimental research design was utilized throughout this study.

2. Setting

The study was carried out at El-Mansoura district. The included villages were Shoha, Beddin and Al-Malha.

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3. Sample size and sampling:

A. Sampling technique for villages

Multi stage sampling technique was used to select villages. These villages were arranged in descending order relating their cultivating areas. Villages with cultivating areas more than 1000 acres were 22 villages which cultivate rice. Adding, convenient sampling technique was used to involve the villages in the study. Out of selected 22 villages, only (3) villages agreed to participate in the study.

B. Sampling technique for Farm-workers

The required sample size of farm-workers is calculated by a hypothetical that mean safe practice scores at farms is 3.8±2 among farm-workers workers before attending training program and 4.3± 1.8 after attending training program, according to (Orozco et al. 2011). The minimum required sample size by considering dropouts by adding 10% is 76 workers by assuming power of 60% at 80% confidence level. Sample size of farm-workers was 158 (n=158). The farm-workers involved in the study were pesticide applicator and farmers. Pesticide applicator who handled agricultural pesticides during mixing, preparing, applying pesticides and cleaning or repairing the contaminated equipment. They applied pesticide for their farms and for others. While farmers who performed tasks related to plants cultivation and harvesting on farms where pesticides are used.

Table 1: Distribution of the included participated farm-workers in included villages

Stratum	Sample size	Population size
Al-Malha	87	48
Shoha	90	50
Beddin	104	60
Total (N)	**N**= 158	**N**= 281

DATA COLLECTION TOOLS:

Three tools were utilized for data collection. All of them were developed by the researcher as the following:

Tool I: Demographic and occupational structured interview sheet:

This tool was used to investigate the demographic data (age and educational level) and occupational data of the farm-workers (nature of work, duration and frequency of pesticide exposure, number of acres sprayed/day).

Tool II: Farm workers' practice in handling pesticides observation checklist (Appendix G)

This observation checklist was used to observe the actual practice of farm-workers during handling and applying pesticides. The tool was classified into 10 categories; (during pesticide marketing, preparation, spraying, cleaning up, storage, disposal of its residue and spillage, pesticide container disposal, wearing personal protective equipment (PPE) and first aid measures for pesticide toxicity), all of these categories were composed of 140 steps. One mark was awarded for each correctly done step. The total skill score of the practice ranged from (0 to 140 marks) and was summed up for each member. The practice level was categorized into two categories as; ***unsatisfied*** = scores less than 65% of total scores (0 - less than 91 marks) and ***satisfied***= scores 65% of total scores and more (91- less than 140 marks).

Tool III: Farm-workers' feedback structured interview after application of health education program:

Structured interview sheet was used to obtain the farmers' feedback about the developed health education program after application. This tool was classified into 5 categories; (Time, the content and its presentation, training physical environment, training activities and feedback (It included 10 items), all of these categories were composed of 23 questions requiring a response with "yes= 1 or no= 0".

METHODS

This study was accomplished throughout two main phases:

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1. Administrative process and ethical considerations

- An official letter from the Faculty of Nursing was submitted to the Agricultural Directorate of Dakahlia governorate to obtain an approval to conduct the study. Adding, an official permission was obtained from the Agricultural Directorate of Dakahlia governorate to all agricultural units of its villages to obtain approval to conduct the study after clarifying the aim of the study.
- Verbal consents were obtained from farm-workers to participate in the study after clarifying the aim of the study and ensuring confidentiality of data. They have the right to participate or not in the study and they can withdraw at any time without any reason.

2. Developing of the study tools

All tools were developed by the researcher after reviewing the related literature. Validity of the developed tools was tested by the following: content validity by submitting the tools to a jury of 5 experts in the field of "community health nursing". Face validity by conducting a pilot study on 10% of study sample (n= 16). Reliability for the practice was done by using Cronbach's alpha and the result was 0.79. Based on the collected information, the necessary modifications were done, some questions were added, and others were clarified or omitted.

3. Evidence-based health education program

Stage 1: Initial data collection

A. The research aim was explained to the managers of agricultural units.

B. Initial data was assessed farm-workers' socio-demographic and occupational characteristics using tool I. Adding, they were observed before and after application of the program using observation checklist for exploration of their practice in relation to safety measures of pesticides handling and application using tool II to measure the level of improvement in their practice after application of the program.

Stage 2: Health education program application

- The health education program was applied program for farm-workers (n=158) throughout 2 days, 2 hours/day.
- The application of program was scheduled at a time that was not conflicted with the farm-workers activities.
- Health education program agenda included the place, date, time, topics, and duration of each session was distributed among the farm-workers individually before starting.

Box (1): Logistics of health education program

Logistics of health education program	Description
Duration	One week (two days/week).
Duration of sessions	About 2 hours /day.
Numbers of sessions	Nine sessions.
Day	Sunday and Tuesday of each week.
Time	11:00 am - 1:00 pm.
Location	Agricultural unit of the village
Presenter	Agricultural unit personnel
Participants	Farm-workers
Numbers of participants/ session	15-20 participants

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Box (2): Program Agenda

Time	Components
Day one 11:00 am - 1:15 pm	***Module one:*** Agricultural employees
	Module two: Pests and chemical pest controls
	Module three: Effects of pesticide exposure
	Module four: Reading pesticide label
	Module five: Personal protective equipment
	Break
	Module six: Pesticides exposure protection *During marketing, transportation, storage and cleaning up. Adding, during and after preparation*
	Reflection
Day two 11:00 am - 1:15 pm	Where we are?
	Module six: Pesticides exposure protection (Cont,…) Before, during and after spray During residue and container disposal Protection from indirect exposure of pesticides
	Break
	Module seven: First Aid for pesticide poisoning
	Module eight: Follow up
	Module nine: Sources of information
	Reflection
	Training evaluation

Stage 3: Health education program evaluation

1. Participants were evaluated for their practice in relation to safety measures of pesticides handling using tool II.

2. The developed health education program was tested to obtain the farm-workers feedback after its application by using structured interview sheet using tool III.

Statistical analysis:

After data were collected, they were sorted, coded, organized, categorized and transferred into especially design formats to be appropriate for computer feeding. Statistical analyses were performed using the statistical software Stands for Statistical Product and Service Solutions (SPSS) v23. Arithmetic mean ± standard deviation for continuous variables and percentages for categorical variables. For comparison between 2 paired within one group, Paired/ Dependent T-test was used if data were normally distributed and Wilcoxon Signed Ranks test was used if the data did not follow normal distribution. P< 0.05 was considered to be statistically significant for tests.

3. RESULTS

Table (2) Distribution of farm-workers according to their demographic and occupational characteristics

Items	Farm-workers setting					
	Beddin		Shoha		Al-Malha	
	N=(60)	%	N=(50)	%	N=(48)	%
Age/ years						
20- < 30	12	20	13	26	13	27.1
30- < 40	6	10	0	0	1	2.1
40- < 50	24	40	23	46	18	37.5

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50- < 60	11	18.3	4	8	11	22.9
≥ 60	7	11.7	10	20	5	10.4
$\bar{X}$±SD	**42.82±12.30**		**43.32±14.53**		**42.31±14.11**	
Level of education						
Illiterate	18	30	16	32	23	47.9
Primary	16	26.7	11	22	3	6.3
Secondary	19	31.7	13	26	15	31.3
University	7	11.7	10	20	7	14.6
Work nature						
Sprayer	16	26.7	17	34	19	39.6
Farmer	44	73.3	33	66	29	60.4

Table (2) shows the distribution of studied farm-workers in relation to their demographic and occupational characteristics. It was noticed that 37.97% of them lived in Beddin village. Relation to age, the largest percentage was for farm-workers aged from 40 to less than 50 years, with mean age of for 42.82±12.30, 43.32±14.53 and 42.31±14.11 for Beddin, Shoha and Al-Malha respectively. Concerning work nature, most of farm-workers were farmers.

Table (3) Distribution of studied farm-workers according to their satisfactory level of their observed practice during pesticide handling pre and immediately post the application of evidence-based health education program

Practice level	N = (158)								Test of significance	P value*
	Pre				Immediately post					
	Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory			
	N	%	N	%	N	%	N	%		
During pesticide marketing (8 marks)	4	2.5	154	97.5	149	94.3	9	5.7	x^2 = 266.406	0.000
$\bar{X}$±SD	**3.20±0.93**				**6.10±0.62**				t= -45.796	0.000
During pesticides preparation (28 marks)	31	19.6	127	80.4	142	89.9	16	10.1	x^2 =157.380	0.000
$\bar{X}$±SD	**14.79±4.44**				**21.89±4.63**				t= -31.529	0.000
During pesticides spraying (17 marks)	28	17.7	130	82.3	151	95.6	7	4.4	x^2 =194.950	0.000
$\bar{X}$±SD	**8.63±2.83**				**13.68±1.82**				t= -39.020	0.000
During pesticide cleaning up (12 marks)	9	57	149	94.3	151	95.6	7	4.4	x^2 = 255.281	0.000
$\bar{X}$±SD	**4.79±1.70**				**9.05±1.30**				t= -39.506	0.000
During disposal of pesticide spillage (6marks)	127	80.4	31	19.6	155	98.1	3	1.9	x^2 = 25.839	0.000
$\bar{X}$±SD	**3.60±0.79**				**3.96±0.23**				t= -5.456	0.000
During disposal of pesticide residue (5marks)	150	94.9	8	5.1	157	99.4	1	0.6	x^2 = 5.604	0.018
$\bar{X}$±SD	**4.89±0.47**				**4.98±0.15**				t= -2.377	0.019
During disposal of pesticide container (10 marks)	19	12	139	88	154	97.5	4	2.5	x^2 = 232.794	0.000
$\bar{X}$±SD	**4.99±1.46**				**8.09±0.90**				t= -37.203	0.000
During pesticide storage (15 marks)	133	84.2	25	15.8	158	100	0	0	x^2 = 27.148	0.000
$\bar{X}$±SD	**12.96±2.10**				**14.16±0.37**				t= -6.146	0.000
During first aids (28 marks)	92	58.2	66	41.8	60	100	0	0	x^2 = 83.424	0.000
MD	**20**				**28**				z= -11.015	0.000
Wearing PPE (11 marks)	0	0	158	100	136	86.1	22	13.9	x^2 = 238.756	0.000
MD	**2**				**9**				z= -10.976	0.000
Total practice score (140 marks)	25	15.8	133	84.2	158	100	0	0	x^2 = 229.661	0.000
$\bar{X}$±SD	**78.43±12.86**				**118.23±7.24**				t= -48.322	0.000

Satisfactory = scores 65% of total scores and more
Unsatisfactory = scores less than 65% of total scores
t for paired t test
z for Wilcoxon Signed Ranks test
P: Significance.
* Significant (p< 0.05).
(SD) = Mean (Standard Deviation)
MD = Median

Table (3) shows the distribution of studied farm-workers relating their satisfactory level of their practice during pesticide handling pre and immediately post the application of evidence-based health education program. It was observed that 97.5% of them showed unsatisfactory level of practice with a mean of 3.20±0.93 during pesticide marketing pre the application of EBHEP. While, immediately post the application of EBHEP, 94.3% of them showed satisfactory level of practice with a mean of 6.10±0.62. The difference was significant **(p≤ 0.05)** between pre and immediately post the application of EBHEP relating the previous item.

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Concerning to pesticides preparation, it was observed that 80.4% of studied farm-workers showed unsatisfactory level of practice with a mean of 14.79±4.44 pre the application of EBHEP session. While, immediately post the application of EBHEP, 89.9% of them showed satisfactory level of practice with a mean of 21.89±4.63. The difference was significant **(p≤ 0.05)** between pre and immediately post the application of EBHEP relating the previous item.

Regarding pesticides spraying, it was observed that 82.3% of studied farm-workers showed unsatisfactory level of practice with a mean of 8.63±2.83 pre the application of EBHEP. While, immediately post the application of EBHEP, 95.6% of them showed satisfactory level of practice with a mean of 13.68±1.82. The difference was significant **(p≤ 0.05)** between pre and immediately post the application of EBHEP session relating the previous item.

In regards to disposal of pesticide spillage, it observed found that 19.6% of studied farm-workers showed unsatisfactory level of practice with a mean of 3.60±0.79 pre the application of EBHEP. While, immediately post the application of EBHEP session, 98.1% of them showed satisfactory level of practice with a mean of 3.96±0.23. The difference was significant **(p≤ 0.05)** between pre and immediately post the application of EBHEP relating the previous item.

In relation to disposal of pesticide residue, it was observed that 5.1% of studied farm-workers showed unsatisfactory level of practice with a mean of 4.89±0.47 pre the application of EBHEP. While, immediately post the application of EBHEP, 99.4% of them showed satisfactory level of practice with a mean of 4.98±0.15. The difference was significant **(p≤ 0.05)** between pre and immediately post the application of EBHEP relating the previous item.

Concerning to pesticide storage, it was observed that 15.8% of studied farm-workers showed unsatisfactory level of practice with a mean of 12.96±2.10 pre the application of EBHEP. While, immediately post the application of EBHEP, all of them showed satisfactory level of practice with a mean of 14.16±0.37. The difference was significant **(p≤ 0.05)** between pre and immediately post the application of EBHEP relating the previous item.

Related first aids, it was observed that 41.8% of studied farm-workers showed unsatisfactory level of practice pre the application of EBHEP. While, immediately post the application of EBHEP session, all of them showed satisfactory level of practice. The difference was significant **(p≤ 0.05)** between pre and immediately post the application of EBHEP relating the previous item.

Regarding PPE, it was observed that all of studied farm-workers showed unsatisfactory level of practice pre the application of EBHEP. While, immediately post the application of EBHEP, 86.1% of them showed satisfactory level of practice. The difference was significant **(p≤ 0.05)** between pre and immediately post the application of EBHEP relating the previous item.

Table (4) Distribution of studied farm-workers' feedback about the developed evidence-based health educational program for controlling pesticides hazards at farms after application

Item	N= (158)	%
Positive points of health education program		
Session time		
Session time was suitable	158	100
Session duration was suitable	140	88.6
Training physical environment		
Agricultural unit was suitable place with adequate lightening and ventilation for training	158	100
The content and its presentation		
Content was related to real field of farm-workers and assisted in solving real problems	158	100
Session added information to farm-workers about pesticide types, pesticide effects, safe pesticide preparation and protective measures.	158	100
Presentation and used media were attractive	158	100
Language was suitable to trainees level of understanding	158	100
Using different training activities	158	100
Retained health education massages at the end of sessions		

Item	N= (158)	%
▪ Pesticide types ▪ Routs of exposure and their effects ▪ Label and time for reading ▪ PPE types, function, principles, maintenance, protection from pesticides ▪ Pesticide emergency ▪ Pesticide follow up ▪ Different sources of its information	158	100

Table (4) presents the distribution of studied farm-workers' feedback related to the evidence-based health education program after application. Relating the session time, it was noticed that the sessions' time was suitable to all the farm-workers (100%) and the sessions' duration was suitable to 80% of them.

Concerning the training physical environment, all the farm-workers reported that the agricultural unit was suitable for application of evidence-based health education program.

Relating the content and its presentation, all farm-workers (100%) reported that the content was related to their real field and assisted in solving their real problems. Adding, they reported that the presentation and media were attractive.

Regarding the retained health education massages at the end of program sessions, all farm-workers were able to mention the different types of pesticide, routs of exposure, PPE types, function, principles, maintenance, pesticide emergency and pesticide follow up.

4. DISCUSSION

Farm-workers are routinely exposed to pesticides **[15]**. Pesticides are used to enhance agricultural production and reduce pests **[5]**. Exposure to pesticides is one of the most important occupational risks among farm-workers in developing countries **[38]**.

Therefore, it is strongly recommended to initiate special educational programs for the all farm-workers prior to engage them for pesticide application **[39]**. Nurse educators have the opportunity to promote improved client outcomes by facilitating an evidence-based nursing approach within clinical nursing education **[40]**. Evidence-based health education programs on safety precautions and reinforcement of safety behaviors, especially the proper use of personal protection equipment (PPE) in the farms, are effective approaches for minimizing hazards related to occupational pesticide exposures **[17,41].**

Low education levels of the rural population, inadequate personal protection, poor maintenance of spraying equipment and lack training on safety handling of pesticide play a major role in causing pesticides hazards **[16]**. These finding is agreement with the findings of the present study.

Pre application of evidence-based health education program, the results of the present study illustrated that the majority of farm-workers showed unsatisfactory level safety measures during most stages of pesticides handling. The poor practices include high toxic pesticides marketing and mal-practice during pesticide preparation, spraying, cleaning up, disposal of its container and first-aid. These findings were agreement with findings stated by similar studies, which reported that most of farm-workers did not follow safety precautions during pesticide handling **[4,17]**. The present study showed an overall improvement in farm-workers' practices, where the mean of total practice score of them had significantly improved from 78.43±12.86 to 118.23±7.24. These results clarify that there was a significant change in farm-workers' total practice after application of evidence-based health education program sessions.

For application of evidence-based health education program sessions, the longer the time commitment, the less desirable is the training method **[42]**. This is agreement with the findings of the present study.

5. CONCLUSION

Based on the findings of the present study, it can be concluded that application of evidence-based health education program for controlling pesticides hazards at farms would be a safe and custom-made intervention that ensures the preferred health outcomes. The application of developed evidence-based health education program resulted in improvement in farm-workers practice to control pesticides exposure and hazards at farms.

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6. RECOMMENDATION

Based on the findings and conclusions drawn from the study, the following recommendations are made:

- Dissemination of evidence-based health education program for controlling pesticides hazards at farms by the professional health educator in different settings.

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