International Journal of Management and Commerce Innovations ISSN 2348-7585 (Online)
Vol. 6, Issue 2, pp: (840-850), Month: October 2018 - March 2019, Available at: www.researchpublish.com

Knowledge, Attitudes and Practices of Pesticide's Sprayers towards Pesticides Use and Handling in Greenhouse Farms, Sudan

Awad O. Mohamed[*1], Adam A. Mater [1], Ahmed M.A. Hammad[2], Abd Elaziz S.A. Ishag[2], Azhari O. Abdelbagi[2], Ali M. Eldein[3], Elsadig M. Eltayeb[4], Asia A. Dahab[4], Ahmed Abdul Gader[5]

[*1, 1] Department of Epidemiology, Faculty of Public Health, Alzeim Alazhari University, Sudan
[2] Department of Crop Protections, Faculty of Agriculture, University of Khartoum, Khartoum, SD 3114, Sudan
[3]Department of Public Health, Faculty of Applied Medical Science, King Khalid University - KSA
[*1, 4] Department of Mother and Child Health, Directorate General of PHC, MoH, Khartoum, Sudan
[5]Department of Public Health and Environmental Studies, University of Khartoum, Khartoum, Sudan

*** Corresponding author;** E-mail: awadomer51@hotmail.com

Abstract: **A descriptive cross-sectional study was conducted in seven localities in Khartoum State (Sudan) to assess the knowledge, attitude, and practice of pesticide's sprayers towards pesticide use and their residues on the vegetables grown in greenhouses. Fourteen farms were selected, and a structured questionnaire was used to interview 20 applicators. The results revealed that the ages of all interviewed pesticide's sprayers were ranging between 25 and 45 years old. Their education levels were 30% primary school, 25% high secondary school, 30% university graduates, and 5% illiterates. A hundred percent of the respondents received training on pesticide handling, 80% knew that pesticides are very harmful, 20% mentioned that they are moderate harmful to the human health, and 75% did not know that the pesticide's residues may remain on the vegetables after application. Seventy percent of them followed the instructions written on the bottle label or packet, whereas 25% were following the instructions on the label and the engineer, and 5% were following only the instructions of the engineer. Fortunately, the whole pesticide's sprayers interviewed were using personal protective equipment (PPE) during spraying the pesticides to reduce occupational exposure to pesticides. The greater part (95%) of them did not smoke, eat or drink water during pesticides use, while only one (5%) did not answer. But unfortunately, all of them had demonstrated poor practices of disposing of empty pesticide's containers. Also, 55% were spraying twice a week, 20% once a week, 20% day after day and (5%) others. In addition, 40% were collected their vegetables three days after spraying, 30% two days after spraying while 30% others irrespective to the instructions of the labels. The study concluded that there is a great risk to the consumers' health and to the environment in short and long-term and recommended to Ministry of Agriculture and Ministry of Health to conduct thorough training and health education programs for pesticides' sprayers of greenhouse farms, along with close supervision and monitoring of pesticides residues level on vegetables in order to reduce the potential health risks to the farm workers and consumers.**

Keywords: **Knowledge; attitudes; practices; Pesticide Residues; Vegetables; Greenhouses; Sudan.**

1. INTRODUCTION

Food safety problems caused by pesticide residues in vegetables have become one of the top issues of public interest (1). However, in many developing countries, there are still reports of high incidences of contamination and poisoning of pesticide users, agricultural workers, and bystanders. These incidences are unnecessary and unacceptable. Among the public, there are food safety concerns related to pesticide residues. This is reflected in a growing consumer demand for safe food, not only in developed countries but increasingly also in developing countries (2). Pesticide residue refers to the

pesticides that may remain on or in food after they are applied to food crops (3). The levels of these residues in foods are often stipulated by regulatory bodies in many countries. Exposure of the general population to these residues most commonly occurs through consumption of treated food sources or being in close contact to areas treated with pesticides such as farms or lawns around houses (4). Many of these chemical residues, especially derivatives of chlorinated pesticides, exhibit bioaccumulation which could build up to harmful levels in the body as well as in the environment (5).

Pesticides applied to food crops in the field can leave potentially harmful residues. Organochlorine pesticides, in particular, can persist in foodstuffs for a considerable period. If crops are sprayed shortly prior to harvest without an appropriate waiting period, even organophosphate residues can persist up until the food is in the hands of the consumer (6). Though it is sometimes thought that residues are destroyed if food is properly washed and cooked, this is not always the case. Washing and cooking may reduce pesticide residues in food; boiling may remove only 35-60% of organophosphate residues and 20-25% of organochlorines (7). Residues above tolerance limits do occur in cooked food. Consumption of contaminated food is an important route of human exposure to pesticide residues and may pose a public health risk (8). Consequently, pesticide exposure can cause a variety of human health problems, both chronic and acute in both farmers and consumers. Chronic effects are typically the result of low levels of exposure over a long period of time even if there are no acute or immediate effects. Major health impacts from chronic exposure include cancers, reproductive and endocrine disruption, neurological damage, and immune system dysfunction (9, 10, 11). The World Health Organization (WHO) and the United Nations Environment Program estimated that nearly 4.0 million people suffer from severe pesticide poisoning and its rate is 2-3 per minute, with approximately 20,000 workers dying from exposure every year, the majority in developing countries (12, 13, 14, 15, 16).

In addition, consumers are subjected to or affected by various types of food-borne diseases associated with pesticide contamination. It is well documented that a major portion of the pesticides is intercepted by the plant leaves during application. Vegetables such as tomatoes, country beans, cabbage, cauliflower, and cucumber may receive higher doses of pesticides (17). As a result, pesticide residues remain in the vegetable though not documented how much active material could be imminent in vegetables even after they are washed and cooked (18, 19). For better production and aesthetic value, farmers are using a large number of insecticides during the entire period of growth of vegetables, even at fruiting stage and sometimes farmers also ignored the recommended waiting period between the harvest and last spray. Owing to this and other injudicious practice related to pesticide usage, pesticides become the inner part of vegetable in the shape of residues, which could be used by consumers thus creating health hazards (20, 21).

The WHO recommends that pesticides should only be used when the benefits outweigh the risks. Users should avoid cosmetic or scheduled use of pesticides in the home, and use integrated pest management (IPM), non-chemical pest controls if pesticides are necessary, store in original containers with child-proof seals out of reach in a locked cabinet, get educated on the safe use of pesticides, follow manufacturer's instructions, and use protective equipment (22).

In Sudan, vegetables are grown extensively and constitute a large portion of the diet of the average Sudanese. Vegetables are essential for a healthy and balanced diet, as well as adding variety, interest, and flavour to the menu. But vegetables also attract a wide range of pests and diseases and require intensive pest management. Therefore, this study is aiming to assess the knowledge, attitude, and practice of pesticide's sprayers towards pesticide residues on the vegetables grown in the greenhouses.

2. METHODS AND MATERIALS

2.1. Study area/setting:

Khartoum state vests the capital of Sudan and it is the largest state population wise. The estimated population of the state is 7,413,239 inhabitants. The state is administratively divided into seven localities. It is bordering with Gazira and White Nile States in the south, Northern State and River Nile in the north, Gedaref and Kassala States in the east and North Kordofan in the west. Both Blue Nile and White Nile congregate to form the River Nile in the state. The population depends on government employment, trade and agriculture. Quite a sizable number of people migrate to the capital from all other states. The state is heavily busy with mixed farming along the Nile banks and in rural artificially irrigated huge areas. The usual diet in Khartoum depends very much on different varieties of vegetables which are mostly grown in Khartoum State and nearby areas of other states.

2.2. Sample size and sampling technique:

The desired sample size was calculated through the following equation:

$$n = \frac{N}{1 + e(N - 1)}$$

Where:

n = the required sample size

N = the total population (49 farms)

e = error allowed by using (95%) confidence level = 0.05.

By substituting the given values of N and e in the equation; then:

n = 49/ 1+ (0.05) * (49 – 1) = 14.4, by rounding then n = 14 farms.

For distributing the desired sample size (selected farms between the localities of Khartoum state), the proportion according to the magnitude of each locality from the total population had been used as shown in Table1.

Table 1: Distribution of the Samples by Localities

Locality	No. of Farms	No. of Samples
Umbada	17	5
Omdurman	3	1
Karri	2	1
Sharg Elneel	5	1
Bahri	12	3
Jabal Awliya	8	2
Khartoum	2	1
Total	**49**	**14**

All farms of each locality had been listed and given serial numbers, and then by using simple random sampling technique, 14 farms had been selected as shown in Table 2.

Table 2: Selected Farms by Localities

District	Farm Name
Bahri	Khartoum Bank (Abu Haleima)
Bahri	AlHai'a Al Arabia
Bahri	Khartoum University
Jebel Awliya	Ziyada
Jebel Awliya	Mohamed Khidir
Karari	Eltiseen
Khartoum	Mohamed S.Elhag
Sharq Elneel	Elzawaya
Umbada	Elsha'er
Umbada	Amir Mustafa
Umbada	Younis Ahmed Younis
Umbada	Mu'awia Elbirair
Umbada	Mazin Esamu Eldein
Umdorman	Elwalda

A structured questionnaire was used by the trained data collectors (Public Health Officers) for interviewing 20 pesticide's sprayers found during the visit of each farm. This was done in each farm and it took about 20 to 30 minutes for each sprayer.

3. DATA MANAGEMENT AND ANALYSIS

3.1. The study variables:

Background Information: Age, educational level and income per month besides types and names of pesticide used, Level of pesticide used, methods of pesticide application, intervals of pesticides spraying, periods of vegetable collection (pre-harvest period) after using pesticides, and the practices of farmers regarding the protective measures taken during and after using pesticide and smoking, drinking and eating during pesticides use.

3.2. Data and Samples' Collection Tools:

The team had used the following data collection tools

Well-structured questionnaire of close-ended and opened questions had been used for each farmer. The questionnaire had been tested during the training of the data collectors and the needed corrections in content or language had been inserted.

The data collection team was composed of the following people

Two data collectors: two public health officers filled the structured questionnaire.

A supervisor: a senior public health officer who supervised and monitored the data collectors and revised the questionnaires to ensure that all questions had been answered and filled properly.

Training of data collectors

Data collectors were selected carefully from experienced public health officers and a senior public health officer was assigned as a supervisor.

All data collectors and the supervisor have been trained for two days theoretically and practically on the contents of the questionnaires and a field test of the questionnaire was conducted.

3.3. Data Entry and Analysis

All filled questionnaires have been checked and revised by the supervisor and data had been entered and analysed by an expert statistician using SPSS software version 16. Tables and charts have been used to present the results. Chi-square tests had been used to examine the relationship between independent variables and the outcomes of interest in the bi-variants analysis. The results of the relationship with $P < 0.05$ were considered statistically significant.

4. RESULTS AND DISCUSSION

This study was conducted in 14 greenhouse farms in seven localities of Khartoum State, Sudan. The ages of all (100%) pesticide's sprayers interviewed were ranging between 25 and 45 years old (Table 3). A similar study in West Bank, Palestine (23) reported that 30.4% of the participants were aged between 30 and 39 years; also similar results were found by other researchers in other countries (24, 25).

Table 3: Age groups of vegetable farm workers in Khartoum State 2016

Age	Frequency	Percentage
25 - 45 years	20	100.0

Regarding the educational level of the pesticide sprayers, the study found that 30% had primary school education, 25% high secondary school education, 30% university graduates, 5% were illiterates, and 10% did not answer (Figure 1). The education level of the pesticide sprayers in this study is higher than that reported by the recent study conducted in Bahri locality of Khartoum state (26) which found that half of greenhouse workers (49%) had finished only their primary school which may lead to poor understanding of the health impact of pesticides on human and environment and their dealing with pesticides. Also, it was found that this level of education is better than the educational background of the farm workers reported by similar studies in other developing countries (23, 24, 27, 28, 29). Farm workers with little formal education might be at higher risk when using pesticides, possibly due to difficulties in understanding the use instructions and safety procedures included on the product labels (23).

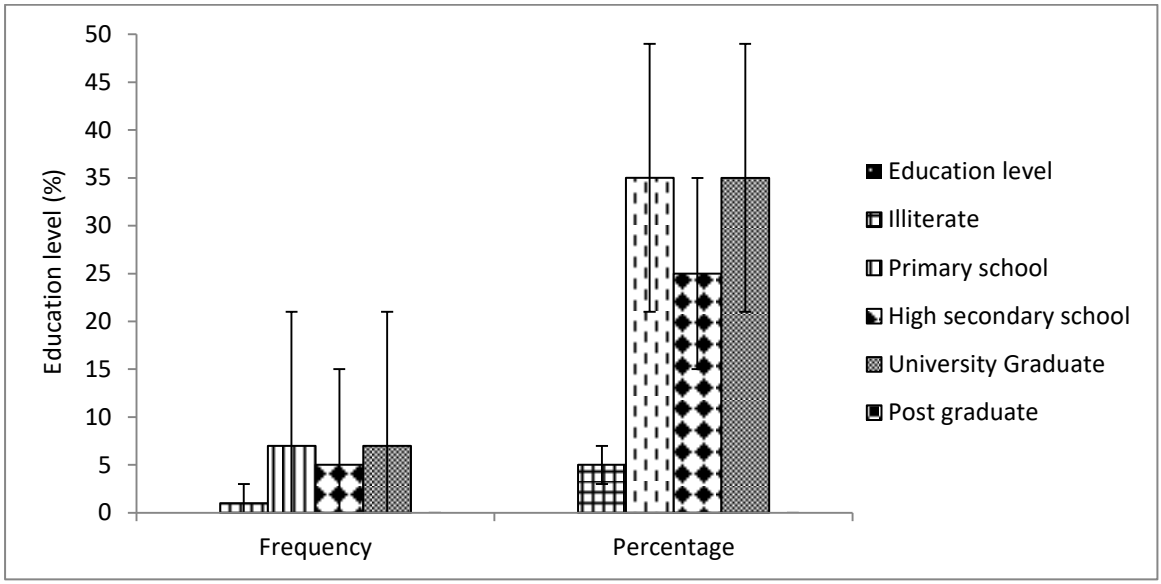

Figure 1: Education level of vegetable farm workers in Khartoum State (N=20)

The results in Table 4 showed that all (100%) sprayers were using insecticides and Fungicides while only (10%) were using Herbicides beside the insecticides and Fungicides. Most (70%) of sprayers followed the instructions written on the bottle label or packet, (25%) of them were following the instructions on the label and the instructions of the engineer while (5%) were following only the instructions of the engineer. These findings were in agreement with the study conducted in West Bank, Palestine (23) which indicated that the majority (71.4%) of the participants stated that they read the labels on the pesticide containers, and 49.9% of the participants stated that they followed the label instructions.

Table 4: Types of pesticides used by sprayers of Greenhouses in Khartoum State, (N=20)

	Insecticides		**Herbicides**		**Fungicides**		**Total**	
Locality	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
Omdurman	1	5.0	0	0.0	1	5.0	1	5.0
Umbada	7	35.0	2	10.0	7	35.0	7	35.0
Karari	1	5.0	0	0.0	1	5.0	1	5.0
Khartoum	2	10.0	0	0.0	2	10.0	2	10.0
Jebel Awlia	3	15.0	0	0.0	3	15.0	3	15.0
Bahri	4	20.0	0	0.0	4	20.0	4	20.0
Sharq Elneel	2	10.0	0.0	0.0	2	10.0	2	10.0
Total	**20**	**100.0**	**2**	**10.0**	**20**	**100.0**	**20**	**100.0**

Table 5 demonstrated that 14 (70%) of sprayers mixed the pesticides according to the instructions on the label/package, 1 sprayer (5%) followed the instructions of the engineer, while 5 (25%) of them mixed the pesticides according to the instructions on the label/package and instructions of the engineer.

Table 5: Level of Pesticide used as mentioned by sprayers, Khartoum State, 2016 (N=20)

Level of Pesticide		**Frequency**	**Percentage**
1.	According to label / package	14	70.0
2.	According to engineer's guidance	1	05.0
3.	Both (1&2)	5	25.0
Total		**20**	**100.0**

In respect to the frequency of spraying the pesticides on the vegetables and the interval of their collection after spraying were presented in Figure 2 and Table 6. The results explained that 55% of sprayers were spraying twice a week, 20% of them once a week, 20% were spraying day after day and (5%) others. Also, the results indicated that about 40% of them

collected their vegetables three days after spraying, 30% two days after spraying while 30% others. Moreover, there was a significant association between frequencies of spraying the pesticides on the vegetables and collection period after spraying (X^2 =14.286, p 0.0001). According to this result, these poor practices of spraying the vegetables more frequently and harvesting the vegetables in shorter period did not comply with the instructions on the bottles of the pesticides, although 95% of sprayers mentioned that they are following these instructions. Therefore, these practices may lead to a high concentration of pesticides' residues on the vegetables thus pose a serious risk to consumers' health.

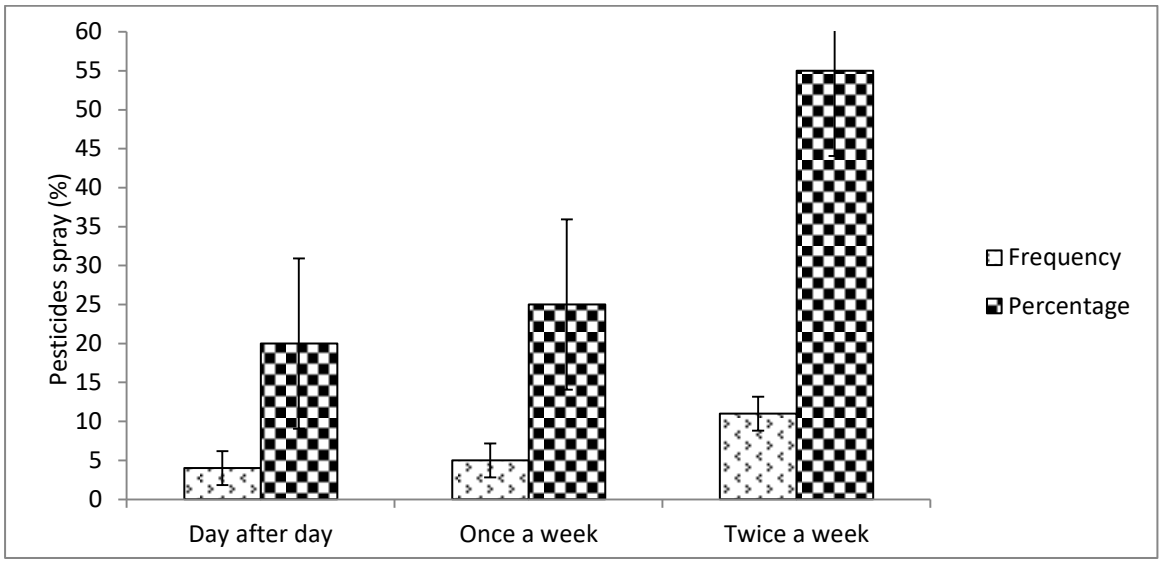

Figure 2: Interval of Pesticide spraying on vegetables in Khartoum State, (N=20)

Table 6: Periods of vegetable collection after pesticides spray in Khartoum State, (N=20)

Periods of vegetable collection	Frequency	Percentage
Two days after	6	30.0
Three days after	14	70.0
Total	**20**	**100.0**

Generally, a **75%** of the pesticides' sprayers in this study did not know that the pesticides residues may remain on the vegetables after the application while only 25% knew that the pesticides residues may remain on vegetables after the application. These findings partially agreed with a similar study conducted Kishi et al (26) in Bahri locality which found that the majority of responders (56%) knew that the pesticide residue may be found in the soil, followed by 49% thought that residues are found in vegetable and fruits, then 38% of them thought residues may be found in the air.

When tested, the association between the education levels of those sprayers and their knowledge towards pesticides residues on vegetables, it was found statistically not significant [X^2 (3, N =20) = 2.079, p 0.668].

Table 79: Knowledge of Sprayers about the pesticides residues in vegetables after application of the pesticides in Khartoum State, 2016 (N=20)

Knowledge of Sprayers	Frequency	Percentage
Yes	5	25
No	15	75
Total	**20**	**100**

The results in Figures 3 and 4 revealed that all (100%) sprayers interviewed were using all personal protective equipment (PPE) during spraying the pesticides to reduce occupational exposure to pesticides (overalls: 100%, gloves: 100, eyeglasses: 100%, face mask: 95% and boots/ shoes: 95%). Results also shows95% of them were taking bath (shower) after spraying the pesticides while only one (5%) was washing his hands and face by soap after spraying pesticides. These findings are in agreement with Zyoud et al. (23) that indicated: use of appropriate PPE, such as coveralls, and the adoption of other protective measures and good personal hygiene such as showering, not smoking, eating or drinking while

handling pesticides are considered good practices to reduce occupational pesticide exposure. But these findings disagreed with the results of the study conducted by Kishi et al. (26) indicated that more than half (53%) of the responders were found not wearing the PPDS; the reason was referred to that most of workers thought the PPDS are not comfortable, others said not allowable.

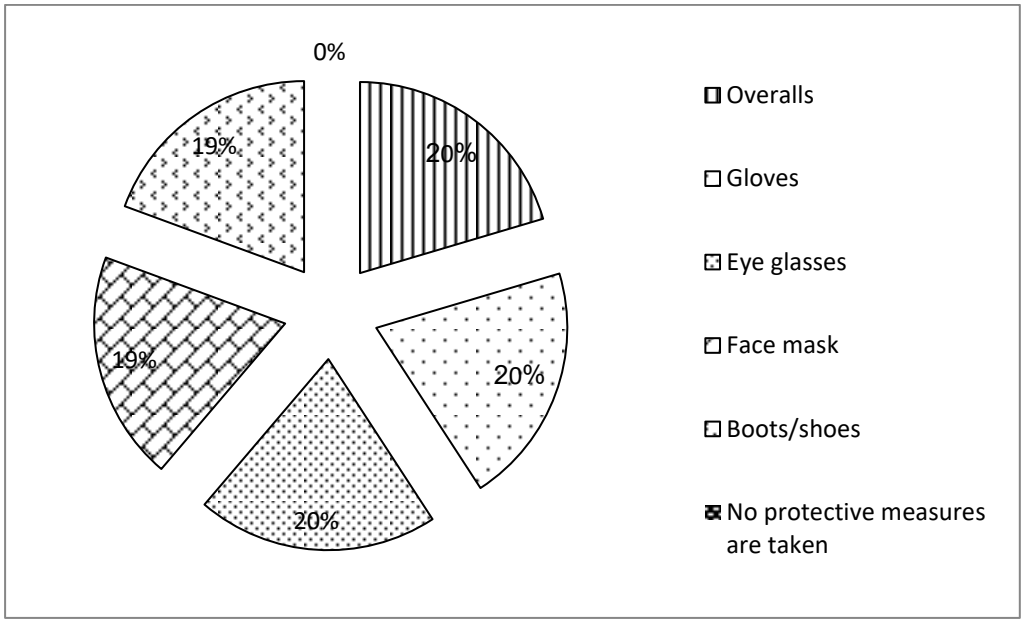

Figure 3: Protective measures used during spraying pesticides on vegetables in Khartoum State, (N=20)

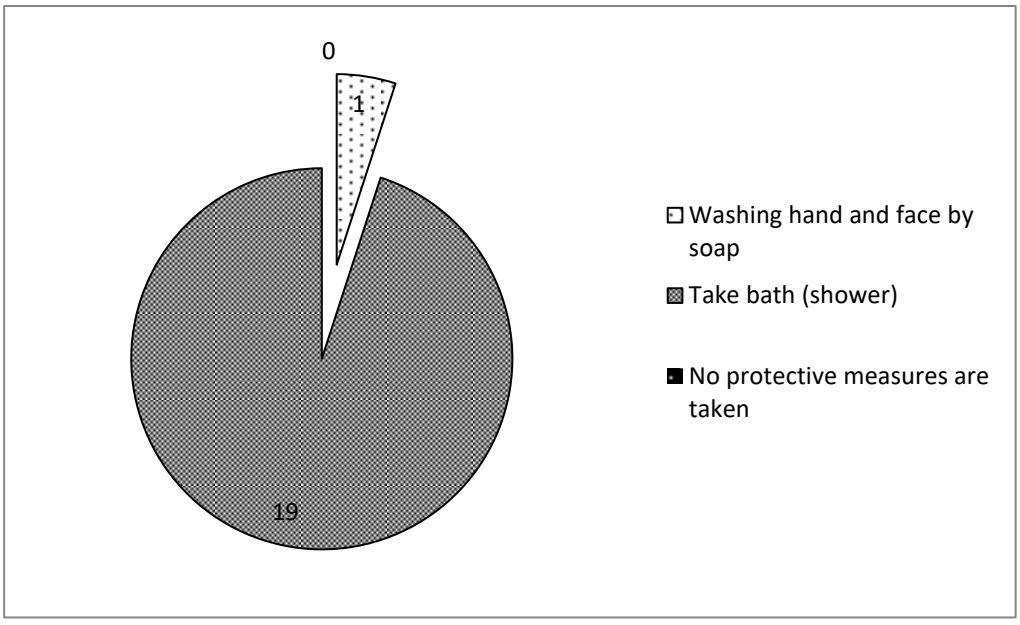

Figure 4: Protection measures taken by sprayers after spraying pesticides in Khartoum State, (N=20)

Table 8 illustrated results of practices while spraying. When the respondents had been asked about smoking, eating or drinking water during pesticide use**,** all (100%) of the pesticide' sprayers were found not smoking, eating or drinking water during pesticides use. This finding agreed with the study of Ekram A. Eldoom et al. (26) which found no one of responders practiced smoking or eating or drinking during spraying pesticides. Also, it agreed with (30, 31) which stated that the basic steps to reduce health effect of pesticides is to not smoke or eat during spraying pesticides. However, the findings of this study disagree with Mekonnen and Agonafir study in Ethiopia (32), they found that most of the sprayers either ate drank or smoked during pesticide work. Also, a similar behaviour was reported by Gomes et al. (33) that 63% and 46% drank and ate while at work respectively. Such an attitude contributes to the total body burden of pesticide.

Table 8: Smoking, drinking water and eating during pesticides use in Khartoum State, 2016 (N=20)

Smoking, drinking water and eating during work	Frequency	Percentage
Smoking	0	0.0
Drinking water	0	0.0
Eating	0	0.0
Nothing	20	100.0
Total	**20**	**100.0**

The study found that most (80%) of the sprayers knew that the pesticides are very harmful to the environment and community health while only 20% mentioned that they are moderate harmful (Table 9). These findings are similar to the study of Ekram A. Eldoom et al. (26) which showed that 85% of responders knew the pesticides have health impact or effect on human health. When tested, the association between the education level of the pesticide' sprayers and their knowledge about the harmfulness of the pesticides and their residues to the environment and community health, it was found statistically significant [X^2 (3, N =20) = 2.339, p 0.032].

Table 9: Knowledge regarding harmfulness of pesticides among vegetable farm workers in Khartoum State (N=20)

Knowledge regarding harmfulness of pesticides	Frequency	Percentage
Moderate harmful	4	20.0
Very harmful	16	80.0
Total	**20**	**100.0**

Regarding the disposal of the pesticides empty containers, it was found that 75% of pesticides' sprayers had disposed of the empty containers of the pesticides by burning them, 15% throwing them in open space, while 10% burning and threw them in the open space (Figure 5). These poor practices were found in a similar study in Lebanon (34) that the proportion of good practice represented only 41.2% of subjects' habits (digging special holes, incineration). The majority of subjects would discard pesticide container wastes into the environment (soil or water) (40%) or with other trash (27%).

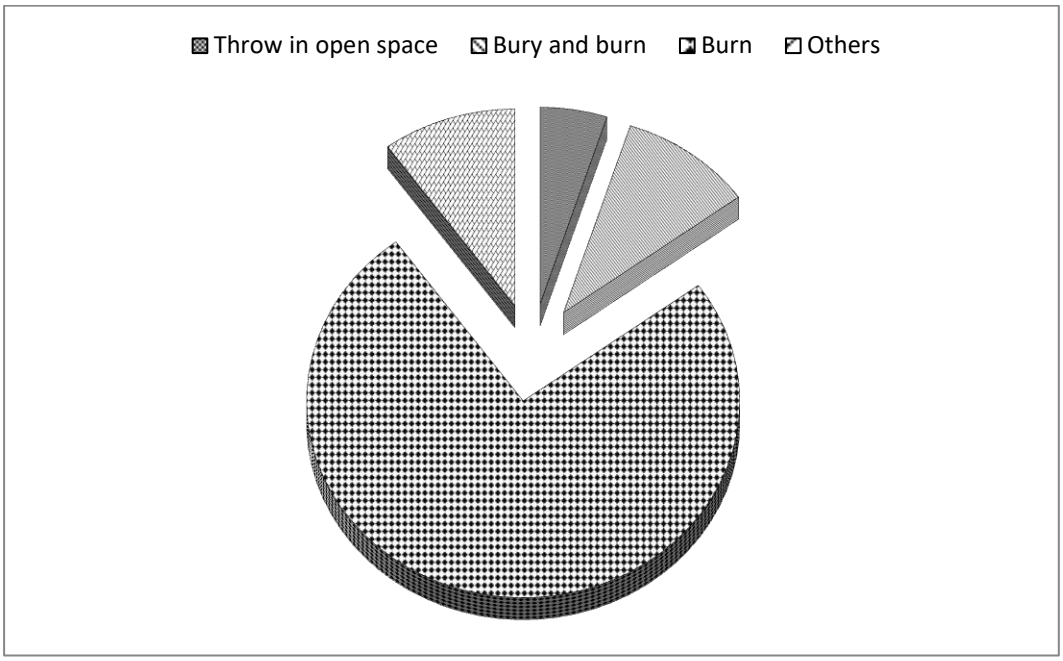

Figure 5: Disposal of pesticides containers in Khartoum State, (N=20)

Result in Table 10 showed that all (100%) pesticides' sprayers had received training or orientation on pesticides use and handling from the Ministry of Health or Ministry of Agriculture. These findings disagreed with the recent study conducted in Bahri locality (26) which showed that 61% of respondents have not received any training on how to use and handle pesticides which might lead to the harmful effect of pesticides to the sprayers.

Table 10: Did you receive training or orientation regard pesticides handling, (N=20)

Received training	Frequency	Percentage
Yes	20	100.0
NO	0	0.0
Total	**20**	**100.0**

5. CONCLUSION

Most of the pesticide sprayers interviewed in the study area had a sufficient level of knowledge regarding pesticide use, handling, and using personal protective equipment (PPE). The majority (95%) of them were found not smoking, eating or drinking water during pesticides use. On the other hand, **75%** of them did not know that pesticides residues may remain on the vegetables after the application and demonstrated poor practices regarding spraying the pesticides on vegetables more frequently and collecting the vegetables in very short periods irrespective to the recommended pre-harvest periods. It is recommended to the Ministry of Agriculture and Ministry of Health to conduct rigorous training and health education programs for pesticides' sprayers of greenhouse farms along with close supervision and monitoring of pesticides residues level on vegetables in order to reduce the potential health risks to the farm workers and consumers.

ACKNOWLEDGEMENTS

We are very grateful to farm's owners, data collectors, their supervisor and all pesticide's sprayers who participated in this study.

Conflict of interest:

The authors have declared no conflict of interest.

REFERENCES

[1] Zhang Y, LI X,, Liu H,, Zhang Y,, Zhao F,, YU Q,, LI H, and Chen J.. (2013). Study on universal cleaning solution in removing blended pesticide residues in Chinese cabbage. Journal of Environmental Chemistry and Ecotoxicology.

[2] FAO (2010). Food and Agriculture Organization of the United Nations (FAO), International Code of Conduct on the Distribution and Use of Pesticides, Guidance on Pest and Pesticide Management Policy Development. Available: http://www.fao.org/3/a-a0220e.pdf.

[3] IUPAC (2006). *Compendium of Chemical Terminology*, 2nd ed. (the "Gold Book") (1997). Online corrected version: (2006) "pesticide residue".

[4] "Pesticide Residue". Environmental Protection Agency.

[5] Walter JC. (2009). "Chlorinated Pesticides: Threats to Health and Importance of Detection". *Environmental Medicine.* 14 (4): 347–59. PMID 20030461.

[6] Stephen W.C.C, Benedict L.S. C. (2011). "Determination of organochlorine pesticide residues in fatty foods: A critical review on the analytical methods and their testing capabilities". *Journal of Chromatography A.* 1218 (33): 5555–5567. doi:10.1016/j.chroma.2011.06.066. PMID 21742333.

[7] Bull D. (1992). *A growing problem: Pesticides and the Third World poor.* Oxford: OXFAM.

[8] MacIntosh D.L., Spengler J.D., Ozkaynak H., Tsai L., Ryan P.B. (1996). Dietary exposures to selected metals and pesticides. *Environmental Health Perspective,* 104, 202-209.

[9] EPA US. (2007). Pesticides: Health and Safety, National Assessment of the Worker Protection Workshop #3, August 30, 2007.

[10] Available at: http://www.epa.gov/pesticides/health/human.htm

[11] Moses M. (1999). Pesticides killers in our midst, in Nair K P. (Eds) Warning: Pesticides are Dangerous to Your Health, (Penang: Pesticide Action Network Asia and the Pacific).

[12] Sanborn M., Kerr K.J., Sanin L.H., Cole D.C., Bassil K.L., Vakil C. (2004). Systematic Review of Pesticide Human Health Effects, Toronto: Ontario College of Family Physicians Toronto. Canadian Family Physician. 53: 1712-1720.

[13] Kishi M., Hirschhorn N., Qjajadisastra M., Satterlee L. N., Strowman S. Dilts R. (1995). Relationship of pesticide spraying to signs and symptoms in Indonesian farmers, Scandinavian Journal of Work & Environmental Health 21: 124-133.

[14] Pimental D., Acquay H., Biltonen M. (1992). Environmental and economic costs of pesticide use, Bioscience 42:750-60.

[15] Rosenstock L., Keifer M., Daniell W.E., McConnell R., Claypoole K. (1991). Chronic central nervous system effects of acute organophosphate pesticide intoxication, Lancet 338: 223-227.

[16] Sarker M.M.R., Alam M.S., Akthar N. (2002). Pesticide use in Modern Rice Production: The Issue of Farmers Health and Environment, in Ahmed MF et al. (Eds), Bangladesh Environment 2002, (Bangladesh Paribesh Andolon (BAPA), Dhaka, 2002), Vol-1.

[17] WHO (1990). Public health impact of pesticides used in agriculture, World Health Organization: New York, USA,.

[18] Ali S, Rahman M., Hossain A. (2002). Pesticide use and male fertility in Bangladesh, in Ahmed M F. et.al, (Eds), Bangladesh Environment, (Bangladesh Paribesh Andolon (BAPA), 2002), Vol-1.

[19] Kabir K.H., Rahman M.A., Ahmed M.S., Prodhan M.D., Akon M.W. (2008). Pesticide analytical research at BARI related to quality, residue and maximum residue limit, in Chowdhury, MKA et al. (Eds), Proceedings of Workshop on Maximum Residue Limits of Pesticides in Agricultural Commodities and Food in Bangladesh, (Bangladesh Agricultural Research Council, Dhaka).

[20] Rahman A et al. (eds.). (2001). Poison in the field, in Peoples Report on: Bangladesh Environment, (The university press limited, Dhaka, Vol-I.

[21] Pakistan (2008). Economic Survey of Pakistan, (2007-08). Economic Affairs Advisors Wing, Finance Division, Government of Pakistan, Islamabad.

[22] Agnihotri N.P. (1999). Pesticide safety evaluation and monitoring, Published in All India-coordinated Research Project on Pesticide Residues, Division of Agricultural Chemicals, Indian Agric. Res. Institute.

[23] WHO (2008). Training for the health Sector (Pesticides) WHO. Geneva.

[24] Zyoud S.H., Sawalha A.F., Sweileh W.M., et al. (2010). Knowledge and practices of pesticide use among farm workers in the West Bank, Palestine: safety implications. *Environmental Health and Preventive Medicine*.;15(4):252-261. doi:10.1007/s12199-010-0136-3.

[25] Recena M.C., Caldas E.D., Pires D.X., Pontes E.R. (2006). Pesticides exposure in Culturama, Brazil knowledge, attitudes, and practices. Environ Res.; 102(2):230–6.

[26] Atreya K. (2007). Pesticide use knowledge and practices: gender differences in Nepal.Environ Res. 104(2):305–11.

[27] Ekram A. Eldoom et al. (2015). Knowledge, Attitudes and Practices (KAP) of Workers in Vegetable Greenhouse toward Peptides in Bahri Locality. Khartoum State. Sudan

[28] Hurtig A.K., San Sebastián M., Soto A., Shingre A., Zambrano D., Guerrero W. (2003). Pesticide use among farmers in the Amazon basin of Ecuador. Arch Environ Health.; 58(4):223–8.

[29] Oliveira-Silva J.J., Alves S.R., Meyer A., Perez F., Sarcinelli P.N., da Costa Mattos R.C., (2001). Influence of socioeconomic factors on the pesticides poisoning, Brazil. Rev Saude Publica.; 35(2):130–5.

[30] Mekonnen Y., Agonafir T. (2002). Pesticide sprayers' knowledge, attitude and practice of pesticide use on agricultural farms of Ethiopia. Occup Med.52(6):311–5.

[31] WHO (2010). International Code of Conduct on the Distribution and Use of Pesticides. Guidelines for the Registration of Pesticides. World Health Organization. Rome, Italy.

[32] WHO (1995). Vector Control for Malaria and Other. Mosquito Borne Diseases, WHO Tech. Rep. Ser. 857. Geneva. Available at: http://www.bigberkeywaterfilters.com/blog/pesticide/pesticides-implicated-as- source-of-human-norovirus.

[33] Mekonnen Y. and Agonafir T. (2002). Pesticide sprayers' knowledge, attitude and practice of pesticide use on agricultural farms of Ethiopia. Occupational medicine (Oxford, England).

[34] Gomes J., Lloyd O.L., Revitt D.M. (1999). The influence of personal protection, environment hygiene and exposure to pesticides on the health of immigrant farm workers in a desert country. Int Arch Occup Environ Health; 72: 40–45

[35] Salameh P.R., Baldi I., Brochard P., Abi Saleh B. (2004). Pesticides in Lebanon: acknowledge, attitude, and practice study. Environ Res.; 94(1):1–6.