Original Article

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Knowledge and Practices of Safe Use of Pesticides among a Group of Farmers in Northern Iran

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Abstract

Background: The unsafe use of chemical pesticides, along with the lack of appropriate preventive protocols and equipment may damage the health of users.

Objective: To determine the knowledge and practice of the safe use of chemical pesticides by farm workers in northern Iran.

Methods: The present cross-sectional study was conducted on 300 farmers in Mazandaran province, in 2017. The data collection instrument was a two-part questionnaire: The first part was concentrated on demographic and agricultural characteristics of the participants; the second part dealt with the farmers' knowledge and practice of the safe use of pesticides.

Results: The mean knowledge and practice scores (out of 100) of the participating farmers in the safe use of pesticides were 84.8 (SD 13.5) and 50.8 (13.2), respectively. There was a significant positive correlation (r=0.466, p<0.001) between their knowledge and practice. Wearing protective clothes, while applying pesticides, was among safe practices. Although more than 60% of farmers had a sufficient level of knowledge of the safe use of pesticides, they did not implement their knowledge in practice. There was a significant (p<0.001) association between the education level and knowledge of the safe use of pesticides.

Conclusion: There was a significant correlation between knowledge and practices of the safe use of pesticides among farmers in northern Iran. There was a clear know-do gap—although the majority of the participants possessed a sufficient level of knowledge of the safe use of pesticides, they did not implement it in practice.

Keywords: Health knowledge, attitudes, practice; Knowledge; Safety; Pesticides; Farmers

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Introduction

Nowadays, there is a growing use of pesticides for agricultural purposes. Although the use of pesticides is an integral part of the eradication of agricultural pests, they exert adverse effects on all kinds of organisms, including human.[1] Various studies have warned against the high risk of poisoning, abortion, dermal and nervous system complications, cancer, and even mortality associated with use of pesticides.[2-5]

Diseases caused by exposure to pesticides may even influence the productivity of farmers' family, as the main workforce in the agriculture sector. Besides, such diseases may impose huge financial bur-

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Received: Oct 1, 2018
Accepted: Mar 5, 2019

Cite this article as: Taghdisi MH, Amiri Besheli B, Dehdari T, Khalili F. Knowledge and practices of safe use of pesticides among a group of farmers in northern Iran. *Int J Occup Environ Med* 2019;**10**:66-72. doi: 10.15171/ijoem.2019.1479

den on health and insurance organizations because of the farmers' lack of sufficient knowledge of the harmful effects of unsafe use of chemical pesticides on human health and environment.[6]

The World Health Organization (WHO) has estimated 1–5 million cases of poisoning and nearly 20 000 deaths among farmers and agricultural workers per year, caused by chemical pesticides. In other words, the poisoning caused by pesticides is regarded as the most prevalent hazard to farmers.[7] According to the WHO, more than half of the pesticides available around the world are consumed in developing countries. The people living therein are also the major victims of the unsafe use of these pesticides.[8] A study conducted by Aghilinejad in five cities in different provinces of Iran indicates that nearly 6% of the farmers refer to clinics for the unsafe use of pesticides and are even hospitalized.[9]

Hazards from exposure to pesticides can be resulted from improper use of highly toxic substances, lack of adherence to preventive principles, lack of protective measures, or use of defective protective equipment during exposure to chemical pesticides.[10]

A study on 381 farms in Palestine shows that most of the farmers have a low level of knowledge of safe pesticide use. They also do not take enough protection measures, which may expose them to higher risks. In this study, less than half of the participants stated that they followed the label directions.[7] In another study on 335 farmers in Egypt, the results indicate that around 67% of the farmers do not follow label directions and more than 90% of them do not put on mask and other protective clothes.[5] A study conducted on 1279 farmers in Iran revealed that the studied farmers had a low level of knowledge of safe use of pesticides and their potential side effects, which could affect their health condition; only 25% of the studied farmers could understand label directions attached to the pesticide container; 86% of them did not use any protective equipment while working with pesticides.[9]

Since the use of pesticides is inevitable, particularly by low-income farmers in developing countries, it is of paramount importance they understand the associated hazards; nevertheless, many farmers do not.[6] We therefore conducted this study to measure the level of knowledge and practice of the safe use of chemical pesticides among a group of farmers in northern Iran.

For more information on pesticide exposure and stunting among children in agricultural areas see http://www.theijoem.com/ijoem/index.php/ijoem/article/view/1428

Materials and Methods

The present cross-sectional study was conducted on 300 farmers in Mazandaran province, northern Iran, in 2017. The sample size was estimated using the Cochran formula (n=1350, d=0.05). A multistage sampling method was used. First, the *Panbezarkatti* Center was selected from seven agricultural centers, affiliated to the Agricultural Jihad Organization, Sari, using randomized cluster sampling. Then, the participants were selected from 68 villages covered by this center using a systematic random sampling. After collecting the names and phone numbers of the participants, and their villages, the researcher visited the eligible participants and filled in the research questionnaire.

The inclusion criteria were willingness to participate, aged 20–70 years (the active age group of farm workers in the given region), lack of learning disability, and full-time or part-time farm workers. The exclusion criterion was unwillingness to participate in the study.

We used a two-part questionnaire designed based on the literature results. The first part included demographic information and agricultural characteristics; the second part dealt with the knowledge and practices of the safe use of chemical pesticides. The first part included two items

on the safe use of pesticides, the associated diseases, and use of protective equipment. The items were supposed to be responded by "yes" or "no." If the answer was "yes," the participant was asked to explain more. The second part included 15 items to measure the knowledge on the safe use of chemical pesticides. Items in the second part should be responded with "true," "false" or "I don't know." Items responded with "true" were scored '1' (correct); "false" or "I don't know" was scored '0' (incorrect). To investigate the implementation of safe practices, 15 two-point items anchored by '1' ("acceptable," taking safety measures) and '0' ("unacceptable," not taking safety measures) were used. The total scores of the participants (out of 100) indicated the level of their knowledge and practices of safe use of pesticides. The participants' level was then classified according to their scores as follows: "Poor" (score 0–25), "moderate" (26–50), "good" (51–75), "excellent" (76–100).

The validity and reliability of the questionnaire used were evaluated. The content validity was evaluated based on the opinions of eight specialists in the fields of agricultural toxicology, health education, and professional health to measure the extent to which the contents were consistent with research objective. For quantitative assessment of the content validity, the relative coefficients of content validity (CVR > 0.7) and content validity index (CVI = 0.8) were calculated for each items. Results confirmed the content validity of the items. In addition, the reliability of the questionnaire was measured—Cronbach's α >0.75.

Ethical Considerations

This study was approved by the Ethics Committee of Iran University of Medical Sciences. After obtaining the informed consent of the participants, the questionnaires were administered and completed.

Statistical Analysis

The collected data were analyzed using SPSS® for Windows® ver 22. Descriptive statistics included frequencies and percentages. χ^2 test was used to examine if there was a significant difference in the frequency of adopting safe practices between two groups with good and poor level of knowledge. One-way ANOVA was used to compare means among three or more groups. Pearson's correlation coefficient was used to assess the correlation between two variables. Multivariate linear regression was used to determine the independent predictors after adjusting for covariates. A p value <0.05 was considered statistically significant.

TAKE-HOME MESSAGE

- Use of pesticides by farmers is associated with several health conditions.
- There was a significant correlation between knowledge and the adoption of pesticide safe use practice.
- Although more than 60% of farmers had a sufficient level of knowledge of the safe use of pesticides, they did not implement their knowledge in practice—know-do gap.
- It seems that although knowledge is necessary, it is not enough for adopting safe practices.

Results

The mean age of the participants was 47 (SD 11.3) years. The median field's surface area was 1.0 (IQR 0.6 to 2.0) hectare. The participants had a median work experience of 25 (IQR 15 to 40) years. Less than a quarter (23.3%) of the participants were illiterate; 29.7% had high school degrees; and 47% had academic degrees. Nearly 13.7% of the participants had a history of diseases associated with use of pesticides; 65.7% of them used protective equipment,

Table 1: Frequency distribution, n (%), of safe pesticide use practice stratified by the level of knowledge

	Acceptable Practice		Unacceptable Practice		
	Knowledge		Knowledge		
Items	Correct	Incorrect	Correct	Incorrect	p value
Eating and drinking during pesticide application	225 (75.0)	0 (0.0)	57 (19.0)	18 (6.0)	<0.001
Smoking while spraying pesticide	231 (77.0)	0 (0.0)	49 (16.3)	20 (6.7)	<0.001
Storing pesticides in food cans	153 (51.0)	0 (0.0)	81 (27.0)	66 (22.0)	<0.001
Keeping pesticide containers for other uses	77 (25.7)	0 (0.0)	188 (62.7)	35 (11.7)	<0.001
Presence of children while spraying pesticide	208 (69.3)	0 (0.0)	79 (26.3)	13 (4.3)	<0.001
Taking products to market shortly after pesticide-spraying	150 (50.0)	0 (0.0)	106 (35.3)	44 (14.7)	<0.001
Spraying pesticide in rainy and windy weather	198 (66.0)	0 (0.0)	93 (31.0)	9 (3.0)	<0.001
Avoiding sprayed areas for 3–7 days	59 (19.7)	0 (0.0)	102 (34.0)	139 (46.3)	<0.001
Overusing pesticide	166 (55.3)	0 (0.0)	47 (15.7)	87 (29.0)	<0.001
Following label directions	213 (71.0)	0 (0.0)	77 (25.7)	10 (3.3)	<0.001
Washing hands and pesticide-contaminated equipment after use	194 (64.7)	0 (0.0)	98 (32.7)	8 (2.7)	<0.001
Burying or burning waste pesticides and empty containers	56 (18.7)	0 (0.0)	136 (45.3)	108 (36.0)	<0.001
Changing clothes after applying pesticide	229 (76.3)	0 (0.0)	59 (19.7)	12 (4.0)	<0.001
Putting on protective clothes while applying pesticides	26 (8.7)	0 (0.0)	233 (77.7)	41 (13.7)	0.034
Taking medical examinations in case of exposure to chemical pesticides (at the beginning of every crop year)	40 (13.3)	0 (0.0)	185 (61.7)	75 (25.0)	<0.001

such as mask.

The mean knowledge score (out of 100) of the studied farmers was 84.8 (SD 13.5); that of practice was 50.8 (SD 13.2). There was a significant ($p<0.001$) positive correlation between knowledge and practice scores ($r = 0.466$). Age had a significant ($p=0.029$) negative correlation with the practice score ($r = -0.126$). Those with a higher education level had a significantly ($p<0.001$) higher knowledge score—those with a university degree achieved higher mean score of "knowledge of the safe use of pesticides" (13.5 out of 15). All who had an acceptable safe pesticide use practice had correct knowledge about working with pesticides (Table 1). However, there were many farmers who in spite of having a good level of knowledge, did not consider the safety measures in practice (Fig 1).

None of the studied agricultural characteristics and demographic variables had a significant association with the "knowledge and practices of the safe use of pesticides."

Knowledge was one of the only independent predictors of the practice score and could explain 22% of the variance ob-

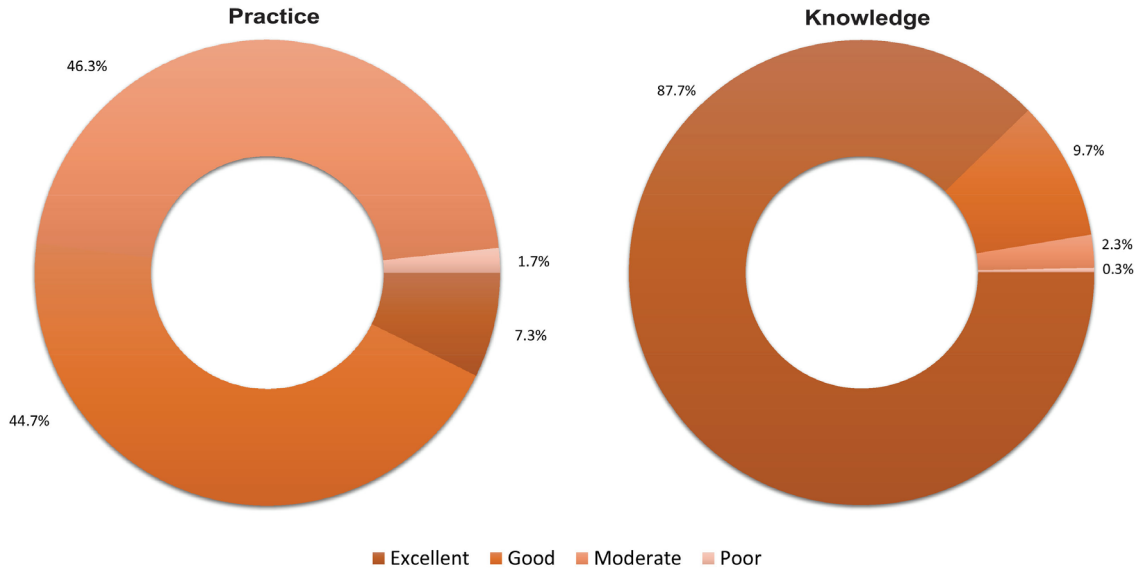

Figure 1: Distribution of knowledge and practice scores in studied farmers

served in the practice score (Table 2).

Discussion

We found that there was a significant correlation between knowledge and safe use practices of pesticides. It is expected that those farmers with a higher level of knowledge of the consequences of an unsafe use of pesticides practice differently handling pesticides, select low-risk pesticides, and consider frequent use of the protective equipment.[11] However, the present study reported unexpected results in taking safety measures: Using pesticide containers for other purposes, not putting on protective clothes while applying pesticides, and not taking medical examinations when exposed to chemical pesticides. Although the majority of the studied farmers had a satisfactory level of knowledge of the safe use of pesticides, they did not use what they knew in practice. The know-do gap among the studied farmers would be attributed to several reasons including cost of protective equipment or difficulty associated with their use. This finding was consistent with the results of studies conducted in Palestine, India and Nepal.[7,12,13] Unfortunately, the know-do gap is a major issue in most developing countries.[7]

Nearly half of the participants in the present study did not use any kind of protective equipment during pesticide application; the rest only used some protective equipment such as masks. The use of effective protective equipment is an important approach to avoid pesticide poisoning. This finding was consistent with the finding of Zare, *et al*,[14] who reported that approximately the same percentage of farmers in Fasa, southern Iran, do not use any kind of protective equipment during pesticide application; this would be attributed

Table 2: Results of multivariate linear regression analysis to predict the level of pesticide safe practice (r^2 = 0.222)

Variables	Coefficient (95% CI)
Constant	16.28 (4.61 to 27.93)
Knowledge	0.45 (0.35 to 0.55)
Age (yrs)	-0.07 (-0.29 to 0.15)
Field's surface area (Ha)	0.89 (-0.35 to 2.13)
Work experience (yrs)	-0.07 (-0.255 to 0.11)

to humid climate of the two study areas, Sari and Fasa.

More than half of the participants used unsafe practice, such as using the pesticide containers for other purposes or disposing them with ordinary wastes. Just a few of the participants buried or burned waste pesticides and empty containers properly. A study conducted in Uttar Pradesh, northern India, shows that most of farmers keep the half-empty pesticide containers out of children's reach, that nearly half of the farmers bury the empty pesticide containers properly, and that the rest throw them away in nature or sell them to recycling centers.[15] In many developing countries, farmers use empty pesticide containers for other storage purposes or sell them to recycling centers.

We found a correlation between education level and knowledge of the safe use of pesticides. Farmers with lower level of education were at higher risk of pesticide poisoning. The high illiteracy rate among the farmers would lead to lack of knowledge of the pesticides' side effects, and of how to manage them.[16] This finding was consistent with the results of other studies.[5,7,12,13,17] Similar to many reports, most of our participants were illiterate or had low education; they were unable to read and understand the information provided on the containers' labels, mostly used specific foreign language words.[18] To raise their awareness, it is thus recommended to train farmers in pesticides' side effects.[9,13]

We found that age had an inverse correlation with pesticide safe use practice. Those with higher exposure to pesticides over a longer period of working on field may feel that they are no longer vulnerable to the side effects. In a study conducted in India, no correlation was found between age of participants and pesticide safe use practice;[13] nonetheless, the more experienced farmers, in spite of their satisfactory level of knowledge, were more careless about adhering to safety measures. This consistency in results could be attributed to the similar socioeconomic situation of the Asian farmers.

We found showed that knowledge could explain only 22% of the variance observed in the pesticide safe use practice. Some researchers believe that although having a satisfactory level of knowledge is necessary, it is not sufficient for adopting a good practice, and other factors should also be taken into account.[16] For example, Ghalavandi, *et al*, reported that knowledge cannot predict the safety behavior; instead annual income is the most important independent predictor of farmers' safety behavior, explaining 60% of the observed variance in the adopted practices.[17] Consistent with our study, they used a self-reporting questionnaire. The use of other data collection instruments could produce different results.

Limitations of this study included the self-reporting nature of the data gathered, and ignoring other behavior-associated factors. We did not look into the reasons why knowledge did not necessarily turn into practice, which needs future research.

In conclusion, we found that there was a significant correlation between knowledge and the adoption of pesticide safe use practice. There was a clear know-do gap, implying that although knowledge is necessary, it is not enough for adopting safe practices. This important issue should be considered in conducting future studies and developing educational interventions for farmers.

Conflicts of Interest: None declared.

Financial Support: This article was sponsored by Iran University of Medical Sciences with grant number 27519.

References

1. Hosseini MH, Ramazani AA, Tavasolian H, *et al*. [Survey of knowledge and attitude of farmers of Southern Khorasan province regarding agriculture related OHS issues in 2008.] *Iran Occupational Health Journal* 2011;**8**:24-9. [in Persian]
2. Ismail AA, Bodner TE, Rohlman DS. Neurobehavioral performance among agricultural workers and pesticide applicators: a meta-analytic study. *Occup Environ Med* 2012;**69**:457-64.
3. Martenies SE, Perry MJ. Environmental and occupational pesticide exposure and human sperm parameters: A systematic review. *Toxicology* 2013;**307**:66-73.
4. Mostafalou S, Abdollahi M. Pesticides and human chronic diseases: evidences, mechanisms, and perspectives. *Toxicol Appl Pharmacol* 2013;**268**:157-77.
5. Gaber S, Abdel-Latif SH. Effect of education and health locus of control on safe use of pesticides: a cross sectional random study. *J Occup Med Toxicol* 2012;**7**:3.
6. Ngowi AVF, Mbise TJ, Ijani ASM, *et al*. Pesticides use by smallholder farmers in vegetable production in Northern Tanzania. *Crop Prot* 2007;**26**:1617-24.
7. Zyoud SeH, Sawalha AF, Sweileh WM, *et al*. Knowledge and practices of pesticide use among farm workers in the West Bank, Palestine: safety implications. *Environ Health Prev Med* 2010;**15**:252-61.
8. Palis FG, Flor RJ, Warburton H, Hossain M. Our farmers at risk: behaviour and belief system in pesticide safety. *J Public Health (Oxf)* 2006;**28**:43-8.
9. Aghilinejad M, Mohammadi S, Farshad A. [Effect of pesticides on farmers' health.] *Pejouhesh dar Pezeshki (Journal of Research In Medical Sciences)* 2007;**31**:327-31. [in Persian]
10. Damalas CA, Eleftherohorinos IG. Pesticide Exposure, Safety Issues, and Risk Assessment Indicators. *Int J Environ Res Public Health* 2011;**8**:1402-19.
11. Isin S, Yildirim I. Fruit-growers' perceptions on the harmful effects of pesticides and their reflection on practices: The case of Kemalpasa, Turkey. *Crop Prot* 2007;**26**:917-22.
12. Khanal G, Singh A. Patterns of Pesticide Use and Associated Factors Among the Commercial Farmers of Chitwan, Nepal. *Environ Health Insights* 2016;**10**(Suppl 1):1-7.
13. Kumari PL, Reddy KG. Knowledge and Practices of safety use of Pesticides among Farm workers. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)* 2013:**6**:1-8.
14. Zare S, Behzadi M, Tarzanan M, *et al*. The impacts of pesticides on the health of farmers in Fasa, Iran. *Electron Physician* 2015;**7**:1168-73.
15. Mahantesh N, Singh A. A Study on Farmers' Knowledge, Perception and Intensity of Pesticide Use in Vegetable Cultivation in Western Uttar Pradesh. *Pusa Agri Science* 2009;**32**:63-9.
16. Aghilinejad M, Farshad A, Naghavi M, Haghani H. [Assessment of the relationship between pesticide and theireffects on farmerhealth in various state.] *Iran Occupational Health Journal* 2006;**3**:81-5. [in Persian]
17. Ghalavandi S, Noorivandi AN, Ommani AR. [Analyzing the Safety Behavioure of Summer Crop Farmers in Andimeshk Township in using Chemical Pesticides.] *Agricultural Extension and Education Research(Aeej)* 2018;**10**:13-22. [in Persian]
18. Jafari MJ, Gharari M, Ghafari M, *et al*. The influence of safety training on safety climate factors in a construction site. *International Journal of Occupational Hygiene (Quarterly)* 2014;**6**:81-7.