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The effect of education based on the health belief model on factors influencing preventive behaviors against exposure to pesticides in farmers

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Abstract

Improper use of pesticides leads to many health problems among farmers, especially in developing countries such as Iran. This study was conducted to assess the constructs of the Health Belief Model in adopting preventive behaviors related to pesticide use among farmers in Fayzabad County. This interventional study was a quasi-experimental design with a control group and included 100 farmers selected through two-stage cluster sampling. Data were collected using a researcher-made questionnaire with confirmed validity and reliability, and the educational intervention was implemented based on the mentioned model. Data were collected immediately and one month after the educational intervention and were analyzed using IBM SPSS version 22 through Chi-square and Kruskal–Wallis statistical tests. The two groups showed no significant difference in demographic characteristics. Based on the results, after the educational intervention, the mean scores of the Health Belief Model constructs (perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and behavior) in the intervention group showed a significant increase compared to the control group ($P<0.001$). Considering the cost-effectiveness and the positive impact of the Health Belief Model on preventive behaviors related to pesticide exposure among farmers, designing and implementing a comprehensive strategic program to promote safe behaviors is essential.

Keywords: Pesticide, Protective Behavior, Health Belief Model, Farmer

Introduction

The agricultural sector is crucial in Iran's economy and is considered a key pillar of national development. It provides nearly 25% of the gross national product, 33% of non-oil exports, 33% of employment, and food for more than 80% of the population (1). Worldwide, 20–30% of agricultural products are destroyed by pests each year. Farmers mainly rely on chemical technologies to manage pests and to increase profit and productivity in their activities and investments (2). Today, more than 300 hazardous chemical compounds, including various chemical fertilizers used to improve soil fertility and different types of pesticides used to control pests, diseases, and weeds, are applied in agriculture (3,4). However, these inputs are also major sources of environmental pollution and affect the health of living organisms, including humans (5,6).

Resistance of pests, diseases, and weeds to chemical pesticides, poisoning, severe soil degradation and erosion, water pollution, threats to human health, skin diseases, various cancers, neurological diseases, diabetes, respiratory diseases, fetal disorders, congenital anomalies, fertility and sexual problems, negative effects on male sperm, genetic problems, fatal poisonings, and environmental destruction are among the most important consequences of these chemical substances (7,8). Exposure to pesticides is the most common and serious occupational hazard faced by agricultural workers in developing countries (9).

Factors influencing farmers' preventive behaviors in pesticide use are more complex than expected. To encourage farmers at risk of pesticide exposure to change their pesticide use practices, they must become sensitive to health threats and understand the risk of disease. Identifying barriers to behavior change is also very important. Therefore, having information about the beliefs and attitudes of at-risk farmers is essential for developing preventive behaviors during pesticide use. Some experts believe that the first step in planning to reduce the risks of pesticides to the environment and human health is conducting studies to assess farmers' knowledge, attitudes, and behaviors regarding pesticide use in agriculture (10). A study by Huybrechts and colleagues (2016) in Vietnam showed that only 30% of farmers had high knowledge about pesticides. In addition, 51% of farmers discarded leftover pesticide containers in the environment, and only 31% burned or buried the containers (10).

Selecting an appropriate health education model is the first step in designing an educational program. The Health Belief Model is one of the oldest health behavior theories and is among the most widely used models in health-related behaviors. It is a psychological model that attempts to explain and predict health behaviors (11). This model focuses on individuals' attitudes and beliefs and shows the relationship between beliefs and behavior. In fact, it allows researchers to examine possible psychological factors influencing individual decision-making. The Health Belief Model is useful in predicting why people accept or reject health behaviors (12). According to this model, to adopt preventive behaviors, individuals must first feel at risk of the problem, such as diseases related to pesticide exposure (perceived susceptibility). Then, they must understand the seriousness and depth of this risk and its physical, psychological, social, and economic consequences (perceived severity). Through positive cues received from the external or internal environment (cues to action), they must believe in the usefulness and feasibility of protective behaviors to prevent disease (perceived benefits) and consider the barriers to action as less costly than the benefits (perceived barriers), leading to preventive behaviors during pesticide use (13).

Considering the harmful effects of pesticides on human health and the low level of farmers' awareness in this area, the present study was conducted to evaluate the effect of education based on the Health Belief Model on factors influencing preventive behaviors against pesticide exposure among farmers in the city of Fayzabad.

Methods

This interventional quasi-experimental study was conducted in 2020 among farmers in Fayzabad. The sample size was determined based on similar studies (14) and calculated using the following formula:

$$\frac{\sum(\bar{y}_{i.} - \bar{y}_{..})/(k-1)}{\sum\sum(y_{ij} - \bar{y}_{i.})/(n-k)} - F_{1-\alpha}(k-1, n-k) > F_{1-\beta}(k-1, n-k)$$

Based on this calculation, 40 participants were considered for each group. Considering a possible 30% attrition rate, the sample size was increased to 50 participants per group.

A two-stage cluster sampling method was used. In the first stage, each village was considered as a cluster. From the villages within the clusters, two villages were randomly selected and assigned to either the intervention group or the control group. In the second stage, according to the list of farmers in each village obtained from the national health system approved by the Ministry of Health and Medical Education (Integrated Health System, SIB), farmers were randomly selected based on the determined sample size.

Inclusion criteria were residence in the village, employment in farming, age between 25 and 55 years, and informed consent to participate in the study. Exclusion criteria were migration from the village during the study period, absence from more than one educational session, and unwillingness to continue participation in the study.

In this study, educational content was delivered to farmers through lectures and question-and-answer sessions using PowerPoint presentations in six training sessions. Each session lasted one hour and was conducted by the researcher over three consecutive weeks at the Fayaz Bakhsh and Emamat health centers. Fifty participants attended the sessions. The educational content was developed based on the training needs identified during the diagnostic assessment phase and according to the assessed needs of the target group (farmers).

Data were collected using the Mahmoudabadi questionnaire (2015). The questionnaire consisted of four sections. The first section included five questions on demographic information. The second section was related to the constructs of the Health Belief Model and included 11 questions on perceived susceptibility, 11 questions on perceived severity, 6 questions on perceived benefits, 6 questions on perceived barriers, 5 questions on self-efficacy, and 13 questions on preventive behavior. The questions were designed and scored based on a five-point Likert scale ranging from strongly agree to strongly disagree. A score of five was assigned to strongly agree and a score of one to strongly disagree. The minimum and maximum scores for perceived susceptibility and perceived severity were 11 and 55, respectively. For perceived benefits and perceived barriers, the minimum and maximum scores were 6 and 30. For self-efficacy, the minimum score was 5 and the maximum was 25. The minimum and maximum scores for preventive behavior were 13 and 65, respectively. The questionnaire was completed by the farmers in three stages: before the educational intervention, immediately after the intervention, and one month after the intervention. Data analysis was performed using IBMSPSS v24 software and Kruskal-Wallis, Kolmogorov-Smirnov and Pearson correlation coefficient statistical tests at a significant level ($p<0.05$). Ethical considerations such as obtaining informed consent, using coded questionnaires, keeping information confidential with the researcher and the right to withdraw from the study, providing information upon request, and acknowledging the people who participated in the study were observed. This study was also approved by the code of ethics (IR.GMU.MEDICAL.REC.1399.038) at Gonabad University of Medical Sciences.

Results

The participants in this study were 100 farmers. The average age of the farmers in the experimental group was 41.52 years and in the control group was 41.60 years, which was not statistically significant between the two groups (P=0.843). Also, the average status of the participants in terms of employment history in the experimental group was 21.56 years and in the control group was 24.26 years, which was not statistically significant between the two groups (P=0.134). There was no statistically significant difference between the level of education of the participants in the experimental and control groups (P=0.934).

Table 1. Comparison of construct scores in the experimental and control groups before educational intervention n = 100

Group / Variable	Intervention		Control		*P-value
	Average	Standard deviation	Average	Standard deviation	
Perceived sensitivity	33.24	11.50	35.59	10.62	0.373
Perceived severity	32.13	11.39	34.88	8.73	0.102
Perceived benefits	22.94	4.33	23.75	1.71	0.437
Perceived barriers	22.24	1.83	23.30	1.82	0.350
Self-efficacy	18.42	3.48	18.96	2.78	0.156
Preventive behavior	27.42	5.31	28.94	5.02	0.507

* Significance level using the chi-square test

Table 2. Comparison of Construct Scores in the Intervention and Control Groups Immediately After the Educational Intervention (n = 100)

Group / Variable	Intervention		Control		*P-value
	Average	Standard deviation	Average	Standard deviation	
Perceived sensitivity	50.22	5.43	36.49	10.03	0.001
Perceived severity	48.96	5.19	36.54	5.55	0.001
Perceived benefits	30.34	7.39	23.70	1.69	0.001
Perceived barriers	25.42	1.83	23.36	1.85	0.001
Self-efficacy	22.82	1.80	19.78	2.31	0.001
Preventive behavior	37.76	4.43	28.80	4.18	0.001

* Significance level using Kruskal-Wallis test

Table 3. Comparison of construct scores in the Intervention and control groups one month after the educational intervention n = 100

Group / Variable	Intervention		Control		*P-value
	Average	Standard deviation	Average	Standard deviation	
Perceived sensitivity	49.86	5.30	36.12	10.27	0.001
Perceived severity	48.90	5.19	36.58	5.20	0.001
Perceived benefits	30.30	7.38	23.72	1.69	0.001
Perceived barriers	25.54	1.70	24.08	2.21	0.001
Self-efficacy	22.75	1.75	19.35	2.21	0.001
Preventive behavior	37.64	4.43	29.06	3.05	0.001

*Significance level using Kruskal-Wallis test

The comparison of the mean scores of the Health Belief Model constructs in the intervention and control groups before the educational intervention is presented in Table 1, immediately after the educational intervention in Table 2, and one month after the educational intervention in Table 3. The findings show that before the educational intervention, there was no significant difference between the intervention and control groups in terms of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and preventive behavior. However, immediately and one month after the educational intervention, a significant difference was observed between the intervention and control groups in perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and preventive behavior (P<0.001). These changes were not statistically significant in the control group.

Discussion

Based on the findings of this study, before the intervention there was no statistically significant difference between the intervention and control groups in the mean scores of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and behavior. However, after the intervention, a significant difference was observed in all constructs in the intervention group, while no statistically significant difference was observed in the control group. The constructs of the Health Belief Model are discussed below.

Since chemical pesticides are produced to disrupt the life cycle of pests, improper use of these substances can be dangerous for individuals who are exposed to them (15). Exposure to pesticides can lead to serious consequences (16). Farmers and agricultural workers, due to the nature of their occupation, are considered among those with the highest level of exposure (53). The findings of this study showed that farmers have a high level of perceived susceptibility regarding the possibility of illness caused by chemical pesticides and believe that diseases resulting from these substances are serious and dangerous for them. On the other hand, they are well aware of the benefits of using protective equipment, but they believe that using such equipment is not easy.

In the study by Yazdanpanah and colleagues, it was shown that extension education can play an effective role in encouraging farmers to use chemical pesticides safely and properly. In addition, farmers should be informed about the severity of diseases caused by chemical pesticides through different methods. This can increase their intention to use protective equipment. In this regard, presenting real cases and examples of farmers who have experienced health problems due to pesticide exposure can be highly effective (17).

Agriculture is directly related to the environment, including water resources, and farmers' behaviors can have major positive or negative effects on these important resources. Some experts believe that the first step in planning to reduce the risks of chemical pesticides is to conduct studies that assess farmers' knowledge, attitudes, and behaviors regarding pesticide use in agriculture (54). According to the study by Bandari and colleagues (55), only 34% of farmers had a relatively positive attitude toward the use of chemical pesticides. Therefore, it is recommended that policymakers and planners use modern educational methods appropriate to farmers' characteristics in order to improve their attitudes toward chemical pesticides (18).

Considering the low literacy level of farmers, lack of awareness about the harmful effects of pesticides is a major threat to them. Occupational pesticides, such as organochlorines, organophosphates, carbamates, pyrethroids, and other chemicals used in agriculture, directly damage testicular cells or indirectly disrupt hormonal regulation of spermatogenesis, leading to impaired sperm production. These disturbances manifest as reduced sperm count, abnormal sperm, and impaired androgen production (19). Therefore, education about the hazards of pesticide exposure and personal protective methods when working with pesticides can play an effective role in preventing adverse effects and poisoning.

Regarding the constructs of the Health Belief Model, education based on this model significantly increased (P=0.001) the mean scores of perceived susceptibility, perceived severity, perceived benefits, and self-efficacy among farmers in the intervention group, while the mean scores of these constructs in the control group showed no significant change before and after the intervention. Education also significantly reduced (P=0.001) the mean score of perceived barriers in the intervention group, but no significant change was observed in the control group.

In a study by Raksanam and colleagues in Thailand, education based on the Health Belief Model increased farmers' scores in perceived susceptibility, severity, and benefits (20). A similar effect was observed in a study examining the impact of education through the Health Belief Model on seatbelt use (21).

According to the results, perceived susceptibility had the strongest direct effect on farmers' protective behaviors. These findings align with the study by Ghanbari and colleagues, which applied the Health Belief Model to analyze farmers' protective behaviors (22). Such susceptibility only occurs when farmers are aware of the risks and diseases caused by not following protective measures when using pesticides. Various studies have shown that farmers often fail to follow protective behaviors due to low knowledge levels. In line with this, Adeola's study (4) found that farmers often do not carefully read pesticide instructions, their understanding of the toxicity of the pesticides they handle does not match the actual risk, and they use pesticides assuming they are safe. Even among literate farmers, many do not pay attention to the instructions on the packaging or follow them (23).

Perceived barriers also have a significant impact on the adoption of preventive behaviors among farmers. In other words, farmers who feel that protective equipment is expensive or who experience fatigue perceive these barriers as obstacles, which reduces the likelihood of engaging in protective behaviors. Several studies have confirmed the role of perceived barriers as a strong predictor of protective behavior (24). For example, Kupenz (2016) and Raksanam (2012) reported an inverse relationship between perceived barriers and protective behaviors in pesticide use; the greater a farmer's understanding of how to overcome barriers, the more likely they are to adopt protective behaviors (62, 63). Many farmers stated that personal protective equipment is hot and uncomfortable, gloves do not fit properly, and the equipment is slippery and warm. Additionally, farmers avoid using protective equipment because it interferes with their work (24–26).

Perceived barriers not only directly affect farmers' protective behaviors but also have an indirect effect through self-efficacy. In other words, when farmers perceive obstacles to performing protective behaviors, these perceived barriers reduce their self-efficacy, which in turn negatively influences their protective behavior during pesticide use. Protective behavior training should be designed so that farmers, through modeling and example (vicarious experiences) such as observing exemplary farmers and their successful experiences, believe that they are capable of performing these behaviors (efficacy expectations). At the same time, educational programs should help farmers understand cognitively that performing protective behaviors while using pesticides can maintain their health. Self-efficacy is an important variable, referring to the extent to which an individual feels that the desired behavior is under their control and is easy to perform (27). Policymakers aiming to expand safe behaviors in pesticide use should focus on strategies that strengthen farmers' plans and programs for implementing these methods. Farmers' confidence and ability should be reinforced through educational programs to empower them to overcome perceived barriers and difficulties in using safety equipment. Farmers should also be taught that their current pesticide practices are risky and hazardous. This knowledge reduces overconfidence in pesticide use and increases their willingness to use protective equipment.

After the educational intervention, the mean score of perceived behavior in the intervention group increased significantly, while no significant change was observed in the control group. These findings indicate that appropriate planning to strengthen external motivators for health behaviors among farmers is not currently in place. Salvatore's study showed that performing preventive behaviors plays an important role in reducing pesticide exposure, and Strong (6) also reported that education significantly affects the adoption of preventive behaviors and the use of personal protective equipment. The results of the present study confirm the effectiveness of the Health Belief Model in promoting preventive behaviors against pesticide exposure. Tang Pobal (7) and colleagues reported similar findings (28–30).

This study, conducted to evaluate the effect of education based on the Health Belief Model on factors influencing preventive behaviors against pesticide exposure among farmers in Fayzabad, showed that farmers' perceived susceptibility significantly increased in the intervention group compared to the control group after the educational intervention.

Conclusion

This study aimed to evaluate factors influencing preventive behaviors against pesticide exposure among farmers. The findings showed that education based on the Health Belief Model effectively improved farmers' perceptions, including perceived susceptibility, perceived severity, perceived barriers and benefits, self-efficacy, and behavior. This improvement led to the adoption of preventive behaviors during pesticide exposure. Therefore, designing educational interventions based on the Health Belief Model, alongside the use of media, is recommended to promote preventive behaviors among farmers.

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