

Do Farmers Think of Producing Healthy Crops? A TPB¹-based Study Aimed to Investigate Farmers' Practice in Optimal Use of Pesticides in City of Sari

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Abstract

Introduction: Today, health of agricultural crops throughout the world is exposed to the excessive use of chemical pesticides and toxicants. Use of pesticides by farmers is associated with various factors. On this basis, the present study is aimed to investigate the farmers' practice in optimal use of toxicants and pesticides in city of Sari based on a behavioral theory. **Methods:** The present cross-sectional study was conducted on 300 farmers living in Sari region, who were selected via random sampling method, in 2017. The data collection tool was composed of three parts. Accordingly, the first part included demographic information and agricultural characteristics, the second was focused on farmers' knowledge and practice of using chemical pesticides, and finally the last part embraced the TPB constructs (including attitude, subjective norms, perceived behavioral control, and behavioral intention). Once data collection was completed, they were analyzed using statistical methods. **Results:** The mean score of knowledge and practice was lower than 50% of the total achievable score, while the mean score of the TPB constructs was higher than 50% of the total achievable score. The regression results indicated that the subjective norms and perceived behavioral control were significant predictors of the farmers' behavioral intention for controlling the overuse of pesticides ($P < 0.001$). Furthermore, the multivariate linear regression showed that TPB constructs and the "knowledge" explained 31% of the variance of the farmers' behavioral intention. **Conclusion:** Observing the obvious importance of some of the constructs over other constructs can serve as a guideline for policy-makers in terms of planning for the projects which aim to reduce agricultural toxicants use.

Keywords: Healthy Crop, Optimal Use, Pesticide, Theory of Planned Behavior (TPB), Farmers.

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¹ Theory of planned behavior

Introduction

Within the world with a growing population, the efforts to industrialize the agriculture sector in order to increase crops production rate in response to the increased demand for more food have resulted in various challenges for food safety (Godfray & Garnett, 2014). Wide use of pesticides in agricultural environments throughout the world is considered as a major problem. Also, the residual pesticide in water and foods exposes individuals to risks. Health of agricultural crops is exposed to and influenced by chemical pesticides, which can lead to the reduced quality and nutritional values of crops (Asami et al., 2003). Residual toxicants in fruits, vegetables, and other agricultural crops may cause chronic poisoning in the long term. This type of poisoning is caused by repeated and consecutive consumption of small amounts of residual toxicants in foods so that, if the amount of such residual toxicant in the human body exceeds a certain permitted limit, it may result in serious hazards for them (Damalas & Eleftherohorinos, 2011). Various studies have noted that such undesirable hazards include a variety of cases, such as poisoning, abortion, skin and nervous complications, some types of cancer, and even death, which can be far too serious for children (Kamel et al., 2003; Swan et al., 2003; Alavanja et al., 2004). Results of a study in Egypt found a relationship between use of organophosphorous (OP) pesticides and increased incidence rate of the liver cancer among farmers (Gaber & Abdel-Latif, 2012). According to a report published by the American National Health and Nutrition Center, the organophosphorous pesticide use rate during 2003-2004 was so highly prevalent that the organophosphorous metabolites were found in the urine of more than 75% of the sample (Curl et al., 2015).

According to the WHO's report, more than a half of the pesticides available around the world is consumed in developing countries, which is of course increasing (Zyoud et al., 2010). Unfortunately, investigations indicate that Iran is exposed to the excessive use of pesticides as well. Statistics implies that 14,000 tonnes of agriculture pesticides were annually used in Iran (Morteza et al., 2017). Reporting the results of a study conducted in India, Bond et al. declared that lack of trained personnel, complexity of making necessary decisions among some of the farmers, and farmers' beliefs about use of pesticides were the constraints for extensive application of the IPM (integrated pests management) plan and also were the reasons for the increased overuse of pesticides in India. Therefore, regarding the complex process of the farmers' decision-making on the use of pesticides, it seems necessary to apply a theory in order to explain and clarify the factors associated with the farmers' behavior. Various papers in this field indicate that TPB can take into consideration the factors associated with pesticide use behavior and provide a helpful theoretical framework for understanding the farmers' behavior in regard to developing health and safety interventions (Bond et al., 2009). According to this theory, behavior is directly determined by individuals' tendencies and is influenced by their attitude (positive or negative), subjective norms (perceived social pressures), and perceived behavioral control (simplicity or complexity of a behavior from their viewpoint), and the individuals' intention is the direct predictor of behavior (Menozzi et al., 2015).

Inspired by the increasing prevalence of the use of pesticides for agricultural crops and their hazardous impacts as well as the shortage of studies on the factors associated with pesticide use behavior among Iranian farmers, the researcher decided to conduct an investigation based on the TPB in order to investigate the practice of optimal use of pesticides among the farmers in city of Sari.

Materials and Methods

Research design

The present cross-sectional study was conducted on 300 farmers in Sari region in 2017. In order for sampling, the researcher randomly selected one center (Panbehzarkati-Agricultural Jihad Services Center) from among 7 Agriculture Jihad Service Centers (AJSC) located in city of Sari. Then, with regard to the list of villages covered by this center as well as list of their farmers, the researcher performed the random sampling and extracted the research samples using the table of random numbers and list numbering. The researcher referred to the selected samples and, in case of qualification, asked them to fill in the research questionnaire.

Tools

In the present study, the data collection tool was a questionnaire composed of three parts. Accordingly, the first part included demographic information and agricultural characteristics, the second was focused on farmers' knowledge and practice of using chemical pesticides (4 questions for knowledge assessment (e.g. knowing the standard dosage of the pesticide used for his crop) and 4 questions for practice assessment (e.g. controlled use of pesticides in accordance with the provided standard instructions) and finally, the third part of the questionnaire was focused on the TPB constructs (attitude, subjective norms (SN), perceived behavioral control (PBC), and behavioral intention (BI)) and directly assessed and measured these constructs. The given questionnaire was built up based on the results of the previous studies on this field. Moreover, some efforts were made to examine the questionnaire's validity and reliability. Accordingly, the questionnaire's content validity based on the TPB was evaluated using the viewpoints of 10 specialists in the field of agriculture, health education and health promotion with regard to level of consistency between measurement tool's content and research objectives. Then,

based on these feedbacks, the suggested cases were modified. Two relative coefficients of content validity for all the items (CVR>0.7) and content validity index (CVI=0.8) were used.

In order to evaluate the face validity, opinions of 20 farmers living in the neighboring cities were used after making the necessary modifications. Moreover, reliability of the questionnaire was evaluated by means of re-test method among 20 of the farmers with a two-week interval, the results of which implied appropriate reliability of the tool ($r=0.823$, $p<0.001$). Reliability of the questionnaire was calculated by Cronbach's alpha coefficient. (Cronbach's alpha for all the constructs were higher than 0.80). The questionnaire included two questions on attitude (e.g. "Overuse of toxicant or pesticide is necessary for growth of agricultural crops."), three questions on SN (e.g. "My relatives expect me to avoid overuse of toxicants for my crops."), seven questions on PBC (e.g. "It is up to myself to decide how much toxicant should be used for my crops.") and finally two questions on BI construct. The responds provided for items of the TPB constructs were set on the basis of Likert scale ranging from "Completely agree" to "Completely disagree" (1 to 5). sum of the scores assigned to the questions was calculated for each construct and, then, each construct's total score out of 100 was reported.

Statistical analysis

The collected data were analyzed in SPSS-22 software and using various statistical methods including descriptive statistics, correlation test, independent t-test, ANOVA, and multiple linear regression. Also, the significance level was considered at $p<0.05$.

Research ethics

Committee of Ethics of Iran University of Medical Sciences approved the research protocol no. 27519. Completing the questionnaire was done fully voluntarily. Moreover, the informed consent of the farmers was obtained after assuring them of the confidentiality of their information.

Results

Mean age, average under-cultivation farmland surface area, and mean farming background of the studied participants were 47 years old with the standard deviation of 11.29 (20-70 age range), 1.4 ha with the standard deviation of 1.14 (0.2-8 in ha), and 25 years with the standard deviation of 13.78 (1-50 years), respectively.

Based on the results obtained from analysis of the research variables in relation to pesticide consumption, 72% of the participants stated they would ask an information resource about the standard dosage of their consumed toxicants while consuming the toxicants. Accordingly, 41% of them acquired their required information from "AJSC", 37.3% from the toxicant-sellers within their region, and the rest from their family members or other people.

Table (1) represents the score levels (in percent) along with mean and standard deviation of the main variables of the study.

Table 1- Percentage, mean and standard deviation of the acquired scores of the main variables of the study

Variables	Poor	Moderate	Good	Excellent	Mean score (out of 100)	Standard deviation	Range of score (out of 100)
knowledge	49.0	26.0	19.3	5.7	39.16	24.60	0-100
Practice	44.0	37.7	18.3	0.0	41.25	28.41	0-100
TPB constructs	Attitude	1.0	14.0	48.3	36.7	69.92	14-100
	SN	6.0	26.7	26.7	40.7	64.60	20-100
	PBC	0.0	1.0	18.0	81.0	83.25	20-100
	BI	1.0	2.3	12.3	84.3	85.96	20-100

One-way ANOVA test revealed statistically significant relationship of the educational level variable with total scores of knowledge ($p=0.002$, $f=3.964$) and practice ($p<0.001$, $f=7.098$). Accordingly, the highest mean scores of knowledge (2.26) and practice (1.85) were achieved by the "high school" and "academic" educational level groups. Based on the one-way ANOVA results, there was a statistically significant relationship between the farmer's practice and selection of the information resource ($p<0.001$, $f=15.504$) so that the mean score of practice was higher in the group that selected mainly the AJSC as the information resource (1.79).

The correlation between the mean scores of knowledge and practice and TPB constructs is represented in Table (2).

Table 2- correlation test between knowledge and practice and TPB constructs

Variable	knowledge	Attitude	Subjective norm	Perceived behavioral control	Behavioral intention	Practice
knowledge	1					
Attitude	0.189**	1				

	0.001					
Subjective norm	.306** .000	.307** .000	1			
Perceived behavioral control	0.205** .000	0.154** .008	.281** .000	1		
Behavioral intention	0.132* 0.022	0.159** .006	.384** .000	0.517** .000	1	
Practice	.327** .000	.171** .003	.367** .000	.180** .002	.141* .015	1

As can be seen in Table (3), the multiple linear regression in the first stage (dependent variable was BI) showed that the "SN" ($\beta=0.222$, $p<0.001$) and "PBC" ($\beta=0.457$; $P<0.001$) served as the significant predictors of the farmers' behavioral intention for controlling the overuse of pesticides. Therefore, based on the obtained results, the TPB constructs and the "knowledge" variable explained 31% of the variance of the BI in this study. In the second stage, "practice" was applied as the dependent variable and the TPB constructs along with "knowledge" were as the independent variables. The results indicated that the "SN" ($\beta=0.278$, $p<0.001$) and "knowledge" ($\beta=0.226$; $P<0.001$) served as the significant predictors of the farmers' practice., the obtained results indicated that the TPB construct along with "knowledge" variable could explain only 19% of the variance of the farmers' pesticide use practice in this study.

Table 3- Multiple linear regression analysis of TPB for farmers' behavioral intention and practice for controlling overuse of pesticides

Dependent Variable: BI							
Independent variable	Standardized beta	Unstandardized beta	T Score	p-value	R	R ²	Adjusted R ²
Attitude	0.27	0.014	0.531	0.596	0/560	0/313	0/304
SN	0.222	0.085	4.127	0.001<			
PBC	0.457	0.165	9.000	0.001<			
knowledge	0.035-	0.044-	0.673-	0.502			
Dependent Variable: Practice							
Independent variable	Standardized beta	Unstandardized beta	T Score	p-value	R	R ²	Adjusted R ²
Attitude	0.37	0.013	0.665	0.507	0.436	0.190	0.176
SN	0.278	0.071	4.615	0.001<			
PBC	0.262	0.015	0.987	0.325			
BI	0.023-	0.16-	0.369-	0.712			
knowledge	0.226	0.196	4.042	0.001<			

Discussion

The results derived from some of the findings of this study showed that the farmers had below-moderate levels of knowledge on the agricultural toxicants use standards. Consistent with these findings, in the study conducted by Abdollahzadeh et al. for evaluating the knowledge of the rice farmers in city of Sari on the consequences and health-related hazards of the use of pesticide, a group of farmers incidentally applying chemical fighting approach for agricultural pests control lacked an appropriate and good level of knowledge, which was the reason for the consistency of its results with findings of the present work (Abdollahzadeh et al.,2017).

Moreover, the studied farmers in Mahantesh's research had below-moderate levels of information and knowledge on IPM and alternative methods substituting for chemical pesticides, such as application of biological pesticides. The knowledge of these farmers on the recommended standard dosage of toxicants was less than 10%, which might lead to excessive consumption and overuse of toxicants (Mahantesh & Singh,2009).

Another notable finding of this study was that most of the studied participants asked the standard dosage of their consumed toxicants from an information resource before using them. Among these resources of information, a governmental organization, namely AJSC, ranked first, followed by the toxicant-sellers in the second rank. The "family members" and "other farmers" attained the next ranks among the information resources.

However, in Mahantesh's work, composition of this ranking was seemingly different in some way; since the first resource of information, to which the farmers referred, was the toxicant-sellers and the next ranks were attained by the agriculture-related governmental

resources, other farmers, and colleagues, respectively (Mahantesh & Singh,2009). Bond et al.'s study introduced family as the main information reference group for farmers; besides, the toxicant-sellers were among the major resources of information for farmers (Bond et al.,2009).

Results of this study showed that Experts in agriculture play a major role in expanding and spreading agricultural patterns and their relevant issues since they train farmers and attempt to make the public society informed of such patterns due to the point that having a sufficient deal of knowledge on a given area before performing any type of training is of great importance. Through these experts, various types of training can be considered for farmers within a region (Malek-Saeidi et al., 2011).

Another finding of the present study is the one including the cases that are rooted in the constructs of a psychosocial theory known as the theory of planned behavior (TPB). Results of the present study showed that a statistically significant relationship was observed between the educational level variable and attitude and SN constructs so that the group with academic educational level achieved higher mean scores in attitude and SN. The results obtained in Jaber's study in Egypt showed that the higher educational levels were associated with better knowledge and behavior in terms of the safe use of pesticides (Gaber & Abdel-Latif, 2012). In Mennatizadeh et al.'s study, it was shown that the farmers with higher educational levels, more communication with experts of the agricultural service centers, and more participation in training sessions of these centers had higher farming practice and attempted to exhibit environmental behaviors to a larger extent (Menati Zadeh et al.,2014).

In the present study, the majority of the studied farmers had a desirable level of attitude, SN, and PBC. In Ahmed's study in Sweden, which was aimed to compare two groups consisting of farmers and non-farmer relatives in terms of their attitudes toward the use of pesticides, the non-farmer relatives had more negative attitudes towards pesticide use than the farmers and expressed that the use of pesticide in farming would cause increased environmental damage as well as reduced quality of agricultural crops (Ahmed et al.,2011). On the other hand, in Bond et al.'s study, most of the farmers had positive attitudes toward the use of pesticides (Bond et al.,2009). Furthermore, results of the present study showed that the SN and PBC were significant predictors of the farmers' behavioral intention for controlling the overuse of pesticides. Based on the obtained results, the PBC variable with beta value of 0.45 exerted a higher effect on intention compared to other variable.Regarding this finding of the present study, it can be said that the farmers' tendency toward using pesticides is influenced by a factor, namely simplicity or complexity of the approach in farmer's viewpoint. Therefore, in order to increase the intention for optimal use of pesticides, it is necessary to scrutinize various aspects of the existing obstacles and barriers and, then, eliminate them from the farmer's path. Subsequently, in the second rank of importance, focusing on the factor of SN through paying attention to the individuals or organizations influencing the farmer, including AJSC, toxicant-sellers, experienced farmers in the village, and family members, is of great importance for promoting the intention of optimal use of pesticides. Furthermore, the result showed that TPB constructs and the "knowledge" variable explained 31% and 19% of the variance of the BI and practice, respectively. Some researchers have suggested that the Factors like knowledge and ...is necessary for an appropriate practice, yet it is not sufficient and thus some other factors should also be taken into consideration as well (16). In Monfared et al.'s study, the TPB constructs could predict the variance of behavioral intention of pesticide use among tomato farmers in the southern part of Iran by approximately 54%. This difference in results may be related to sample size, how to collect information and socioeconomic characteristics of the samples studied, and so on (Monfared et al.,2015). This difference in results may be related to sample size, how to collect information and socioeconomic characteristics of the samples studied, and so on.

From the limitations of this study were the questionnaire and its being self-reported, Non-generalizability of Findings.

Conclusion

In the present study, observing the importance of some of the TPB constructs (PBC and SN constructs) over other constructs can serve as a guideline for policy-makers in planning for the agricultural toxicants use reduction projects. Additionally, TPB theory can be utilized as a framework for intervention programs.

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