



Knowledge, attitude and practices of farmers about pesticide use, risks, and wastes; a cross-sectional study (Kermanshah, Iran)

Kiomars Sharafi^a, Meghdad Pirsaeheb^a, Sara Maleki^b, Hossein Arfaeinia^c, Kamaladdin Karimyan^{d,e}, Masoud Moradi^a, Yahya Safari^{a,*}

^a Research Center for Environmental Determinants of Health, Kermanshah University of Medical Sciences, Kermanshah, Iran

^b Department of Public Management, Faculty of Management and Accounting, Allameh Tabataba'i University (ATU), Tehran, Iran

^c Department of Environmental Health Engineering, School of Public Health, Bushehr University of Medical Sciences, Bushehr, Iran

^d Environmental Health Research Center, Kurdistan University of Medical Sciences, Sanandaj, Iran

^e Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

HIGHLIGHTS

- Most of the farmers have not been trained for pesticide use.
- Farmers mainly had weak knowledge about pesticides and their risks.
- Farmers used incorrect and high-risk methods for disposing pesticide's wastes.
- Health symptoms were more associated with lack of pesticide training.
- The lack of general education and pesticide training affected pesticide use.

GRAPHICAL ABSTRACT



A questionnaire, 4 parts:
Basic farm information
Pesticide use & risks
Waste disposal
Clinical symptoms



No Pesticide Training
Age > 65
Low income
No education
 ...
Health symptoms

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ABSTRACT

This study was aimed to investigate the knowledge, attitude, and behavior of farmers about the pesticide use and wastes, and to determine the factors affecting the use of pesticides and their health effects, in agricultural lands located in Kermanshah province, western Iran. Three hundred eleven (311) farmers were included in this study, and filled a structured questionnaire containing questions about their basic information, their knowledge and attitude regarding pesticides, and their practices for pesticide disposal. In addition, the type and amount of pesticide consumption, and the health symptoms during the last year were recorded. Prevalence ratios and linear regression were used to evaluate the association between the different factors, and health symptoms and the amount of pesticide use, respectively. The majority of respondents had not been trained formally for the use of pesticides before. Approximately 10%, 45%, and 17% of pesticides contained highly hazardous, moderately hazardous, and slightly hazardous compounds, respectively. The farmers mainly had incorrect knowledge about pesticides and their risks, and used incorrect and high-risk methods for handling and application of pesticides and relevant wastes. Health symptoms were more associated with age ≥ 65 , having no education, having income < 482 USD, not trained for pesticide use, and applying highly hazardous pesticides. In addition, the factors contributing to the amount of pesticide use included age, education level, and pesticide training. In order to reduce the amount of pesticide released to the environment, comprehensive training programs and implementing a waste management system could be effective.

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* Corresponding author.

E-mail address: Y.safary@kums.ac.ir (Y. Safari).

1. Introduction

Farmers and agricultural workers are exposed to a wide range of pesticides in concentrations capable to impose adverse health effects (Hvistendahl, 2013). In addition, misuse and improper disposal of agricultural pesticides can result in serious environmental contamination. It should be noted that mixing pesticides leads to interactions which may increase the health and environmental risk of pesticides. Pesticide conditioning and preparation before application exacerbate the exposure of farmers (Pedlowski et al., 2012). The factors leading to pesticide contamination include inadequate education and training about pesticide use and disposal; low costs of pesticides; insufficient information on hazards; unwillingness of farmers to accept the risks of crop loss; the effect of tropical climates; and inadequate regulation and enforcement, and gender issues (Al Zadjali et al., 2013; Atreya, 2007; Williamson et al., 2008). Poverty, inappropriate sanitation, and the standards of medical care can worsen the health consequences of pesticide misuse (Enserink et al., 2013). Low educational levels in people working in agriculture section are associated with higher exposure to pesticides (Recena and Caldas, 2008). However, the awareness about the health risks of pesticides does not decrease the usage, because farmers still misuse pesticides to prevent a lower crop yield (Enserink et al., 2013), leading to the idea that the use of agrochemicals is unavoidable.

The extensive use of pesticides brings the necessity for proper management of pesticide wastes, which is an important part of responsible pesticide use. Pesticide wastes are defined as any kind of useless material containing pesticide, such as surplus spray solutions, pesticide residue in the equipment after use, pesticide-contaminated water and materials produced after cleaning up spilled pesticides, empty pesticide containers, and old pesticide products (Nesheim and Whitney, 1989). Unintentional release or uncontrolled discharge of pesticide waste can harm humans and the environment. Even empty pesticide bottles can release unacceptable amounts of toxic compounds, if they are not rinsed correctly. Knowing the farmers' attitudes about disposal of pesticide wastes is a prerequisite to develop intervention or prevention programs (Damalas et al., 2008).

Iran is a country with high pesticide consumption (Pirsaheb et al., 2017), even much more than that required (Karamidehkordi and Hashemi, 2010). High concentrations of pesticides in agricultural products have been reported in several studies (Pasdar et al., 2017; Pirsaheb et al., 2016; Shamsipur et al., 2012; Sharafi et al., 2015). About 3.2%, 11.8%, and 24.7% of formal consumed pesticides in Iran are extremely dangerous, seriously poisonous, and potentially dangerous, respectively (Yousefi, 2008). Kermanshah province that is located in western Iran, have about 1 million ha of agricultural land. There are some reports about the extensive use of pesticides in Kermanshah. Pirsaheb et al. (2013) reported that the concentrations of 2,4-dichlorophenoxyacetic acid and alachlor toxin in ground water were more than the standard level recommended by the World Health Organization (WHO) (Pirsaheb et al., 2013). Measurement of diazinon pesticide in tomato and cucumber introduced in Kermanshah revealed that the diazinon level in some samples were more than the maximum residue limit (MRL) (Ghayebzadeh et al., 2016). In general, extensive agricultural land in this province creates a high potential for soil and water pollution by pesticides. Furthermore, pesticides can enter the meat and fish, due to the presence of numerous livestock breeding and fish ponds in this province. Despite the high consumption of pesticides in this area, there is no study about the use and disposal procedures of these compounds. In general, it is reported that Iranian farmers have low knowledge about the amount and procedure to use pesticides safely (Karamidehkordi and Hashemi, 2010).

Farmers are the end-users of pesticides; therefore, their knowledge and behavior about the safe usage and disposal of these compounds can play an important role in decreasing the environmental contamination and health problems for themselves and the society in general (Yang et al., 2014). In addition, the need to assess pesticide use in

rural populations, particularly in developing countries, is urgent, especially for areas with less trained farmers such as Kermanshah and more agricultural products export. On the other hand, the factors affecting proper pesticide handling is not well known yet. These factors can be useful for proper management, implementation, and dissemination of public policies (Fan et al., 2015).

This study was aimed to: 1) investigate the knowledge, attitude, and behavior of farmers about the pesticide use and risks, 2) investigate the behaviors of farmers during pesticide disposal, and 3) determine the factors contributing to the use of pesticides and their health effects, in agricultural lands located in Kermanshah province, western Iran.

2. Materials and methods

2.1. Study area and population

This study was conducted in rural agricultural lands of Kermanshah province, located in Western Iran. The map and location of Kermanshah province is illustrated in Fig. 1. This province with about 1 million inhabitants and 1 million ha of agricultural land, produces about 4% of total food production in Iran. Its main agricultural products include wheat, corn, barley, sugar beet, rapeseed, tomato and chickpea. The total value of products exported from Kermanshah province is >400 million USD. In addition, this province is one of the major center of livestock, poultry and fish products in Iran. Extensive agricultural land in this province creates a high potential for soil and water pollution by pesticides.

Kermanshah province was divided to 5 agricultural regions: Central, Northern, Eastern, Southern, and Western. The list of villages or sub-urban counties having agricultural activities was obtained from Organization of Agriculture. This list includes the name and characteristics of farmers in each area. Separate numbers were assigned to each village/sub-urban county and farmer. From each region, 20 villages or sub-urban counties were chosen randomly. From each village or county, 5 farmers selected randomly again. We talked to each farmer individually in person. We explained clearly that this study will use the information just for academic research. Then, only farmers were selected that were older than 21 years old, their main income was depended on agriculture, and were working on minimum 5 and maximum 10 ha of agricultural lands within Kermanshah province during the past year. Three hundred and twenty-four (324) farmers were included in the study. Thirteen farmers refused to participate in the study just before the filling the questionnaires. Therefore, three hundred eleven (311) farmers participated in our study.

2.2. Data acquisition

A structured questionnaire was designed for farmers based on the questionnaires used in two previous studies with some modifications (Damalas et al., 2008; Yang et al., 2014). The original questionnaires were translated to Persian by an academic skilled translator, and then checked by another person. The reliability of questionnaires was evaluated using Cronbach's α test for 30 farmers. The knowledge and attitude questionnaire and practice questionnaire had the Cronbach's alpha values of 0.75 and 0.82, respectively.

This questionnaire included questions about: 1) socio-economic characteristics and agricultural practices, including age, sex, level of education, types of crops and products, the type and amount of pesticide used, and income; 2) knowledge, attitude, and practice of farmers about pesticide use and risks; and 3) practices used for pesticide disposal. The questionnaires were delivered manually to farmers, and farmers were instructed before and during the filling, in case of any problem. The details of questions are provided in the tables in Results section.

No systematic and comprehensive training is performed in Kermanshah. Therefore, training in this article means any course

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