

PESTICIDE APPLICATION AND SAFETY BEHAVIOUR AMONG MALE AND FEMALE CHILLI-GROWING FARMERS IN HUA RUA SUB-DISTRICT, UBON RATCHATHANI PROVINCE, THAILAND

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ABSTRACT: Pesticides are widely used in Thailand, and can lead to serious acute and chronic health effects. To understand the determinants of pesticide exposure, such as farmers' behaviors, is important in the effort to reduce exposure effectively. In this study, a standardized questionnaire was designed and used in order to collect information on use and safety behavior related to pesticide in chilli-growing farmers in the northeastern agricultural area of Thailand. The study assessed safety behaviour among the farmers, by gender, in Hua Rua sub-district Ubon Ratchathani Province. 35 randomly selected chilli-growing farmers had face-to-face interviews to investigate, general characteristics, frequency of spraying pesticide and pesticide safety behavior such as the pesticides used on their crops, use of personal protective equipment (PPE), cleaning gloves, pesticide container condition, and the place of changing and laundering work clothes and shoes. 74.3% and 25.7% of study participants were males and females, respectively. The average age (\pm SD) was 56.3 (\pm 11.1) years. Most participants only rarely used protective equipment. 85.7% of them sprayed pesticide once per week. Nearly 80% did not wash or clean their gloves after application. In conclusion, this study observed that the chilli-growing farmers in this area might be exposed to pesticides due to their pesticide using behavior which could contribute to increased health risk. For further study, the pesticide residues and biomarkers of pesticide exposure might be included to better understand risk factors for pesticide exposure. Moreover, risk communication should be applied to increase pesticide exposure awareness, in order to protect themselves from exposure and increase quality of life.

Keywords: Pesticide use, Exposure, Safety behavior, chilli-growing farmers

INTRODUCTION

Agriculture accounted for 11.5% of Thailand's gross domestic product in the second quarter of 2011; agriculture remains highly significant despite the rise of industrialization [1]. Pressures to sustain agricultural products have led to intensive usage of pesticides. The quantities of imported agricultural pesticides increased significantly from 1994 to 2005. Organophosphates still contributed the majority of imported pesticides since 1994, followed by carbonates and organochlorines [2]. One of the important sectors in agriculture in terms of income and growth in northeastern Thailand is chilli farming. Normally, the farm area grew chilli once per year, starting from October till March. Pesticides are used extensively, and are sprayed in

the middle of each crop, around December and January, in order to protect peppers from pests and increase product yield.

Chilli farmers could be exposed to pesticide through multiple pathways; dermal, inhalation and accidental ingestion, during performance of their tasks. Dermal might be the most important exposure route [3].

Although the use of pesticide has already been documented to have adverse effects to human health, misunderstanding and misusing are still widely found in rural areas. Pesticide-related health problems usually manifest as a series of symptoms depending on severity of exposure [4]. For instance, mild organophosphate poisoning manifests in the form of malaise, vomiting, nausea, diarrhea, loose stools, sweating, abdominal pain and salivation. Moderate poisoning includes dyspnea, decreased muscular strength, bronchospasm, miosis, muscle

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fasciculation, tremor, motor incoordination, bradycardia, and hypotension/hypertension [5]. Severe poisoning could result in coma, respiratory paralysis, extreme hypersecretion, cyanosis, sustained hypotension, extreme muscle weakness, muscular paralysis and convulsion. Other illnesses associated with pesticide exposure are dermatitis, asthma exacerbation, sensory peripheral nerve defects, chronic neurobehavioral and motor dysfunction, deficits in verbal abstraction, attention, and memory, and anxiety and depression [6, 7]. These effects have been suggested to impair farmers' ability to comply with established safety procedures. Reducing exposure from pesticide can be accomplished through several procedures if appropriate facilities are available, such as wearing clothes cover the whole body, washing hands after work, not wearing work clothing into the home, bathing immediately after work, and laundering work clothing separately from other clothing [8]. Furthermore, safety equipment and adequate sanitation, including safety behavior education and training, are desirable.

This study aimed to characterize factors related to pesticide exposure among chilli-growing farmers in Hua Rua sub-district Ubon Ratchathani province Thailand. Data from this study can be helpful in formulating surveillance for farmers and in improving working conditions in the chilli farm by formulating an integrated program on safe and healthy work practices of chilli farmers in this area.

MATERIALS AND METHODS

Subjects and sampling method

Ubon Ratchathani, a province in northeastern Thailand, has 25 districts. Muang district is defined as the center of the province and divided into 12 sub-districts. Hua Rua sub-district was chosen as the study area because of the large chilli farm area and heavy pesticide use. The subjects were male and female chilli-growing farmers, aged more than 18 years. A total of 35 chilli farmers were randomly selected by drawing technique from the chilli farmers in this area. They were engaged in mixing the pesticides, and loading them into containers including application on the farm fields.

Observation and Questionnaire

The data collection instrument in this study was a questionnaire adapted from the study of Aponso et al. [9] by face to face interview at their house and/or farm. The questionnaire was separated into 2 parts; general information and pesticide use. In this step, the investigator and 2 trained assistants had coordinated with leader of community before

interview. Both assistants were well trained to understand the questionnaire. They were able to speak the local dialect and familiar with the farmers in this area in order to avoid communication bias. Details included general characteristics, frequency of spraying pesticide and their pesticide safety behavior such as the pesticides used on their crops, use of personal protective equipment (PPE), washing or cleaning glove, their container condition, and the place of changing and laundering work clothes and shoes. Observation of pesticide safety behavior was also done during the interviews. It was employed to validate the findings from the interview by observing processing of mixing and applying pesticides, and watching the pesticide safety behaviors addressed in the questionnaire, for example PPE worn during their work.

Statistical analysis

The statistics use was descriptive; percent, mean and standard deviation, to explain the general information of subjects. Chi square (χ^2) test performed to assess associations between independent variable (gender) and dependent variables (PPE usage, washing or cleaning glove, tank condition and frequency of spraying pesticide). The association between pesticide safety behavior and gender was analyzed. The Statistical Package for Social Science (SPSS) version 17 was used in this study.

RESULTS

1. Socio-demographic characteristics of the farmers

Age ranged from 25 to 65 years. There were 74.3 % male and 25.7 % female. The average age (\pm SD) of the participants was 56.34 (\pm 11.11) years. The mean body weight of subjects was 44.29 (\pm 11.08) kilograms and the mean height was 161.31 (\pm 7.89) centimeters. Characteristics of the study population are summarized in Table 1.

2. Pesticide use in the farm

All of the households used pesticide on their crops. The farmers used both natural homemade pesticides and commercial pesticides, and they applied more than the amount recommended by the company. In this study concentrated on gloves usage as a PPE because farmers can be exposed through dermal route, especially hands, during loading, mixing and spraying pesticide. Normally, farmers in this area use rubber gloves for farm activities. Most subjects had never used other PPE or used inappropriate PPE, such as plastic bag covering their hands. Some farmers usually used the reused gloves and had never cleaned or washed them before using. From the observation, cleaning glove was done after farm activities by water in the farm area, and gloves

were left for drying by sunlight. Some farmers left pesticides near their laundry area. Most households applied pesticide once per week. Approximately, 65% of their containers were in good condition. In general, farmers in this area used backpack sprayer. Good condition means there is no pesticide leaking from the tank and the handle was not broken and ready to use, in order not to expose other body parts. In term of average condition means there is some part of tank leaking and could not use appropriately because it increases exposure. Tank condition was rated by researchers according the the guidelines given above. The details are shown in Table 2.

Table 1 Characteristics of study population

General Information	Chilli farmers				Total	
	Male		Female		n	%
	n	%	n	%		
Gender	26	74.3	9	25.7	35	100
Age (years)						
≤ 30	4	11.4	-	-	4	11.4
31 – 40	5	14.3	2	5.7	7	20.0
41 – 50	10	28.6	5	14.3	15	42.9
51 – 60	5	14.3	2	5.7	7	20.0
≥ 61	2	5.7	-	-	2	5.7
Body Weight (kilograms)						
≤ 50	7	20.0	4	11.4	11	31.4
51 – 60	9	25.7	4	11.4	13	37.7
61 – 70	6	17.7	1	2.9	7	20.0
≥ 71	4	11.4	-	-	4	11.4
Height (centimeters)						
≤ 150	1	2.9	4	11.4	5	14.3
151 – 160	10	28.6	3	8.6	13	37.1
161 – 170	14	40.0	2	5.7	16	45.7
≥ 171	1	2.9	-	-	1	2.9

Male sprayed pesticide statistically significantly more frequently than females ($p < 0.001$). Farmers also changed and laundered their clothes in living room or outside their house and did not wear shoes around farmers' houses. Farmers did not protect themselves from pesticide by using personal protective equipment. There was no statistical difference of PPE use between male and female. They were also mixing pesticide nearby their farms or house with their hands. Washing or cleaning glove of male was statistically higher than female ($p < 0.01$), Table 2. Despite the high risk and frequency of exposure, farmers did not wear proper personal protection while working with pesticides. Practically no one used aprons or gauntlet gloves. Cloth face masks of farmers were not adequate protection for pesticide. Improvised forms of personal protective equipment were also used such as handkerchiefs, long sleeves and plastic pants.

DISCUSSION

In this study, all chilli-growing farmers in Hua Rua subdistrict used pesticide and used more than one kind of pesticides. Many studies have reported increasing safety behaviors of pesticide use among farmers in agricultural sector [7-9]. This study also indicated an association between frequency of spraying pesticide and sex. The frequency of exposure was associated with an increased risk of poisoning [10]. Some studies suggested that pesticide poisoning is significantly associated with factors such as geographic area, use of PPE whether the farmers received pesticide safety training. In Denmark, one study of self-reported glove use found a significant reduction in cholinesterase activity among all workers and no change in non exposed workers. Hand contamination may result

Table 2 Pesticide safety behavior, by gender (p -values are for gender comparisons)

Pesticide safety behavior	Chilli-growing farmers				Total		P -value
	Male (74.3%)		Female (25.7%)		n	%	
	n	%	n	%			
Use of Personal Protective Equipment Gloves							0.237
Use	9	25.7	5	14.3	14	40.0	
Not use	17	48.6	4	11.4	21	60.0	
Wash or clean gloves							0.001
Wash/ Clean	7	20.0	1	2.9	8	22.9	
Never	19	54.3	8	22.8	27	77.1	
Tank Condition							0.063
Good	17	48.6	6	17.1	23	65.7	
Average	9	25.7	3	8.6	12	34.3	
Frequency of spraying pesticide							<0.001
Least than once a week	2	5.7	2	5.7	4	11.4	
Once a week and more	24	68.6	7	20.0	31	88.6	

from improper glove removal. Moreover, disposable and reusable gloves allowed for almost 40% penetration of pesticides [11]. Use of rubber gloves was reported as a reducing pesticide exposure factor but could not eliminate completely dermal exposure [12]. From previous research, there were gender differences on pesticide using behavior, such as household decision on pesticides to be used, care of wind direction during spraying, reading and understanding of pesticides labels and awareness of the labels and protective covers [13]. Subjects in the present study exhibited gender differences in cleaning glove behavior. Most chili-growing farmers in Hua Rua sub-district used a proper backpack sprayer but some of them still used a leaking one. So, sealing the tank lid with a piece of cloth to prevent leakages should be suggested in order to decrease exposure [6].

In this study most of subjects did not engage in appropriate pesticide safety behavior [14]. A study from China demonstrated the importance of certain behaviors in increasing the risk of acute pesticide poisonings and indicated how important effective education programs regarding pesticide safety could be in preventing pesticide poisoning among their farmers [14]. While pesticide use and poisoning is common in less developed countries, this seems to be especially true in Thailand [15, 2]. In the present study, pesticide safety behavior in females was less than males. Female had less education than men because of Thai culture so they might misunderstand and had less awareness of pesticide label. This finding was the same as other studies. A study showed that pesticide poisoning prevalence among female applicators was nearly two-fold greater than that of male applicators [16]. Atreya [13] reported that gender differences in acute pesticide poisoning have been demonstrated among agricultural workers. Females may have a significantly lower percentage of self-protective behaviors during pesticide application than males and gender-related working conditions might also aggravate work-related exposure to agricultural pesticides among female applicators [13, 16, 17]. Safety knowledge and protective behaviors were significantly associated with a lower prevalence of work related pesticide poisoning [13]. Previous studies have suggested that pesticide safety education among farmers could raise awareness of both pesticide exposure risk and the adverse health consequences associated with acute pesticide poisoning. Improvements in pesticide safety knowledge using different delivery modes may lead to some improvement in protective practices and increase the use of personal protective equipment.

In remote environments of this study, training programs using oral presentations and storytelling could provide a basic safety education and help farmers to understand pesticides manufacturers' complex labeling information [8, 18]. However, reducing the risk of pesticide poisoning may require behavioral changes.

Some limitations of this study should be noted. This was a cross-sectional study, and uncertainty in time relationships can cloud interpretation of this type of study. Also, participants' behavior was observed only during interviews, and may not have been representative of general behavior. Even so, study results should be of benefit for policy makers, to clarify their knowledge of pesticide use and pesticide safety behavior in the study area. Further study should be conducted to develop an educational model for these farmers to protect themselves from pesticide exposure.

CONCLUSIONS

At present, pesticides remain an integral part of agricultural activities in many parts of Thailand. There are increasing efforts to develop safer alternatives to pesticides, but economic realities may influence whether these options are considered viable ones for many less developed nations [9]. Findings from the present study suggest that pesticide safety education and use of protective application methods could be effective in reducing the risk of acute pesticide poisoning. An appropriate next step is the development of educational programs to teach Thai farmers to practice precautionary measures when working with pesticides. Special emphasis should be placed on improving education for females.

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