EVALUATING PESTICIDE USE AND SAFETY PRACTICES AMONG FARMWORKERS IN GALLIPOLI PENINSULA, TURKEY

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Abstract. Unsafe pesticide use among farmworkers is a major public health problem in Turkey. This study aimed to investigate pesticide use and safety practices of farmers in a village of Gallipoli Peninsula, Turkey. This cross sectional study was conducted with 117 farmers. The questionnaire included questions on demographic data, knowledge, attitudes, and safety practices concerning pesticides. The mean age of participants was 42.8 years, and 38.5% was female participants. Of the total 177 respondents, 77.8% reported that they prepared the chemical mixture at a public fountain, whereas 22.2% prepared it in their houses. Almost half (44.4%) reported that they experienced at least one health problem after pesticide application in the previous one year. Total scores for pesticide safety practices of the subjects, who declared that they experienced at least one health problem after the application in the previous one year, were statistically significantly lower (p<0.001). Their responses about safe use of pesticides and storage conditions were very striking. Our findings indicated that there is a need to increase health promotion activities through training, and the local administrations should promote safe use of pesticides by farm workers.

Keywords: farmworkers, pesticides, public health, safety practices, Turkey

INTRODUCTION

Unsafe pesticide application is a serious global public health problem, especially the neglect of personal protective measures, keeping chemicals at easily reachable places, and mixing of chemicals with water, soil, and air (WHO, 2012a, b).

Pesticide pollution in Asia, Africa, Latin America, the Middle East, and Eastern Europe are now serious. After the 1990s, the global pesticide sales increased from 270 to 300 billion dollars (Zhang *et al*, 2011). Currently, the most commonly used pesticides are herbicides, insecticides and fungicides/bactericides. Europe is currently the biggest and Asia is the second pesticide consumer in the world (Zhang *et al*, 2011). Pesticides are mostly used to protect fruit and vegetable crops (Zhang *et al*, 2011). Previous studies have reported that more frequent unsafe application of pesticides is associated with higher pesticide poisoning and health problems (Calvert *et al*, 2008; Levesque *et al*, 2012a, b). Water pollution, which is caused by unsafe use of pesticides, is also an important public health problem (Lichtenberg

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and Zimmerman, 1999).

Turkey, located in Europe and Asia, has suitable geographic and climatic conditions allowing farmers to commercially grow grains, vegetables, and fruits. Pesticide consumption in Turkey was 12,199 tons in 2002; 18,258 tons in 2006 (an increase of approximately 50%); and 22,681 tons in 2007 (with an increase of 24.22%) (Durmuşoglu *et al,* 2010). Currently, 3 million tons in the world and 30,000 tons of pesticides in our country are used in order to protect of agricultural products (Durmuşoglu *et al*, 2010). However, the most important point is that pesticides application is a global public health problem, not only in consumption, but also in developing countries. Unsafe use of pesticides by agricultural workers is a result of poor understanding of the health risks of pesticides (Ngowi *et al,* 2002; Salameh *et al,* 2004; Dellavalle *et al,* 2012).

Studies investigating attitudes and behaviors, knowledge, risk perception, risk beliefs, and preventive method applications of farmers in pesticide use are being conducted around the world and interventional programs can be developed (Ngowi *et al*, 2001, 2002; Peres *et al*, 2005; Recena *et al*, 2006; Recena and Caldas, 2008; Le Prevost *et al*, 2011). However, it is not known how pesticides have been used by farmworkers, what they know about safety application methods, and how their habits help to prevent health risks from the use of pesticides in the Gallipoli Peninsula, Canakkale, Turkey. According to WHO, regional evaluation of pesticide application and continuous follow-up are important from the public health perspective to intervene against this important global health problem (WHOPES, 2012).

The aim of the present study was to investigate knowledge status and habits of farmworkers concerning pesticides in a village of Gallipoli Peninsula, Canakkale, Turkey.

MATERIALS AND METHODS

Study site

Gallipoli Peninsula is located in the European side of the Dardanelles. The Dardanelles divides the city of Canakkale into two sides, and different crops are grown on each side. Vegetables and fruits, such as tomatoes, apples, cherries, peaches are grown on The Anatolian side; cereals, such as wheat, sunflowers and corn are grown on the Gallipoli Peninsula. Therefore, farmers can choose to use different pesticide application methods because of the product variety.

Study population and data collection

This cross sectional study was carried out between January 9 and February 9, 2012 in the Village of Gallipoli Peninsula of Canakkale. According to the database of Address-based Birth Registry System of Turkish Statistical Institute (ABPRS) of the year 2011, the village population was 546 (females=270 and males=276). The village population changed according to the season. All households (n=180) were included in the present study.

The researchers collected data from 117 houses out of a total of 180 (65% of households were reached). A person over 18 years of age was included from each household. The questionnaire was created through a search of relevant literature and consisted of 21 questions about the socio-demographic characteristics of each participant and 47 questions investigating the farmers' knowledge of the pesticide effects, usage status of personal protective clothes, and safety usage of the pesticides.

Subjects were given background information about the purpose of the study

and its methodology and were given the opportunity to ask questions. Names are not used, as they are not related to the reliability of the survey. Participants who were absent or who did not wish to take part in the study were not included. Investigators completed the questionnaires with female farmers during house visits by face-to-face interview method. Male farmers were interviewed in the two coffee houses located in center of the village.

A questionnaire consisted of 11 items prepared by the researchers according to the related literature in order to evaluate whether or not farmworkers comply with the safety regulations for pesticide applications. Scoring of this questionnaire was performed according to responses (None: 1, Rare: 2, Sometimes: 3, Always: 4, Frequently: 5). Values of 1, 2, 3, 4, and 5 were given to favorable behaviors shown to item numbers of 1, 2, 7, 8 and 11. Values of 5, 4, 3, 2, and 1 were given to unfavorable behaviors shown to item numbers of 3, 4, 5, 6, 9, and 10. A high total score would indicate increasingly safe use of pesticides.

The statistical program SPSS® (version 19.0; IBM, Armonk, NY) was used in the analysis of descriptive data. Obtained data were presented as frequency and percentage values. Variables were checked as to whether they were normally distributed. Means, standard deviations, and range values were given in the descriptive analysis. Because safe use of pesticide total scores were not normally distributed, this parameter and compared variables were evaluated between the groups by using Kruskal Wallis test, and double comparisons were performed using Mann-Whitney *U* test. A $p < 0.05$ was accepted as statistically significant.

Ethical considerations

The study was approved by the Ethics Committee, Faculty of Medicine, Canakkale Onsekiz Mart University, Canakkale, Turkey (Ref Nº 050.99-221; 2012 Dec 28). In addition, informed and written consent was obtained from those who agreed to participate and the village authorities.

RESULTS

Demographic characteristics

The participants comprised of 38.5% females and 61.5% males. The mean age was 42.8 years. All participants (n=117) declared that they used pesticides at least once in their lives. Of the study group, 83.8% graduated from the primary school, 13.7% graduated from high school; 2 participants (1.7%) were literate, whereas one participant (0.8%) was illiterate. Responses about some demographic characteristics of farmers, their treatment seeking sites when they had health problems, presence of health problems, and substance abuse are shown in Table 1.

Of all respondents, 86.3% declared that they applied pesticides 1-5 days in a month, 10.3% of participants reported that they used pesticides 5-7 days in a month, and the remainder (3.4%) said that they used their pesticides more than 7 days in a month. Fifty-nine percent of subjects applied pesticides 3-7 hours a day, other farmers reported that they used pesticides 1-3 (22.2%) hours, and >7 (18.8%) hours a day (data not shown).

Of all respondents, 77.8% prepared chemical mixtures at the "village fountain," whereas 22.2% prepared them "at home." A majority (80.3%) of respondents stored the chemicals in storages places where they kept dry foods and other substances, 17.1% kept them in barns with animals; and 2.6% kept them in their houses. Approximately two-thirds of respondents (59.8%) knew the names of

Table 1
Socio-demographic characteristics of the study group in Canakkale, 2012.

Characteristics	*n* (%)
Gender	
Female	45 (38.5)
Male	72 (61.5)
Education level	
Illiterate	1 (0.8)
Literate	2 (1.7)
Primary school	98 (83.8)
High school	16 (13.7)
Marital status	
Married	99 (84.6)
Single	13 (11.1)
Widow	4 (3.4)
Divorced	1 (0.9)
Occupation	
Farmer	115 (98.3)
Housewife and farmer	2 (1.7)
Feeding livestock	
Yes	103 (88.0)
No	14 (12.0)
The first treatment seeking site for health problems	
FMC[a]	80 (68.4)
Hospital	37 (31.6)
Presence of health problems	
Yes	42 (35.9)
No	75 (64.1)
Smoking	
Yes	55 (47.0)
No	52 (44.5)
Used to smoke, but quit	10 (8.5)
Alcohol consumption	
Yes	45 (38.5)
No	65 (55.6)
Used to drink, but quit	7 (5.9)
Total	117 (100.0)

[a]Family Medicine Center.

chemicals they used, whereas 40.2% did not (data not shown).

After the applications of pesticides, 48.7% of respondents stated that they washed their dirty clothes unmixed and manually; 26.5% washed them in a washing machine and without mixing them with the other clothes; and 24.8% washed them in the washing machine with other clothes (data not shown).

Personal protective clothing use of farmers is shown in Table 2. Farmers stated that 82% of them never used overalls, 77% never used glasses, 68% never used a mask, 52% never used a jacket, 50% never used long pants, 46% never used boots/high boots, 45% never used a hat, and 43% never used gloves.

When safe chemical pesticide application methods by the farmers were investigated, 71% have applied the recommended dose every time; 40% reported that they sometimes used protective clothing; 63% reported that they have never smoked during the applications; 36% have sometimes applied pesticides when they were tired; 38% have sometimes consumed water and foods during applications; 39% reported that they have sometimes performed applications when they were very sweaty; 86% said that they have always changed their clothes after they applied pesticides; 83% reported that they have always taken shower during the day they applied pesticides; 38% stated that they sometimes applied pesticides against the wind; 44% said that they sometimes had breaks with short intervals during the pesticide applications; and 42% stated that they have sometimes taken preventive measures while they were cleaning or repairing the equipment for the pesticide application (Fig 1).

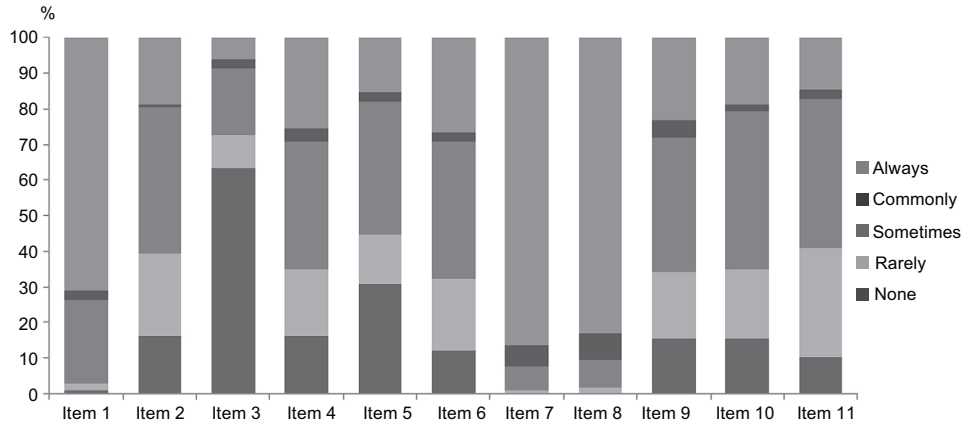
The total mean score for safe use of pesticide was 37.55±6.10 (min=22; max=50) in our group. No statistically significant difference was detected between safe use of pesticide total scores with respect to gender (p=0.245). There was no statistically significant difference between

Table 2
Protective clothing use reported by farmers in Canakkale, 2012.

Personal protective clothes	Always *n* (%)	Commonly *n* (%)	Sometimes *n* (%)	Never *n* (%)
Gloves	23 (19.7)	3 (2.6)	41 (35.0)	50 (42.7)
Glasses	5 (4.3)	1 (0.9)	21 (17.9)	90 (76.9)
Hat	21 (17.9)	6 (5.1)	37 (31.6)	53 (45.3)
Jacket	17 (14.5)	5 (4.3)	34 (29.1)	61 (52.1)
Pants	17 (14.5)	6 (5.1)	35 (29.9)	59 (50.4)
Boot-higher boot	20 (17.1)	2 (1.7)	41 (35.0)	54 (46.2)
Mask	5 (4.3)	2 (1.7)	31 (26.5)	79 (67.5)
Overalls	7 (6.0)	1 (0.9)	13 (11.1)	96 (82.1)

Table 3
Knowledge status of farmers about harmful effects of pesticides, and their attitudes and behaviors about empty chemical packages and buying pesticides, Canakkale, 2012.

Questions	*n* (%)
Are pesticides harmful?	
Yes	68 (58.1)
No	49 (41.9)
Do you check whether there are any animals in the surrounding before pesticide applications?	
Yes	65 (55.6)
No	52 (44.4)
Where do you throw the empty packages?	
In the field	44 (37.6)
Near the stream	22 (18.8)
In the woods	26 (22.2)
Gathering them in a bag and burn them	24 (20.5)
Into the well	1 (0.9)
Do you use the empty packages for other work?	
Yes	13 (11.1)
No	104 (88.9)
Where do you buy the pesticides?	
From chemical dealers	56 (47.9)
From county-farming-agriculture chambers	36 (30.8)
From markets selling chemical	14 (12.0)
From chemical dealers and agriculture chambers	10 (8.5)
From other farmers	1 (0.8)
Do you receive information where you have bought the pesticides?	
Yes	98 (83.8)
No	19 (16.2)
Do you consult when you are buying any pesticides?	
Yes	55 (47.0)
No	62 (53.0)
Total	117 (100.0)



Item 1, Application of the recommended dose; Item 2, Taking preventive measures during mixing the pesticides; Item 3, Smoking during pesticide application; Item 4, Chemical application when tired; Item 5, Eating and drinking during pesticide application; Item 6, Pesticide application when very sweaty; Item 7, Changing clothes after applications; Item 8, Having a shower in the same day after the application; Item 9, Pesticide application against the wind; Item 10, Frequent breaks during pesticide application; Item 11, Taking preventive measures while repairing the equipment.

Fig 1–Safe use of the pesticides in our study group, Canakkale, 2012.

education level and safe use of pesticide total scores (p=0.689). No statistically significant difference was detected in safe use of pesticide total scores between smoker and non-smoker farmers (p=0.176). There was a statistically significant difference in safe use of pesticide total score between farmers who reported health problems after pesticide application, and those who reported no problems in the previous one year (p<0.001).

Of all respondents, 42.7% said that they could not read product information leaflets, and 66.7% stated that they did not understand the labels on the chemical packages. When they were asked what they did when they could not understand the labels, 44.4% of respondents stated that they used less chemical, 37.6% responded that they did not use any, 8.5% stated that they continued using the chemicals, 5.1% said that they consulted someone, and 4.4% responded as unknown (data not shown).

Attitudes and behaviors of participants about harmful effects of chemical, empty chemical packages, and buying sites of the pesticides are shown in Table 3.

Of farmers, 78.6% reported that there were water sources around the fields they applied pesticides; 73.5% reported that they knew water, soil, and air were contaminated with the pesticides; and 44.4% reported to experience at least one health problem after pesticide application in the previous one year. All participants reported that they would like harmful effects and chemical use information included on the chemical packages as well as in the guidelines of pesticides clearly and in a plain language. Moreover, the majority of farmers included in our study

group (76.9%) reported that they would like to receive training sessions in safe use of pesticides (data not shown).

DISCUSSION

Gallipoli Peninsula is a region where small- and medium-sized family type of farming and livestock raising are the common occupations. Because Gallipoli Peninsula has appropriate geography for farming, which are more commonly plain fields, wheat products, such as wheat, corn, and barley are farmed with sunflowers. Our results indicated that farmers have not applied pesticides safely, and they rarely take personal protective measures or none at all.

The rapidly increasing needs for agricultural products leads to increased pesticide use in developing countries. However, these chemical agents have presented agriculture workers with occupational risks, especially in developing countries because they have been used in unsafe conditions (Ibitayo, 2006; WHOPES, 2012). In studies undertaken in Egypt and Thailand, it was reported that farmers used pesticides unsafely; they threw empty chemical packages and waste in unhealthy and unsafe conditions (Ibitayo, 2006; Plianbangchang *et al*, 2009).

In our study, 37.6% of farmers left the chemical packages in fields, 22.2% left them in the forests, 20.5% collected them in a bag to burn, and 0.9% threw them into wells (Table 3). In a study in Egypt (Ibitayo, 2006), knowledge levels about pesticides were defined as adequate, and a majority of farmers stated that they were not sure whether the pesticides they used contaminated ground water sources. It was reported that low knowledge level of farmers about pesticides might be related to variables such as low education levels of farmers. It was suggested that farmers gained information about pesticides and their uses often from official personnel, who were deemed reliable, while in a Thai study (Plianbangchang *et al*, 2009), the majority of farmers learned from advertisements.

In our study group, 47.9% reported that they bought pesticides from chemical dealers and 30.8% bought them from the county agriculture chambers; 83.8% said that they received information while they were buying, and 47% declared that they consulted while they were buying pesticides. Conversely, 16.2% of farmers were not informed, and 53% of farmers did not consult any persons or affiliations (Table 3). In a study in Tanzania (Ngowi *et al*, 2002), the majority of farmers reported that they knew that pesticides could enter human bodies, but very few farmers reported that they perceived pesticides as a big problem endangering public health. Although the majority of farmers knew that different pesticide uses might be dangerous, they did not know pesticides could cause intoxication in human (Ngowi *et al*, 2002).

In our study, 59.8% of farmers knew the names of pesticides they used, but 40.2% did not; also 78.6% of farmers knew that there were water sources around fields they applied pesticides, and 73.5% knew that pesticides contaminated water, soil, and air (data not shown). Participants who said that they knew the names of pesticides, stated that they performed pesticide applications most commonly in May-June, and farmers also stated that the most commonly used weed pesticides were herbicides with the active ingredients of "Trifluralin" and "Chlorsulfuron", amines, and pesticides for wheat insects.

In a Chinese study (Tu *et al*, 2012), acute pesticide intoxications were investigated, occupational pesticide intoxica-

tions resulted from risk factors such as the absence of safety instructions on pesticide use, farmers not able to read the chemical labels before applications, farmers wiped their sweat with their hands, or leakage from pulverizers. Farmers in our study also reported that they could not read or understand the pesticide labels and guidelines for use, although we found that there was only one illiterate person (0.8%). This may be because all farm workers do not have the same level of understanding of the labels on pesticide containers. Because most written precautions on the pesticide container are not completely readable and understandable, farm workers in our study reported that labels on the boxes should be written more clearly.

One of the most important points in pesticide use is that pesticide mixture is often used. Therefore, considering many different and unknown toxic effects may appear during mixing, it is crucial that the procedure should be performed according to chemical label instructions, and under safe conditions (Hernández *et al*, 2012). Occupational health could be promoted by training sessions on the use of cheap, safe, and efficient personal protective equipment, providing easily readable and understandable labels on chemicals (Han and Cai, 2012).

In our study group, majority of farmers (83.8%) graduated from the primary school. Moreover, all of the farmers indicated that they would like chemical labels written more clearly, precisely, and in a plain language; whereas, 76.9% would like to receive training sessions on safe use of pesticides.

Of farmers in our study group, 44.4% reported that they experienced at least one health problem after the pesticide application in the previous one year. The mean score for safe use of pesticide was statistically significant higher in farmers who had no health problems after the applications than those with health problems ($p<0.001$). This result was in line with the literature that the health of farmers could be protected by safe use of pesticide especially during the pesticide applications. In a study investigating protective glove use in farmers (Perry and Layde, 1998), 20% of farmers reported that they "Never" or "Mostly Not" used gloves, and 53.7% reported that they "Never" or "Mostly Not" wore protective clothing. After the last pesticide applications, 22% of farmers stated that they experienced dermatological exposure; whereas, 32% reported that they breathed in the pesticides. In a study from Brazil (Recena *et al*, 2006), 90% of farmers thought that pesticides were harmful for human health, but less than 20% of farmers used masks, impermeable clothing, or gloves while applying pesticide. In our study, similar results were obtained in terms of personal protective measures.

In Gazza, the majority of farmers said that pesticides affected their health, and protective measures should be taken during the applications. Although they knew that they should take precautions, none of agriculture workers took those precautions. Burning sensation in eyes and face were the most commonly encountered symptom (64.3%) reported (Yassin *et al*, 2002). In a study from Lebanon (Salameh *et al*, 2004), knowledge levels of farmers were low, and rates of taking protective measures were also low among farmers with low knowledge levels. In a study from Iran (Hashemi *et al*, 2012), there was no relationship between farmers' ages, and perception and application of safety measures.

The best reflecting factors for perception and application of safety measures

of farmers were their experiences of unwanted health problems related to previous pesticide application, and basic training that they received related to this issue. In a Ghana study (Ntow *et al*, 2006), researchers have found that farmers working in vegetable agriculture did not wear protective clothing, and did not perform pesticide applications under safe conditions. It was also observed that this condition increased the risk of intoxication. Cotton workers took no safety precautions during the pesticide applications in a Gambian study (Kuye *et al*, 2007). An adequate monitor system was not present for safe and correct use of pesticides all over the country.

Using personal protective equipment and safe and appropriate use of pesticides can reduce pesticide exposures. In the USA, effects of farmers' risk perceptions on personal protective equipment use and application stages (mixing the pesticides and application methods) were investigated (Dellavalle *et al*, 2012). The possibility of any personal protective equipment used during mixing the chemicals and loading stages were lower among the ones accepting the risk than their counterparts. Moreover, the farmers who took risks performed the preparation stage of chemicals approximately 15 meters away from their houses; whereas, the non-risk taker subjects worked 402 meters away. Investigators found that risk perceptions of farmers might affect the personal protective equipment use during application, and their attitudes and behaviors during chemical preparation stages.

In another study performed in USA, farmers who had any health problems related to pesticide use in the past, would be more probably show protective attitudes and behaviors in the future. Farmers who had health problems during pesticide mixing, loading up the pumps, and applications, would be more careful in pesticide use during the next periods; they searched for alternative methods, and at least they tried to reduce the pesticide use (Lichtenberg and Zimmerman, 1999).

In our study group, the majority of farmers (77.8%) stated that they prepared the pesticide mixtures, not in their houses, but at the village fountains. During observations in the village, two village fountains, which were in common use, were found. Water demands for both animals and humans were supplied from those fountains. Farmers had a misconception and mistaken attitude that they were protected from harmful effects when they prepared the mixtures at the fountains in the middle of village rather than preparing them in their houses. Although their preferences of mixing pesticides with water away from their houses indicated that they had risk perception, their preferences for village fountains indicated that they did not know that they risked environmental, animal, and human health significantly; furthermore, they did not perceive such conditions as risky.

In a study from Ethiopia (Karunamoorthi *et al*, 2012), 99% of participants knew pesticides had harmful effects on human health. However, 77.2% of farmers stated that they were using empty packages of pesticides at home for various reasons. A statistically significant correlation was shown between the education levels of farmers and the reported health complaints (Langley and Mort, 2012). In our study group, 58% of farmers said that pesticides were harmful, and 56% reported that they checked the area whether there were any animals present before pesticide applications. When compared with the Ethiopian study, only 11% of farmers in our study group stated that they were

using empty packages of pesticides for other reasons. However, if this is considered from the health protection point of view, the rate of this unfavorable behavior should be 0%, and the safest application methods should be encouraged for the minimum level of risk taking.

In our study, it was observed that 80% of farmers stored dry foods and animal feeds in the same place, called "storage," with the pesticides. Another important finding about very low level of farmers' risk perception in our study was that, although they did not understand the labels, 44% of them declared that they used pesticides in lower amounts; whereas, 9% used pesticides without any dose changes. Farmers touching the chemical packages with a "Poisonous" label with bare hands, storing pesticides with dry foods or animal feeds, using personal protective clothing at a very low rate or not at all, not caring about the safe use of pesticide all indicated that they did not perceive the dangers adequately, and they could not also predict risks in health.

According to WHO and other literature, healthier and environment-friendly alternative methods should be used against pests instead of chemical agents (Ngowi *et al*, 2002; Plianbangchang *et al*, 2009; WHOPES, 2012). Currently, it has been recommended that all those involved in the agriculture sector (farmers, consumers, chemical manufacturers, health personnel) should be encouraged to use pesticides safely, receive training sessions in using less toxic agents, and consider alternative control methods like biopesticide applications in solving this significant public health problem (Ngowi *et al*, 2001; Yassin *et al*, 2002; Karunamoorthi *et al*, 2012; Langley and Mort, 2012).

Continuous training programs could improve the knowledge level, attitudes, and behaviors in safe pesticide application, and monitoring of pesticide applications have decreased the amount of pesticides used, and increased farmer's awareness (Sam *et al*, 2008), along with reducing the numbers of intoxication cases (Mancini *et al*, 2009).

Although the present study has yielded some preliminary findings for Gallipoli territorial, there are some limitations in our study; one of them is study type. The second limiting factor is that we used and analyzed data reported by farmers; we did not use any specific types of measurement such as making field observations during farmers use pesticide and estimating dosage of pesticide used in the area. Further studies are required investigating duration of pesticide use and health problems, and causative relationships. Despite these limitations, our study is the first report on pesticide use by farm workers in the Gallipoli Peninsula in Turkey. Therefore, we believe that it can be a reference for similar studies, which will be performed in different regions of Turkey.

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REFERENCES

Calvert GM, Karnik J, Mehler L, *et al*. Acute pesticide poisoning among agricultural workers in the United States, 1998-2005. *Am J Ind Med* 2008; 51: 883-98.

Dellavalle CT, Hoppin JA, Hines CJ, Andreotti G, Alavanja MC. Risk-accepting personality and personal protective equipment use within the agricultural health study. *J Agromed* 2012; 17: 264-76.

Durmuşoglu E, Tiryaki O, Canhilal R. The use of pesticides, residues and durability problems in Turkey (in Turkish). Ankara: Turkey Agricultural Engineering 7th Technical Conference, 11-15 January 2010. [Cited 2012 Jun 05]. Available from: URL: http://www.zmo.org.tr/resimler/ekler/52cf38361a20908_ek.pdf

Han HY, Cai SK. [Research on health cost of pesticide application and influence factors]. *Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi* 2012; 30: 33-5.

Hashemi SM, Hosseini SM, Hashemi MK. Farmers' perceptions of safe use of pesticides: determinants and training needs. *Int Arch Occup Environ Health* 2012; 5: 57-66.

Hernández AF, Parrón T, Tsatsakis AM, Requena M, Alarcón R, López-Guarnido O. Toxic effects of pesticide mixtures at a molecular level: their relevance to human health. *Toxicology* 2013; 307: 136-45.

Ibitayo OO. Egyptian farmers' attitudes and behaviors regarding agricultural pesticides: implications for pesticide risk communication. *Risk Anal* 2006; 26: 989-95.

Karunamoorthi K, Mohammed M, Wassie F. Knowledge and practices of farmers with reference to pesticide management: implications on human health. *Arch Environ Occup Health* 2012; 67: 109-16.

Kuye RA, Donham KJ, Marquez SP, *et al*. Pesticide handling and exposures among cotton farmers in the Gambia. *J Agromedicine* 2007; 12: 57-69.

Langley RL, Mort SA. Human exposures to pesticides in the United States. *J Agromedicine* 2012; 17: 300-15.

Le Prevost CE, Blanchard MR, Cope WG. The Pesticide Risk Beliefs Inventory: a quantitative instrument for the assessment of beliefs about pesticide risks. *Int J Environ Res Public Health* 2011; 8: 1923-35.

Levesque DL, Arif AA, Shen J. Effectiveness of pesticide safety training and knowledge about pesticide exposure among Hispanic farmworkers. *J Occup Environ Med* 2012a; 54: 1550-6.

Levesque DL, Arif AA, Shen J. Association between workplace and housing conditions and use of pesticide safety practices and personal protective equipment among North Carolina farmworkers in 2010. *Int J Occup Environ Med* 2012b; 3: 53-67.

Lichtenberg E, Zimmerman R. Adverse health experiences, environmental attitudes, and pesticide usage behavior of farm operators. *Risk Anal* 1999; 19: 283-94.

Mancini F, Jiggins JL, O'Malley M. Reducing the incidence of acute pesticide poisoning by educating farmers on integrated pest management in South India. *Int J Occup Environ Health* 2009; 15: 143-51.

Ngowi AV, Maeda DN, Partanen TJ. Knowledge, attitudes and practices (KAP) among agricultural extension workers concerning the reduction of the adverse impact of pesticides in agricultural areas in Tanzania. *Med Lav* 2002; 93: 338-46.

Ngowi AV, Maeda DN, Partanen TJ. Assessment of the ability of health care providers to treat and prevent adverse health effects of pesticides in agricultural areas of Tanzania. *Int J Occup Med Environ Health* 2001; 14: 349-56.

Ntow WJ, Gijzen HJ, Kelderman P, Drechsel P. Farmer perceptions and pesticide use practices in vegetable production in Ghana. *Pest Manag Sci* 2006; 62: 356-65.

Peres F, Rozemberg B, de Lucca SR. Risk perception related to work in a rural community of Rio de Janeiro State, Brazil: pesticides, health, and environment. *Cad Saude Publica* 2005; 21: 1836-44.

Perry MJ, Layde PM. Source, routes, and frequency of pesticide exposure among farmers. *J Occup Environ Med* 1998; 40: 697-701.

Plianbangchang P, Jetiyanon K, Wittaya-Areekul S. Pesticide use patterns among small-scale farmers: a case study from Phitsanulok, Thailand. *Southeast Asian J Trop Med Public Health* 2009; 40: 401-10.

Recena MC, Caldas ED. Risk perception, attitudes and practices on pesticide use among farmers of a city in Midwestern

Brazil. *Rev Saude Publica* 2008; 42: 294-301.

Recena MC, Caldas ED, Pires DX, Pontes ER. Pesticides exposure in Culturama, Brazil: knowledge, attitudes, and practices. *Environ Res* 2006; 102: 230-6.

Salameh PR, Baldi I, Brochard P, Abi Saleh B. Pesticides in Lebanon: a knowledge, attitude, and practice study. *Environ Res* 2004; 94: 1-6.

Sam KG, Andrade HH, Pradhan L, *et al*. Effectiveness of an educational program to promote pesticide safety among pesticide handlers of South India. *Int Arch Occup Environ Health* 2008; 81: 787-95.

Tu ZB, Cui MJ, Yao HY, *et al*. [A case-control study on the risk factors of work-related acute pesticide poisoning among farmers from Jiangsu province]. *Zhonghua Liu Xing Bing Xue Za Zhi* 2012; 33: 382-5.

Yassin MM, Abu Mourad TA, Safi JM. Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip. *Occup Environ Med* 2002; 59: 387-93.

World Health Organization (WHO). Health topics. Pesticides [webpage]. Geneva: WHO, 2012a. [Cited 2012 May 21]. Available from: http://www.who.int/topics/pesticides/en/

World Health Organization (WHO). Chapter 10: safe use of pesticides [webpage]. Geneva: WHO, 2012b: 385-97. [Cited 2014 Jun 05]. Available from: http://www.who.int/water_sanitation_health/resources/vector385to397.pdf

WHO Pesticides Evaluation Scheme (WHOPES). [webpage]. Geneva: WHOPES, 2012. [Cited 2014 May 21]. Available from: http://www.who.int/whopes/questions/en/index.html

Zhang WJ, Jiang FB, Ou JF. Global pesticide consumption and pollution: with China as a focus. *Proc Int Acad Ecol Environ Sci* 2011; 1: 125-44.