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ARAŞTIRMA / RESEARCH

Are pesticide applicators in Turkey able to protect themselves?

Türkiye'de pestisit uygulayıcıları kendilerini koruyabiliyorlar mi?

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Abstract

Purpose: The purpose of this study was to determine various characteristics of municipal workers engaged in nonagricultural pesticide application and factors related to proper pesticide application and pesticide-related health symptoms.

Material and Methods: This was a descriptive study. A supervised questionnaire was administered to 1344 pesticide applicators in 63 of the 81 provincial municipalities in Turkey that perform such procedures.

Results: All the participants in the research were male. The results showed that 83.9% of pesticide applicators showered after each application, 51.6% had showering facilities in their workplaces and 40.4% washed the clothing they wore during the procedure after each application. The factor receiving most attention during application was the direction of the wind (97.2%). Rates of use of personal protective equipment were goggles 87.3%, masks 88.1%, rubber boots 90.2%, hats 90.9%, long-sleeved shirts 91.1%, gloves 91.2%, long rousers 92.2%, overalls 95% and jackets 100%. The level of applicators performing correct procedures was 44.3%. The factor negatively affecting correct application was working in the field for more than 1 year, while factors with positive impacts were never smoking, working 6 hours a day or less and appropriate training. At least one health symptom possibly related to pesticides was present in 25.3% of participants. Factors affecting presence of at least one health symptom were total employment exceeding 5 years, alcohol use, incomplete use of personal protective equipment and failure to perform proper procedures.

Conclusions: Despite the legal provisions concerning pesticide applicators in Turkey, incomplete and defective procedures still persist. Health symptoms may also possibly be seen as a result.

Key words: Pesticide, pesticide applicator, Turkey

Öz

Amaç: Bu çalışmada tarım dışı alanda pestisit uygulaması yapan belediye çalışanlarının pestisit uygulaması ile ilgili bazı özellikleri ile doğru pestisit uygulamaya ve pestisitlerle ilişkili sağlık yakınmalarının varlığına etki eden faktörlerin belirlenmesi amaçlanmıştır.

Gereç ve Yöntem: Tanımlayıcı türde bir çalışmadır.Türkiye'deki 81 il belediyesinden 63'ünde pestisit uygulaması yapan 1344 çalışana gözlem altında anket uygulanmıştır.

Bulgular: Araştırmaya katılanların tamamı erkektir. Pestisit uygulayıcılarının %83.9'u her uygulama sonrası duş almakta; %51.6'sının işyerinde duş alma olanağı bulunmakta; %40.4'ünün uygulama sırasında giydiği kıyafet her uygulamadan sonra yıkanmaktadır. Uygulama sırasında araştırmaya katılanlar en fazla rüzgarın esme yönüne dikkat etmektedir (%97.2). Kişisel koruyucu malzemelerin kullanılma sıklıkları; gözlük %87.3, maske %88.1, lastik çizme %90.2, şapka %90.9, uzun kollu gömlek %91,1, eldiven %91.2, uzun pantolon %92.2 tulum %95.0, mont %100.0 olarak bulunmuştur. Katılımcıların %44.3'ü pestisit uygulamasını doğru yapmaktadır. Doğru uygulama yapmaya olumsuz etkili faktör bu işte 1 yıldan daha fazla çalışma; olumlu yönde etkili olanlar ise hiç sigara içmeme, günde 6 saat ve daha az çalışma ile eğitim almış olmadır. Katılımcıların %25.3'ünde pestisitlerle ilişkili olabilecek en az bir sağlık yakınması bulunmaktadır. En az bir sağlık yakınması varlığına etki eden faktörler toplam çalışma süresi 5 yıldan uzun olma, alkol kullanma, günde 6 saatten fazla çalışma, kişisel koruyucu malzemeleri tam kullanmama ile doğru pestisit uygulaması yapmamadır.

Sonuç: Türkiye'de pestisit uygulayanlara yönelik yasal düzenleme olmasına rağmen eksik ve hatalı uygulamaların olduğu da saptanmıştır. Belki bunun sonucu olarak da sağlık yakınmaları görülebilmektedir.

Anahtar kelimeler: Pestisit, pestisit uygulayıcısı, Türkiye

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INTRODUCTION

Pesticides are toxic chemical substances widely used across the world in order to eradicate or control undesirable organisms regarded as harmful to humans, animals and plants[1-5]. They can be absorbed by the human body through the respiratory system, the gastrointestinal system, the skin and the eyes. Approximately 97% of humans are affected by skin contact[2,3,5-9]. Those most at risk in terms of adverse health effects are pesticide manufacturers, personnel involved in storage and preparation, and pesticide applicators, in whom various chronic and acute health problems can occur[3,5,8-11].

Non-agricultural pesticide applications in Turkey are carried out according to principles determined by and supervised by the Ministry of Health[12]. The main institutional organizations applying non-agricultural pesticides in Turkey, particularly aimed at recreation areas, towns and buildings, are the municipalities. Studies have largely investigated the effects of pesticides on agricultural workers in Turkey[13-19]. No previous studies have considered non-agricultural pesticide applicators and municipal workers. The purpose of this study, the first to investigate the position of municipal workers in terms of non-agricultural pesticide use in Turkey, was to reveal the pesticide application-related status of municipal pesticide operatives and also to determine self-reported health complaints potentially linked to pesticides and factors affecting correct pesticide application and pesticide-related symptoms or diseases. This study is the first to elicit data concerning the true position of non-agricultural pesticide applicators, despite the legal regulations in force in Turkey and the sector being more tightly controlled than the agricultural sector. The study will contribute to identifying problems in this area and to generating proposals for solutions.

MATERIALS AND METHODS

Ethical approval for this descriptive study was obtained from the Hacettepe University Senate Ethical Committee (permission No. 1039 dated 29.03.2011). Participants were informed about the study, and verbal consent was obtained.

There are 81 provincial municipalities in Turkey, with pesticide application being performed in 63. We contacted 1344 of the total 1571 workers involved in pesticide application in these municipalities (a participation rate of 89%), and a questionnaire was administered under supervision. Data were collected between August and November 2011.

The questionnaire was prepared by the authors. It contains questions intended to determine sociodemographic characteristics such as age and educational status, behavior during pesticide applications, such as use of special clothing and showering after application, use of personal protective clothing and health complaints potentially associated with pesticides (fatigue, headache, reddening/tears in the eyes, cough, sensitivity in the throat, skin reddening/itching/swelling etc.) .

A pre-test was performed with 50 individuals working in one pesticide and spraying company who were not included in the study.

Definitions

Health complaints: Health symptoms reported in workers involved in pesticide application and investigated in the questionnaire were fatigue, headache, reddening/tears in the eyes, cough, sensitivity in the throat, skin reddening/itching/swelling, back pain, sleeplessness, irritability, nocturnal sweating, nasal reddening/obstruction, shortness of breath, nasal discharge, muscle cramps, decreased appetite, dizziness, joint pain/swelling, depression, muscle spasms, abdominal pain, blurred vision, palpitation or hearth rhythm disturbance, constipation, contractions, nausea, fever, diarrhea, nosebleed and vomiting[3,5,6,10,20].

Daily hourly conditions of pesticide applicators: Not more than 6 hours a day and 3 hours a day uninterrupted[12].

Full use of personal protective equipment: Subjects using all the following at the same time when applying pesticides;

- Wearing a long-sleeved shirt or jacket
- Long trousers or overalls
- Headgear
- Goggles
- Mask
- Gloves
- Rubber boots

Subjects performing correct procedures: Those performing all the following;

a. Wearing overalls during spraying or 'buttoning up shirts and tucking them into the trousers when spraying'
b. Using gloves, boots and headgear during spraying
c. Paying attention to the wind direction when spraying

Statistical analyses

Logistic regression analysis was performed in order to identify both factors influencing correct application during spraying and those affecting possession of at least one health symptom. When performing logistic regression analysis, univariate analysis results were evaluated first. Univariate logistic regression analyses were also performed. Variables with $p<0.20$ at this analysis were included in the multivariate logistic regression model.

In that context, a model was established involving correct application during spraying as a dependent variable, and education level, age, working for a municipality or private company, working more than 6 hours a day, working continuously more than 3 hours a day, receiving training concerning spraying, length of employment in this work, smoking status and having children as independent variables. In order to examine factors influencing possession of at least one health symptom, correct application during spraying, length of working, cigarette use status, alcohol use status, hours worked per day, and full use of personal protectors were adopted as independent variables, and the model was then investigated.

Table 1. Sociodemographic characteristics of participants.

Sociodemographic characteristics	Number	Percentage
Age (n=1285)		
15-24	90	6.9
25-34	436	33.7
35-44	469	36.3
45-54	267	20.6
55 or over	33	2.5
Education level (n=1331)		
Literate	15	1.1
Primary school	583	43.8
Middle school	327	24.6
High school	337	25.3
College/University	69	5.2
Employment status (n=1316)		
Working for private pesticide firm	1158	88.0
Municipal worker, primarily employed in pesticide applicator	81	6.2
Municipal worker/not primarily employed in pesticide applicator	77	5.8
Length of employment (n=1302)		
< 1 year	268	20.6
1-5 years	820	63.0
> 5 years	214	16.4
Received instruction concerning spraying (n=1282)		
Yes	1091	85.1
No	191	14.9
Smoking status (n=1327)		
Still smoking	674	50.8
Never smoked	356	26.8
Quit	297	22.4
Alcohol consumption status (n=1314)		
Never consumed alcohol	894	68.0
Drinks on special occasions	227	17.3
Used to drink, but no longer	178	13.5
Drinks regularly	15	1.1

Logistic regression results were expressed as estimated relative risk (OR), 95% confidence interval (CI) and level of statistical significance (p). Qualitative data were expressed as number and percentage.

RESULTS

All the participants in the research were male. Mean age of the participants was 37.2±8.8 years, and mean length of employment in pesticide application was 39.9±35.4 months. Various sociodemographic characteristics are shown in Table 1. The results showed that 83.9% of participants showered after each application, 51.6% reported that showering facilities were available in their workplaces and 38.6% of the entire study group reported showering at work after each application. Clothing worn during spraying was washed after each application in 40.4% of cases, with 66.2% of subjects washing their clothing at home. Participants in the study paid the most attention (97.2%) to wind direction, while the least attention was paid to 'glove, boot and headgear use' (97.2%) (Table 2). The protective equipment most commonly provided by employers were gloves (97.7%), while the most commonly used were jackets (100%) (Table 3).

Table 2. Various characteristics executed by participants during application

Characteristic	Number	Percentage
Showering		
Subjects showering after every application (n=1217)	1127	83.9
Subjects with showering facilities at work (n=1286)	663	51.6
Subjects showering at work after each application (n=626)	496	79.2
Subjects showering at work after each application (among all participants) (n=1286)	496	38.6
Clothing worn during application		
Special clothing provided by the company (n=1327)	1224	92.3
Clothing washed after each application (n=1325)	543	40.4
Clothing washed at home (n=1329)	880	66.2
Clothing washed at home together with other clothes (n=897)	709	79.0
Procedures in most recent pesticide application		
Noting wind direction during spraying (n=1187)	1154	97.2
Doing up buttons of clothing worn during application (n=1133)	1055	93.1
Tucking shirt into trousers during application (n=1109)	929	83.8
Wearing overalls during application (n=1133)	843	74.4
Using gloves, boots and hat during application (n=1068)	722	67.6
Smoking during application (n=1327)	74	5.6
Eating or drinking during application (n=1310)	95	7.3

Table 3. Features of protective equipment for participants

Personal protective equipment	Provided with personal protective equipment by employer		Using personal protective equipment		Personal protective equipment available for use	
	No.	%*	No.	%**	No.	%***
Jacket	13	1.0	13	100.0	13	100.0
Overalls	201	15.0	191	95.0	191	100.0
Long trousers	1287	95.8	1187	92.2	1088	91.7
Gloves	1313	97.7	1197	91.2	1106	92.4
Long-sleeved shirt	1235	91.9	1125	91.1	1048	93.2
Hat	1292	96.1	1174	90.9	1096	93.4
Rubber boots	1179	87.7	1064	90.2	1013	95.2
Mask	1289	95.9	1136	88.1	1039	91.5
Goggles	990	73.7	864	87.3	864	100.0

* Based on n=1344, ** Based on 'Equipment given, *** Based on 'Using.

The number of subjects correctly performing all procedures during pesticide application was 596. Logistic regression analysis was performed in order to investigate the factors affecting correct procedure during application. Accordingly, subjects working in pesticide application for more than 1 year constituted a risk group in terms of correct pesticide procedures (OR:0.63, 95% CI:0.41-0.95; OR:0.34, 95% CI:0.20-0.58) while factors affecting correct procedures were identified as working for 6 hours or less a day (OR:3.95, 95% CI:2.81-5.55) and receiving proper instruction on the subject of pesticide application (OR:5.12, 95% CI:3.15-8.30) (Table 4).

Table 4. Factors affecting correct pesticide application procedures; logistic regression analysis results.

Characteristic	OR	95% CI	p
Age			
<25	1		
25-34	0.77	0.41-1.46	0.426
35-44	1.01	0.53-1.92	0.972
≥45	1.18	0.59-2.35	0.646
Education level			
Literate/primary school graduate	1		
Middle school graduate	1.00	0.70-1.61	0.785
High school graduate	1.11	0.73-1.66	0.646
University / college graduate	0.58	0.28-1.22	0.152
Smoking status			
Still smoking	1		
Ex-smoker	1.27	0.83-1.93	0.271
Never smoked	1.39	0.94-2.03	0.096
Total years worked			
<1 year	1		
1-5 years	0.63	0.41-0.95	0.028
>5 years	0.34	0.20-0.58	<0.001
Employment status			
Municipal worker	1		
Private company worker	0.81	0.47-1.39	0.442
Working more than 6 hours a day			
Working more	1		
Working 6 hours or less	3.95	2.81-5.55	<0.001
Working more than 3 hours uninterrupted			
Working more	1		
Working 3 hours or less uninterrupted	1.26	0.86-1.84	0.242
Training regarding pesticide application			
No	1		
Yes	5.12	3.15-8.30	<0.001

Three hundred forty participants (25.3%) reported 'at least one pesticide-related health complaint' after pesticide application. Logistic regression analysis was performed to examine the factors affecting possession of at least one symptom. More health complaints were observed in subjects working for longer than 5 years (OR:1.74, 95% CI:1.03-2.92), using alcohol (OR:2.12; 95% CI:1.33-3.37; OR:2.01; 95% CI:1.36-3.04), working more than 6 hours a week (OR:3.22, 95% CI:2.45-4.63), not using personal protective equipment (OR:3.30, 95% CI:2.32-4.70), and not performing the correct procedures during application (OR:2.43, 95% CI:1.70-3.47), than in other groups (Table 5).

DISCUSSION

Showering as soon as possible and in the workplace is recommended after pesticide application in order to keep length of contact with the skin to a minimum. Showering facilities therefore need to be provided in the workplace[2,4,10]. In this study, 83.8% of subjects reported showering after each pesticide application. One study from Turkey involving

farmers applying pesticides reported a rate of 59% showering after those procedures. A study from Ethiopia reported a level 33.1%, and one from Brazil reported a level of 97.0%[18,21,22].

In addition, despite there being an obligation to provide showering facilities in workplaces in Turkey, only half the subjects in this study stated that such facilities were available in their places of work, and only 38.6% of all participants stated that they showered in the workplace after every application. Although the level determined in this study appears higher than those in some other studies, 17.4% of subjects not showering and the level of showering in the workplace being low may be regarded as posing a risk to the individual and the family.

Table 5. Factors affecting possession of at least one health complaint; logistic regression analysis results.

Characteristic	OR	95% CI	p
Total time worked (years)			
<1 year	1		
1-5 years	0.99	0.68-1.45	0.974
>5 years	1.74	1.03-2.92	0.038
Smoking status			
Never smoked	1		
Quit	0.88	0.54-1.41	0.582
Still smoking	0.77	0.52-1.15	0.198
Alcohol consumption			
Never used	1		
Quit	2.12	1.33-3.37	0.001
Still using	2.01	1.36-3.04	0.001
Hours worked per day			
6 hours or less	1		
More than 6 hours	3.22	2.45-4.63	<0.001
Full use of personal protective equipment			
Yes	1		
No	3.30	2.32-4.70	<0.001
Correct procedures during pesticide application			
Yes	1		
No	2.43	1.70-3.47	<0.001

Contaminated clothing must be removed at once, showers taken and clean clothing put on for the health of the individual worker and of the general community, and work clothing must be washed after each application[2,4,23,24]. A study from Greece reported that 48% of subjects washed their clothes after several applications[25]. In a study from Brazil, 4.5% of participants said that they changed their clothing after applying pesticides[22]. In that study, 60% of subjects reported wearing contaminated clothing several times, and 10% even said they continued their daily lives and went home wearing the same clothing as during application. These results show an alarming lack of information and problem behavior among pesticide operatives.

It is also very important for such work clothing to be washed in the workplace and never to be washed together with other clothing at home[2,4,10,15,26-28]. However, 66.2% of participants said that they washed such clothing at home, and 79.0% said it was washed together with other clothing in the home. A study of agricultural workers from Turkey reported that 45.3% of subjects washed their work gear at home, and that 31.5% washed it together with other clothing. [18] A study from the Philippines reported that 45.3% of subjects washed work clothes at home and that 31.5% washed it together with other clothing, while a study from India reported that 63.0% of subjects washed work clothing with other clothes[29,30]. This is significant in revealing that in addition to the operative himself, the health of people sharing the same home is also at risk. The use of personal protective equipment is exceedingly important in order to prevent operatives being affected by pesticides[2,3,6,11,31]. Prevalence of personal protective equipment use in studies from other countries are shown in Table 6[13-19,21,22,25,29,30,32-38].

Table 6. Levels of personal protective equipment use in the literature (%).

	Mask	Gloves	Full covering protective clothing/special clothing	Boots/special footwear	Any personal protective equipment
Ethiopia (Mekonnen and Agonafir, 2002)(21)					6.7
Armenia (Tadevosyan et al., 2013)(32)	11.0	21.3			
Brazil (Pasiani et al., 2012)(22)	72.3	57.1	58.9	78.6	
Brazil (Recena et al., 2006)(33)	18.4	15.9	9.4	36.3	
Brazil (Waichman et al., 2007)(34)	1.0	5.0	1.0	85.0	
Palestine (Zyoud et al., 2010)(30)	37.5	48.6	63.0	59.1	
Greece (Damalas et al., 2006)(25)	3.0	8.0	7.0	63.0	54.0
Costa Rica (Polidoro et al., 2008)(35)					31.0
Lebanon (Salameh et al., 2004)(36)	2.0	22.0	8.0	47.0	
El Salvador (Mejia et al., 2014) (37)	10.0	10.0	23.0	30.0	
India (Mohanty et al., 2013) (29)	55.0	46.0	59.0	22.0	
British Columbia (Nicol et al.,2008) (38)	75.0	84.0			63.0
Turkey (Şahin et al., 2010) (17)	9.0	23.5	9.6	4.4	24.0
Turkey (Tuna, 2011) (19)	35.5	37.0	12.1		
Turkey (Işın and Yıldırım, 2007) (16)	48.0	26.0			
Turkey (Ergönen et al., 2005) (14)	29.0				41.0
Turkey (Demircan and Aktaş, 2004) (13)	34.8	34.8			35.0
Turkey (Şimşek, 2012) (18)	34.0	45.0	12.5		
Turkey (Gün and Kan, 2009) (15)	42.6		9.8		19.7
The present study	88.1	91.2	95.0	90.2	

The high level of personal protective equipment use in this study compared to other research may be largely attributed to the use of such equipment being enshrined in law in Turkey. Standards have also been established for personal protective equipment for pesticide applicators in Turkey[39,40]. In addition, the fact that the research group consisting of workers with official status, rather than agricultural workers/farmers whose activities are impossible to check, may also have contributed to the high level of use. In that context, legal measures regarding pesticide applicators will be useful in protecting them from the harmful effects of pesticides. Another point requiring emphasis here is effective

and constant monitoring of use of personal protective equipment among pesticide applicators and operatives. Additionally, although the questionnaire asked 'Do you use personal protective equipment?' the fact that the study was not an observational assessment, that it was self-reported in other words, may represent a limitation. Another point that should not be forgotten in the use of personal protective equipment is that these should not be permeable to pesticides, and that 'all such equipment must be used all the time.'

Behavior such as eating, drinking or smoking during pesticide application can increase the amount of pesticide entering the body. The incidence of smoking during application in this study was 5.6%, and that of eating during application was 7.3%. Various studies involving agricultural workers from Turkey have reported levels of smoking during application of 18-32% and of eating or drinking during application of 36-73%[14,16,17,19]. Studies from Brazil, Ethiopia and Palestine have reported levels of eating and drinking between 14% and the very high figure of 79.4% [21,29,30]. A study of farmers in Palestine reported that 30% smoked during pesticide application[30]. We think that the low incidences in our study, in contrast to agricultural workers (farmers), who are less supervised, may be due to the operatives working for companies with control mechanisms and receiving appropriate training on the subject.

In terms of use of personal protective equipment, studies in the literature generally cite levels of use of any item of such equipment. However, all such equipment must be used, and on a continuous basis, in order to achieve protection against the effects of pesticides. According to logistic regression analysis performed in order to examine the factors involved in correct application procedures, subjects working for more than one year in pesticide application were interestingly a risk group in terms of correct procedures. This may be due to a gradual lack of sensitivity to chronic effects of pesticide application that are more important than acute effects but that do not appear immediately.

In contrast, positive behaviors such as not smoking and receiving training on the subject of pesticide application were, as anticipated, among the factors positively affecting correct procedures. The position of those individuals working 6 hours or less suggested that subjects working shorter hours are more cautious and thus more sensitive.

The incidence of at least one health complaint possibly associated with pesticides in this study was 25.3%. One study of agricultural workers in Turkey reported an incidence of health symptoms of 72.1%[17]. The relatively low incidence of health complaints in this study may be ascribed to the higher level of use of personal protective equipment.

According to logistic regression analysis performed to examine potential factors involved in presence of at least one health complaint, more symptoms were observed in subjects with a total length of employment exceeding 5 years, those using alcohol, those working more than 6 hours a day, those not using personal protective equipment and those not performing correct procedures during application compared to other groups. Research from America reported a 5-fold lower level of health complaints in a group with a high level of use of personal protective equipment.[41] In that context, there may be an association with a failure to use personal protective equipment properly and completely, and care needs to be taken to ensure that pesticide applicators use such equipment fully and properly.

One limitation of this study is that the health symptoms assessed are non-specific. These were selected from those linked to pesticides in the literature[3,5,6,10,20]. These symptoms may also occur in association with smoking, alcohol use or other causes. Despite their being non-specific, it must not be forgotten that these symptoms can also indicate the effect of pesticides, and their presence in pesticide applicators must not be disregarded or underestimated. We think that this study should be interpreted in the light of this limitation.

In conclusion, there are legal regulations in place in Turkey for the protection of pesticide applicators against the effects of pesticides, and these have positive effects. However, we also determined various gaps and incorrect practices. Provision of training using adult education models, and continuous and effective supervision are essential in order to bring about a change of behavior in operatives to ensure complete compliance with regulations.

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