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ORIGINAL ARTICLE

Effects of different occupational exposure factors on the respiratory system of farmers: the case of Central Anatolia

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Abstract

Aim Past studies show that farmers are especially at risk for respiratory diseases due to occupational exposure and not using protective equipment. This study aimed to provide information about the effects of occupational pesticide exposures on the respiratory system of farmers working in Central Anatolia from a wider perspective to gain insight into the effects of pesticides and other occupational exposures on the respiratory system of farmers.

Subject and methods A cross-sectional study was conduct with a representative sample size of 380 agricultural workers living in the Central Anatolia region. Data were collected with a face-to-face questionnaire and spirometry. The chi-square test was used for testing relationships between categorical variables. The Shapiro–Wilk test was conducted to investigate the distribution characteristics of FVC, FEV_1, FEV_1/FVC and FEF_{25-75} ($p > 0$ .050), and nonparametric Mann–Whitney U tests (MW) and Kruskal–Wallis tests were used to examine differences in FVC, FEV_1, FEV_1/FVC and FEF_{25-75} between groups. Univariate analysis was performed before multiple logistic regression analyses to identify candidate variables for the final model.

Results The median duration of pesticide use was 25.00 years. According to the FEV_1 of agricultural workers, 23.16% had an FEV $1 \leq 80\%$ predicted. The odds for FEV1 ≤ 80% predicted was 2.44 times higher for smokers (95% CI 1.2–5.0), 1.74 times higher for those with respiratory symptoms in the past 3 months (95% CI 1.1–2.9) and 5.01 times higher for those farming 30 years and more (95% CI 1.8–14.1).

Conclusion The results of the study found that pulmonary function values of agricultural workers were lower compared to reference values. Lower FEV1 was associated with the duration of farming and smoking.

Keywords Agricultural workers · Occupational exposure · Pesticide · Agricultural health · Spirometry

Introduction

Agricultural workers are an occupational group that should be given priority in terms of public health (ILO 2011). The risk of accumulated exposure is higher from an early age due to long working hours and multiple exposures at work and home environments (Rother 2000). Those working in agriculture may be exposed to a variety of organic–inorganic dust and pesticides, during planting and harvesting and may experience health problems related to this exposure (Lamprecht et al. 2007; ILO 2011; Unenvironment Programme 2020). Agricultural workers are exposed to a wide range of inhalatory agents: inorganic dust from the soil; organic dust containing microorganisms, mycotoxins, or allergens; decomposition gases; pesticides; etc. These exposures occur when handling animals, harvesting grains or other plant matter, and handling chemicals such as pesticides and disinfectants (Schenker et al. 1998). Exposures to airborne dust particles derived from

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farming activities, including grain dusts, have consistently been associated with adverse respiratory health effects, including chronic cough, chronic phlegm, reduced lung function, shortness of breath and wheezing (Mirabelli et al. 2011). Grain dusts exposure has been associated with a range of acute and chronic respiratory symptoms and reduced lung function (Spankie and Cherrie 2012). High levels of occupational exposure may be due to insufficient knowledge of the risks, unsafe use or deficiency of personal protective equipment (PPE), especially in developing countries (Bouvier et al. 2006; ILO 2011). In addition, those with sufficient knowledge and equipment may not be using PPEs as they underestimate the risks (Bouvier et al. 2006). It has been proven by many studies that these unwanted health effects can be prevented or at least minimized by appropriate protection. However, there is a knowledge gap among farmers regarding hazards caused by dust, chemicals and control measures (Cramer et al. 2017; Linaker and Smedley 2002; Schenker et al. 2002).

In developing countries, agricultural workers encounter pesticide exposure from the use of pesticides that have restricted use or are banned in developed countries, improper application techniques, use of leaking or otherwise faulty equipment, and improper reuse of pesticide containers such as storing food and water (Ibitayo 2006). Pesticides are used in different amounts to protect agricultural products. Sometimes this amount may exceed the recommended limits (Damalas and Eleftherohorinos 2011; ILO 2011). This situation increases the amount of pesticide exposure and leads to negative health outcomes. As a result, the agricultural worker does not adopt practices or use protective equipment (Remoundou et al. 2014). Kapeleka et al. also found that even though workers understand the poisonous nature of pesticides and their potential to harm and even kill users, most of them do not properly use personal protective equipment (Kapeleka et al. 2016).

The prevalence and incidence of work-related respiratory disease, including asthma, bronchitis and upper respiratory tract symptoms remained high among livestock workers (Sigsgaard et al. 2020). The respiratory system is one of the most affected systems by this exposure. Field research has shown high levels of respiratory problems among agricultural workers, such as asthma, chronic bronchitis, and other respiratory dysfunctions (Chatzi et al. 2005; Dalphin et al. 1998; Gainet et al. 2007; Zejda and Dosman 1993). The prevalence of respiratory disease and symptoms among people working in agriculture in Turkey has recently been investigated by only focusing on asthyma disease (Saglan et al. 2020). This study aims to provide information about the effects of occupational pesticide exposures on the respiratory system of farmers working in Central Anatolia from a wider perspective.

Methods

Study design

A representative multipurpose cross-sectional study was conducted in Kirsehir between June–October 2018. Kirsehir is located in the Central Anatolia region of Turkey, with a general population of 229,975. Approximately 42% of the population lives in rural areas (Turkish Statistical Institute Population Registration System 2017). Selected farmers were invited to the local Provincial Agriculture and Forestry office to conduct the surveys and the spirometry.

Study population

According to the Provincial Directorate of Agriculture and Forestry of Kirsehir, 20,516 individuals are employed in agriculture and animal husbandry (Kirsehir Directorate of Provincal Agriculture and Foresty 2017). The following sample size formula was used to calculate the sample size. Using a probability cluster sampling method, the sample size (n) was calculated as 377, where the populatiın size (N) was 20,516; $n = \frac{Nt^2pq}{d^2(N-1)+t^2pq}$ are the z-score values of +1.96 that are the critical for a two-tailed hypothesis test using the normal distribution for representing the sample distribution (1.96), P is the probability of occurrence frequency of an incident (0.50) and d is the deviation of occurrence frequency of an incident (0.05).

An alphabetical list of all registered farmers was obtained from the Ministry of Agriculture and Forestry Kirsehir Directorate of Provincial Agriculture and Forestry. We performed a systematic sampling according to the surname list. The number of participants was distributed according to the ratio of populations of each county to the total population of Kirsehir (Table 1). Involuntary farmers and non-adult workers (age < 18 years) were excluded from the study population.

Survey form

The questionnaire consisted of the following titles: (I) sociodemographic features, (II) working conditions, (III) exposure to risk factors in the workplace, (IV) PPE use and (V) respiratory symptoms. The questionnaire enquired about personal and family respiratory disease, respiratory symptoms experienced in the past 3 months, including wheezing or whistling in the chest, shortness of breath or coughing, morning cough or phlegm.

Spirometry

The respiratory capacity was recorded using a spirometer (Spirolab III, MIR, Italy). Technicians performing the tests

Table 1 Distribution of sociodemographic and occupation features of farm workers ($n = 380$)

Factors	Number (n)	Percentage (%)	Factors		Number (n)	Percentage (%)
Demographics factors			Occupation factors			
Educational level			Training			
8 or less	302	79.48		Yes	52	13.68
8 and above	78	20.52		No	328	86.32
BMI*			Who provides information about pesticides			
BMI<20	47	12.4		Brochure in box	29	6.6
BMI 20–25	195	51.3		Television seminar	33	8.72
BMI 25–30	114	30		Agricultural engineer	175	46.32
BMI>31	24	6.3		Place of sale	88	23.89
Smoking				Friend	55	14.47
Smokers	211	55.53	Pesticide preparation area			
Non-smokers	93	24.47		Garden of house	230	60.53
Former smokers	76	20.00		Beside fountain/-water	20	5.3
Daily cigarette consumption				Field	124	32.59
Smokers	1.58	0.49		Mixed	6	1.58
Former smokers	1.46	0.50	Harmful effect			
Presence of chronic disease				Yes	352	92.63
Yes	119	31.32		No	28	7.37
No	261	68.68	Empty pesticide containers			
Occupation factors				Buried	72	18.95
Duration of farming (years)				Burned	150	39.47
≤10	68	17.89		Discarded	154	40.53
11–20	99	26.05		Left by fountain/-water	4	1.05
21–30	119	31.32	Use of empty containers for other purposes			
≥31	94	24.74		Yes	70	18.42
Product cultivated				No	310	81.58
Barley, wheat	322	84.74	Pesticide intoxication			
Fruit	47	12.37		Yes	8	2.11
Vegetables	11	2.89		No	372	97.89
Size of Farm (decare)			Respiratory symptoms			
no farm	178	46.84	Respiratory symptoms			
<30	42	11.06	Cough		33	8.70
>30	160	42.11	Shortness of breath		64	16.80
Animal husbandry			Phlegm		7	1.80
Yes	227	59.74	No symptoms		276	72.70
No	153	40.26				
Pesticide application method			Age (median and IQR)			52 (44–58)
Tractor	333	87.63	Duration of pesticide use			25 (15–30)
Back-pack pump	47	12.37	(median and IQR)			

were trained by a pulmonologist according to American Thoracic Society (ATS) standards and recommended quality control measures were followed (Redlich et al. 2014). Spirometry measurements included the total volume of air forcibly expelled after inhaling to maximum (forced vital capacity (FVC)), forced expiratory volume in the first second (FEV_1) of FVC and forced expiratory flow (FEF) from 25% to 75% of vital capacity (FEF25%–75%) and FEV_1/FVC. Tests were carried out in an upright sitting position and repeated until three valid results were obtained. Reference values were obtained from the European Community for Steel and Coal (ECSC). Prediction equations for FEV_1, FVC and the FEV_1/FVC ratio were based on the ECSC reference values and calculated concerning gender, age, weight and height (Burney et al. 1994; Quanjer 1983). The following parameters have been obtained for each individual; two absolute values (FEV_1, FVC), two percentage of normal values (%FEV_1, %FVC), one ratio (FEV_1/FVC) and $FEF_{25–75}$.

Analysis of data

Chi-square test was used to assess differences in categorical variables for univariate analyses. The Shapiro–Wilk test was significant for FVC, FEV_1, FEV_1/FVC and $FEF_{25–75}$ ($p > 0.050$), suggesting that these variables are non-normally distributed. Therefore, nonparametric Mann–Whitney U tests (MW) and Kruskal–Wallis tests were used to examine differences in FVC, FEV_1, FEV_1/FVC and $FEF_{25–75}$ between groups.Univariate analysis was performed before multiple logistic regression analyses to identify candidate variables for the final model. Variables with a p value <0.20 in the univariate analysis were included in the multiple logistic regression model.

Factors affecting FEV_1 (<80% or >80% predicted) were analysed with backward logistic regression. Multiple logistic regression models were conducted afterward. Odds ratios (ORs) were used to evaluate risk factors associated with <80% predicted FEV_1. For multivariate analysis, the possible factors identified with univariate analysis were further included in the logistic regression analysis to determine independent predictors of <80% predicted FEV. Several factors, such as lifelong smoking history, raising animals, experiencing respiratory symptoms in the past 3 months, educational level, duration of farming, size of farm (hectares) and training request were evaluated as independent factors. In the last step, smoking status and the region of residence remained as independent variables. We used $p < 0.05$ to indicate statistical significance. All data analyses were performed using IBM SPSS version 23 for Windows. This study was approved by the Kirsehir Ahi Evran University Non-Medication Clinical Research Ethics Committee (Decision no:2017–06/53).

Results

After the elimination of improper answers and inconsistent spirometry results, 92.71% ($n = 380$) of data were included in the analyses.

Sociodemographic findings

Though agriculture in Turkey involves all family individuals, the demographic structure is male-dominated (Erdal et al. 2016). In our study, all participants were male. The median age of participants was 52.00 (Q_1:44.00, Q_3:58.00). Of farmers, 79.48% stated they received 8 years or less of education. The median body mass index (BMI) of farmers was 23.88 (Q_1:21.63–Q_3:26.40). All participants were engaged in agriculture and 59.74% were also engaged in animal husbandry. Of participants, 42.11% stated they farmed >30 decares of agricultural land (Table 1). Nearly one third (31.17%) had a self-reported diagnosis of chronic respiratory disease.

Smoking

Participants were categorised as smokers (55.53%), former smokers (20.00%) or non-smokers (24.47%). Spirometry parameters were compared for smoking habits. There was a statistically significant correlation found for FEV1, FEV1/FVC and FEF25–75 ($p = 0.002$, $p = 0.005$ and $p < 0.001$, respectively). The median value of FEV1/FVC data for smokers was 99% (Q1 93.00, Q3 108.00), while the median value for non-smokers was 105% (Q1 99.00, Q3 114.00). The median value of FEV1/FVC data for those who did not smoke was higher. The median value of FEF25–75 data for smokers was 77% (Q1 57.00, Q3 96.00), while the median value for non-smokers was 94% (Q1 71.00, Q3 113.50) (Table 3).

Pesticide and personal protection use

All participants used pesticides. Agricultural workers stated they had been using pesticides for a median of 25.00 (Q1 15.00, Q3 30.00) years. Pesticides were applied using a tractor (87.63%) or backpack pump/hand sprayer (12.37%). Of the participants, only 13.68% received training about pesticide use, 46.32% received information from agricultural engineers and 23.89% received information at the time of purchase (Table 1). During application, 52.10% used gloves, 41.73% used a mask and 25.47% used protective goggles (Fig. 1).

Spirometry

The spirometry results of participants are presented in Table 2. Nearly one quarter (23.16%) of agricultural workers had an FEV1 < 80% predicted and 17.11% had evidence of airflow obstruction (FEV/FVC < 70%) (Table 2). Those who were

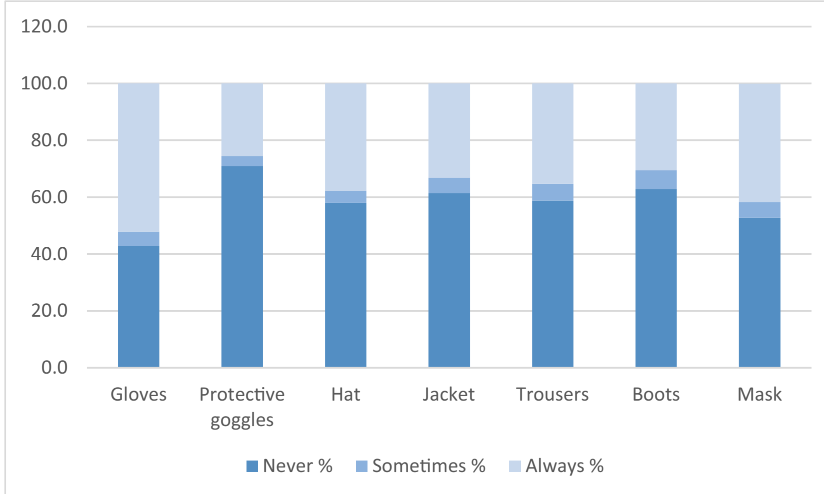

Fig. 1 Use of personal protection by participants

engaged in animal husbandry had significantly lower FEV1, FEV1/FVC and FEF25–75 values ($p = 0.034$, $p = 0.010$, $p < 0.001$, respectively). According to the pesticide application method, the FEF25–75 value of those using a tractor was higher compared to those using a backpack pump ($p = 0.029$). There was no significance between the use of PPE and spirometry parameters (Table 3).

According to the size of land worked, the FVC value for those working in ≥31 ha was identified to be higher compared to those working in larger areas ($p = 0.044$). The FVC, FEV1, and FEF25–75 values of those using pesticide containers for other purposes were lower ($p = 0.020$, $p = 0.010$, $p = 0.021$, respectively) (Table 3). The relations of BMI-spirometry parameters were insignificant ($p = 0.755$, $p = 0.897$, $p = 0.296$, $p = 0.435$ respectively).

Table 2 Distribution of smoking and pulmonary function test results of participants (n = 380)

Spirometry	Number (n)	Percentage (%)
FEV_1/FVC		
≤70% predicted	65	17.11
>70% predicted	315	82.89
FEV_1		
≤80% predicted	88	23.16
>80% predicted	292	76.84
Spirometry	Median (IQR)	
FVC	96.00 (83.00–107.00)	
FEV_1	94.00 (81.25–105.00)	
FEV_1/FVC	101 (94.00–109.00)	
FEF_{25-75}	82 (60.00–103.75)	

Respiratory symptoms

Only seven participants in the study (2.11%) stated they suffered from intoxication after pesticide use. Respiratory symptoms were experienced by 27.30% in the past 3 months. Of these, 16.80% had shortness of breath and 8.70% had a cough. When the spirometry values are investigated with experiencing respiratory symptoms in the past 3 months, there was statistical significance for FEV1 and FEF25–75 ($p < 0.001$, $p = 0.004$, respectively) (Table 3).

Regression analyses

The odds for FEV1 ≤ 80% predicted was 2.44 times higher for smokers (95% CI 1.2–5.0), 1.74 times higher for those with respiratory symptoms in the past 3 months (95% CI 1.1–2.9) and 5.01 times higher for those farming 30 years and more (95% CI 1.8–14.1) (Table 4). In further analysis, the risk of FEV1 ≤ 80% predicted was higher in farmers over 30 years, smokers and farmers with a history of respiratory disorder.

Discussion

In this study, the association between occupational exposure and respiratory function parameters of those working in agriculture was investigated. In this population, 55.53% were current smokers, 31.32% had a chronic disease, the majority was overweight or obese; all were working in agriculture and around half also were engaged in animal husbandry; 12.37% used a backpack for spraying and 86.32% had no training in using pesticides. Approximately 1/3 had respiratory symptoms and 1/4 had a FEV1 < 80% predicted. Smoking and respiratory symptoms were significantly associated with a

Table 3 Univariate analysis of association between socioeconomic and professional variables and spirometry results (n = 380)

	FVC		FEV_1		FEV_1/FVC		$FEF_{25–75}$	
	Median	IQR	Median	IQR	Median	IQR	Median	IQR
Smoking								
Smokers	96	83–107	94	81–104	99	93–108	77	57–96
Former smokers	91	79–106	89	78–103	103	94.50–108.75	71	53.25–106
Non-smokers	98	89–109.5	98	88.50–111	105	99–114	94	71–113.50
p	0.061		0.002*		0.005*		<0.001*	
Animal husbandry								
Yes	96	83–107	92	80–104	100	92–108	76	57–98
No	96	84–106.50	97	86–107	103	95–111	91	68–109
p	0.851		0.034*		0.010*		<0.001*	
Pesticide application method								
Tractor	96	83–10	94	81–105	101	94–109	79	59.50–103
Backpack pump	105	86.50–118	99	87–112	102	91–111	101	72–113
p	0.230		0.290		0.505		0.029*	
Use of mask								
Always	97	84–108.5	94	84–105	101	92–109.50	86	64–102
Never	95	83–106	95	80.75–106	103	95–109.25	80	57–107
p	0.392		0.858		0.149		0.999	
Experiencing respiratory symptoms								
Yes	95	78–107	89	79–99	97	91–109	77	52–96
No	97	84–107	95	85–106	102	95–109	87	63–107.50
p	0.080		<0.001*		0.088		0.006*	
Educational level								
8 or less	96	83–107	94	80–104	101	93–110	78	59–103
8 or more	99.50	87.75–106	98	87–107.25	103	95–108.25	91	66.50-106.25
p	0.356		0.048*		0.470		0.049*	
Duration of farming (years)								
≤10	95	86–105	94	89–104.75	102.5	95.75-104.75	83	68.25-107.50
11–20	97	84–106	96	81–105	102	91–109	87	59–102
21–30	101	83–111	95	79–107	99	91–109	77	53–104
≥31	91	83–103	93	79–103.50	104	95–110	80	58.50-107.25
p	0.067		0.631		0.081		0.479	

reduction in FEV1. Smoking, animal work, respiratory symptoms and backpack use were significantly associated with a reduction in FEF25–75. Lung capacities of participants were lower than reference values. Additionally, 23.16% of farmworkers had FEV1 < 80% predicted. More than half of the participants (61.22%) experienced respiratory symptoms such as shortness of breath. The use of PPE was less than half since 52.80% of farmers have never used a mask. Smoking increased the incidence of airway obstruction 2.44 times. Dealing with animals was associated with having lower spirometry parameters. Duration of farming was the most effective parameter on airflow obstruction and reduced lung function. Reducing personal exposure and training about the correct use of PPE, would be effective in lowering respiratory symptoms.

Among participants, 23.16% had an FEV1 value of 80% and below, and 17.11% had an FEV1/FVC value of 70% and below. Similar respiratory tract symptoms and low respiratory function values were identified among agricultural workers in Ethiopia and North America (Carruth et al. 2008; Negatu et al. 2017). These findings strengthen the consideration that occupational exposure of agricultural workers is associated with respiratory system health (Damalas and Eleftherohorinos 2011; Hoppin et al. 2009; Negatu et al. 2017).

The $FEF_{25–75}$ values of those working in farms of 30 ha or larger and those applying pesticides with tractors were

Table 4 Multivariate analysis (using logistic regression) of factors associated with an FEV1 < 80% predicted

	B	OR	95% CI	*P*
Constant	−3.512	0.03		<0.001
Smoking				
No (0)		1		
Ex-smoker (1)	1.312	3.713	1.655–8.329	0.001
Yes (2)	0.89	2.436	1.187–5.000	0.015
Experiencing respiratory symptoms				
No (0)		1		
Yes (1)	0.552	1.736	1.058–2.963	0.043
Duration of farming (years)				
≤10 (0)		1		
11–20 (1)	1.18	3.255	1.143–9.269	0.027
21–30 (2)	1.685	5.393	1.983–14.667	0.001
≥31 (3)	1.612	5.015	1.781–14.122	0.002

Backward conditional logistic regression analysis (5th step)

Dependent variable: FEV1 (< 80%: 0; ≥ 80%: 1)

Independent variables: Lifelong smoking history (never smoked 0; ex-smoker 1; current smoker 2); animal husbandry (no 0; yes 1); respiratory symptoms in the past 3 months (no 0; yes 1); education level (8 years or more 0; 8 years or less 1);, duration of farming, size of farm (decare) (≤10: 0, 11–20: 1, 21–30: 2, ≥31: 3); wish for training in the use of pesticides (no 0; yes 1);

OR odds ratio CI confidence interval

identified to be lower. FEF_{25-75} generally reflects flow coming from moderate and small air tracts. Small airway blockages in the lungs is a sensitive marker of pesticide and dust exposure (Seaton 2000). A study in Holland found FEF_{25-75} was lower in agricultural workers with pesticide exposure (De Jong et al. 2014).

Those dealing with animals in addition to agriculture were identified to have lower FEV_1, FEV_1/FVC and FEF_{25-75} values compared to those only dealing with agriculture. In the literature, it appears that those dealing with animals had more frequent respiratory symptoms and lower FEV_1 values (Carruth et al. 2008; Viegas et al. 2013). Studies from North America, New Zealand and Europe show that farmers dealing with animals experienced more respiratory symptoms compared to other agricultural workers (Hoppin et al. 2003; Kimbell-Dunn et al. 2001). The reason for this is considered to be associated with exposure to more dust, allergens, endotoxins and ammonium in closed environments.

Of participants, 18.42% used empty pesticide containers for other purposes. Similarly, another study in Turkey found that 11% of participants used empty pesticide containers (Cevizci et al. 2015). Repeated use of empty containers causes continuous pesticide exposure. In our study, the FVC and FEV_1 values of those using empty pesticide containers for other purposes were observed to be lower. To reduce risks to a minimum, it is necessary to destroy the containers by the necessary methods. There is a need for training and warnings about waste management for farmers.

A study on European agriculture and animal farmers found that 10–15% of respiratory symptoms consist of shortness of breath, 10–20% of dry cough and 7–11% of wheezing (Radon et al. 2001). Similar rates were found in this study. Another study in Turkey stated that 24% of farmers living in rural areas and dealing with animals had cough, 13.3% had phlegm and 27.3% had shortness of breath (Gulec Balbay et al. 2014). These symptoms may have occurred at high rates due to the allergic response to dust, pesticides and animals among those dealing with agriculture and animals.

Generally, it is stated that the negative effects of occupational exposure of farmers have less or the same size of effect as smoking. It is believed that smoking and occupational exposure are additional effects (Garshick et al. 1996). In our study smoking increased the odds of FEV_1 being 80% or lower by 2.44 times. Although the high rate of smoking complicates the determination of occupational factors, the time spent in agriculture was found to be an important factor in addition to the history of respiratory disease in the past 3 months.

The use of PPE reduces exposure to pesticides and dust and is associated with reduction in respiratory symptoms in farmers (Carruth et al. 2008; Reed 2004). However, studies show that the majority of agricultural workers do not use PPEs (Cevizci et al. 2015). The use of PPEs in this study was also low. Similarly, a study of male Palestinian farmworkers did not identify an association with mask use (Abu Sham'a et al. 2010). Masks used by farmworkers may not be appropriate or beneficial due to not being worn properly or not being appropriate for the job. However, many studies prove that masks and other PPEs are protective when used properly (Carruth et al. 2008; Cevizci et al. 2015; Damalas and Eleftherohorinos 2011). Therefore, it is important to provide regular training to farmers on the use of PPE to reduce respiratory symptoms and development of disease. Moreover, it should be facilitated for farmers to access this equipment.

Limitations

During the questionnaire, the participants may have given some biased answers to some questions, especially self-reporting on the use of PPEs. Recall bias may be important as some information related to experiences several years ago. Pesticide exposure measurement could not be done. Occupational exposures were evaluated with the information provided by participants (year of use, method of use). Therefore, the investigation of relations of allergy effects and respiratory symptoms are limited depending on the statements where there were deficiencies of detailed tests to crosscheck the data under control of health professionals.

Further work should be done to provide pesticide exposure by analysing blood samples. Longitudinal epidemiologic studies are needed to gain insight into both chronic effects caused by long-term airborne endotoxin exposure and the underlying processes of these effects.

Conclusion

The results of this study provide additional information about farmers' occupational exposure and their behaviour and attitudes towards the use of PPEs. With increasing time spent as a farmer, a decrease in respiratory function was observed, particularly in smokers and those engaged in animal husbandry. The simplest measure against this is the use of personal protectors. However, in this study, it was found that the use of PPEs was low. Participants had a need for training regarding the use of PPE and that the occupational exposure might cause illness in themselves. Regular training is required to change behaviour regarding the use of PPE among farmers living in this region. It would also be beneficial to supply PPEs to employees to encourage their use. Translating these concerns into proactive preventive action by farmers should remain a priority for the agricultural health worker and healthcare provider. The results of this study will contribute to the development of necessary interventions to reduce respiratory diseases in farmers. Because smoking rates were higher in this occupational group compared to the general population support programs and education should be conducted regularly to reduce smoking among farmers. The exact identification of risk factors is difficult due to the limitations of this cross-sectional study and the effects of many environmental and behavioural factors. There is a need for more precise studies using direct measurement of exposure.

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Authors' contribution All authors contributed equally to the preparation of this manuscript.

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Declarations

Ethics This study was approved by the Kirsehir Ahi Evran University Non-Medication Clinical Research Ethics Committee (Decision no:2017–06/53).

Conflict of interest The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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