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Respiratory symptoms and functions in barn workers

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Abstract

Introduction and aim. The presented study was undertaken to investigate the respiratory health problems in family barns with one or more cows and at least one family member working in the barn.

Methods. 150 workers (128 female, 22 male) from 4 villages of Yığılca district near the city of Düzce in north-west Turkey were enrolled in this study between October – December 2011. An Occupational and Environmental Chest Diseases questionnaire developed by the American Thoracic Society, pulmonary function test, physical examination and investigation for nasal eosinophil were performed in all subjects.

Results. The mean age of workers was 47.7 ± 14.2 years. Cough was present in 24% of subjects. The rates of phlegm, wheezing, chest tightness and dyspnea were 13.3%, 6%, 6% and 27.3%, respectively. Obstructive ventilatory pattern was observed in 37 workers (24.6%). 43 workers (28.6%) showed restrictive ventilatory pattern. Nasal eosinophilia was detected in 47.3% (71/150) of the subjects. Pulmonary functions of workers with nasal eosinophilia did not differ from the other workers. There were statistically significant negative correlations between the duration of working in barns and respiratory functions.

Conclusions. Pulmonary functions of barn workers have been found to be decreased related to the duration of barn working. Furthermore, respiratory symptoms increased in relation with both barn working and biomass consumption. Precautions should therefore be taken to ventilate both barns and houses.

Key words

Barn Worker, respiratory symptoms, respiratory function tests

INTRODUCTION

Farmers have a greater risk of respiratory disorders than people employed in other occupations [1]. Farming is commonly a lifelong occupation [2]. Because farmers often live on their farms, they can be continuously exposed to hazardous agents and, due to animal and plant cycles, exposure patterns on farms may vary during the course of a year [3].

Animal farmers are exposed to organic dusts containing microorganisms, aeroallergens, endotoxins, animal feed particles and chemical agents [4]. These substances are known to cause organic dust syndrome, chronic bronchitis, allergic and non-allergic asthma, asthma-like syndrome, chemical and hypersensitivity pneumonitis [5, 6, 7, 8], allergic and non-allergic rhinitis [9].

Depending on the type of farming practice, respiratory symptoms are common among agricultural workers [6]. Exposures can cause disease of either the upper or the lower respiratory tract, or both. Farmers often report more problems with smell impairment and often have more nasal polyps and hyperaemia of the nasal mucosa, possibly indicating effects of allergens and irritants in their workplaces [10]. Agricultural production has been recorded as the leading industry for deaths due to hypersensitivity pneumonitis [11].

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The presented study aimed to investigate the respiratory health problems in family barns with one or more cows, and at least one family member working in the barn.

MATERIAL AND METHODS

Study population. 150 workers (128 female, 22 male) from 4 villages of Yığılca district (Aksaklar, Gokceagac, Sarikaya and Yogunpelit) near Düzce city in north-western Turkey were enrolled to the study between October – December 2011. The total population of the study area was 2,526 people, of whom approximately 600 were barn workers. The total number of family barns was approximately 250.

A written informed consent was obtained from all participants. The local Ethical Committee approved the study. Data on demographics, episodes of wheezing or chest tightness, symptoms of dyspnea, cough, phlegm, any other allergic and/or respiratory symptoms, duration of symptoms and smoking habits were determined by a questionnaire modified from the American Thoracic Society Questionnaire [12]. Physical examination and investigation for nasal eosinophil were performed in all subjects. The questionnaire was administered in a person-to-person interview.

Lung function measurements. The tests were performed by using a standard spirometer (Vitalograph Alpha, Vitalograph Ltd., Ireland) according to American Thoracic Society criteria, while the patients were at rest and seated in the upright position [13]. A minimum of 3 satisfactory forced

expiratory manoeuvers was required for each subject. Forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), FEV_1/FVC (%) and maximal mid-expiratory flow rate (MMFR) were measured. Results were expressed as absolute values and as percentages of predictive values.

The nasal eosinophilia assessment. Nasal eosinophilia was assessed by nasal scraping. Nasal mucosal specimens were obtained by gently scraping the anterior part of the inferior turbinate with Arlington Rhinoprobes. The specimens were transferred onto glass slides, air-dried for 30 minutes, fixed in 95% ethyl alcohol for 3 minutes and stained by Giemsa. Eosinophils were counted by light microscopy at high-power by 2 experienced microbiologist.

Statistics. Data analyses and descriptive statistics were performed with the statistical package for the social sciences (SPSS, 19.0). When making comparisons among multiple groups for continuous variables, analysis of variance (ANOVA) statistics was used. Chi-squared test was used to compare categorical variables. Pearson's analysis was used as the correlation test. To study the relationship of age, working duration and smoking as pack/year with pulmonary functions, linear regression was used. P values less than 0.05 were considered to be statistically significant.

RESULTS

The mean age of workers was 47.7 ± 14.2 years. Smoking rate was 12% (18/150). The declaration rate for both feeding cattle and gardening was 90.7% (136/150). Almost half of the subjects (73/150) noted that they were exposed to dust and fumes in barns, and again half of them (39/73) stated that their environments were dusty and mouldy. More than half of the subjects (76/150) noted odour in their environment. 43 workers (28.7%) detected dust in phlegm. Almost all subjects noted barns ventilated with windows in a natural manner. Half of the subjects declared that they changed the clothes used in barns. More than 80% of the subjects used wood, coal, hazelnut shell and gas for heating and cooking. Cough was present in 24% of subjects. The rates of phlegm, wheezing, chest tightness and dyspnea were 13.3%, 6%, 6% and 27.3%, respectively.

Demographic, clinical, spirometric, and working condition parameters of barn workers are shown in Table 1.

Obstructive ventilatory pattern (FEV_1/FVC<75%) was observed in 37 workers (24.6%). 24 workers (16%) presented a FEV_1/FVC ratio less than 70%. 43 workers (28.6%) showed restrictive ventilatory pattern.

Nasal eosinophilia was detected in 47.3% (71/150) of the subjects. Pulmonary functions of workers with nasal eosinophilia did not differ from the other workers.

There were statistically significant negative correlations between the duration of work in barns and FVC (r=–0.281, p=0.001), FEV_1 (r=–0.217, p=0.008), MMFR (r=–0.168, p=0.040).

Cough and dyspnea according to working duration by years was shown in Table 2. Cough and dyspnea were significantly low in barn worker with work duration less than 20 years (p=0.001).

The mean predicted FVC, FEV_1, FEV_1/FVC, and MMFR values according to working duration by years are shown in Graph 1. The mean predicted FVC values was significantly different between barn workers with a working duration less than 20 years and more than 41 years (p=0.015). The mean predicted FEV_1 values was significantly different between barn workers with a working duration less than 20 years and

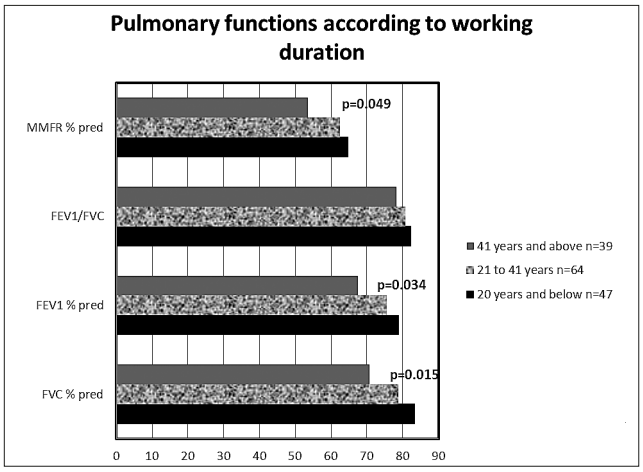
Table 1. Demographic, clinical, spirometric, and working condition parameters of barn workers

PARAMETERS	n=150
Demographic data	
Age, yrs. (mean±SD)	47.7 ± 14.2
Female, n (%)	128 (85.3)
Non-smokers, n (%)	132 (88)
Duration of barn working, yrs. (mean±SD)	30.8 ± 16.1
Respiratory symptoms, n (%)	
Cough	36 (24.0)
Phlegm	20 (13.3)
Dusty phlegm	43 (28.7)
Wheezing	9 (6.0)
Chest tightness	9 (6.0)
Dyspnea	41 (27.3)
Cough/3 months a year/more than 2 years	10 (6.6)
Phlegm/3 months a year/more than 2 years	41 (27.3)
Nasal eosinophilia, n (%)	71 (47.3)
Pulmonary functions, (mean±SD)	
% FVC	78.2 ± 24.1
% FEV_1	74.5 ± 24.4
% FEV_1/FVC	80.6 ± 12.8
% MMFR	60.9 ± 26.6
Barn working and gardening, n (%)	136 (90.7)
Barn working (only), n (%)	14 (9.3)
Dust in barn, n(%)	75 (50.0)
Floor of the barn, n (%)	
Dusty	32 (21.3)
Wet	2 (1.3)
Dusty and wet	39 (26.0)
No dust	77 (51.3)
Barn environment, n (%)	
Smelly	76 (50.7)
Odourless	74 (49.3)
Ventilation of barn, n (%)	149 (99.3)

SD, standard deviation; yrs. – years; FVC – force vital capacity;
FEV_1 – force expiratory volume in the first second; MMFR – maximal midexpiratory flow rate

Table 2. Cough and dyspnea according to working duration

	Working duration			
	20 years and below n= 47	21–41 years n=64	41 years and above n=39	p
Cough				
Yes	2	20	14	0.001
No	45	44	25	
Dyspnea				
Yes	4	20	17	0.001
No	43	44	22	



Graph 1. Mean predicted FVC, FEV_1, FEV_1/FVC, MMFR values according to working duration

more than 41 years (p=0.034). The mean predicted MMFR values was significantly different between barn workers with working duration less than 20 years and more than 41 years (p=0.049).

The effect of working duration in barns, smoking and age on spirometric values are shown in Table 3. Working duration in barns, smoking and age had no independent effect on FVC and FEV1, FEV_1/FVC and MMFR values.

Table 3. Effect of working duration in barn, smoking and age on spirometric values

	Beta	t	p
FVC			
Age	-0.149	-0.565	*0.580*
Working duration	-0.079	-0.298	*0.769*
Smoking (pack-year)	0.128	0.505	*0.621*
FEV_1			
Age	-0.277	-1.120	*0.280*
Working duration	-0.141	-0.567	*0.579*
Smoking (pack-year)	0.217	0.914	*0.375*
FEV_1/FVC			
Age	-0.171	-0.678	*0.508*
Working duration	-0.266	-1.051	*0.310*
Smoking (pack-year)	0.046	0.191	*0.851*
MMFR			
Age	-0.420	-1.992	*0.066*
Working duration	0.254	0.597	*0.560*
Smoking (pack/year)	0.425	2.095	*0.055*

FVC – force vital capacity; FEV_1 – force expiratory volume in the first second; MMFR – maximal midexpiratory flow rate

DISCUSSION

This cross-sectional study demonstrated a strong association between the cow barn environment and respiratory symptoms. Cough was present in 24% of subjects. The rates of phlegm, wheezing, chest tightness and dyspnea were 13.3%, 6%, 6% and 27.3%, respectively. A study of self-reported symptoms in European animal farmers revealed the prevalence of shortness of breath of 10 – 15%, dry cough of 10–20%, productive cough of 9 – 18% and wheeze of 7- 11%, which was similar to the presented study [3].

Many farmers start working in childhood and frequently continue to work well beyond the age of 65 years [14]. In the presented study, the mean age of workers was 47.7 ± 14.2 years, and mean duration of barn working – 30.8 ± 16.1.

Compared to other occupational groups, the percentage of smokers is known to be low in farmers [15]. In the presented study, the smoking rate was 12%.

Farmers involved in animal production have a higher prevalence of respiratory symptoms than other farmers and other rural residents. An increase in respiratory symptoms has been noted among animal farmers in North America, Europe and New Zealand [16, 17]. In the presented study, the declaration rate for both feeding cattle and gardening was 90.7%. A study of work-related respiratory symptoms in New Zealand farmers demonstrated that working with horses was consistently associated with higher prevalence rates of chronic bronchitis, dyspnea, organic dust toxic syndrome and farmer's lung, than were other types of farming [17]. Tutluoglu et al. speculated that occupational exposure to horses increases the sensitization to horse hair, induces asthma and allergic symptoms, and also impairs lung functions. They found sensitization to horse hair at 12.8% in grooms and 4.3% in controls. [18].

Obstructive ventilatory pattern was observed in 37 workers (24.6%). 24 workers (16%) presented a FEV_1/FVC ratio of less than 70%. 43 workers (28.6%) showed restrictive ventilatory pattern. Heller et al. found in their study a significant lower FEV_1/FVC ratio in subjects working regularly with dairy cattle and with silage, compared to others farmers and controls [19]. Dosman et al. found a lower FEV_1 and FVC in swine producers than controls, although there was a modest increase in FEV_1/FVC ratio among swine farmers, suggestive of a mixed restrictive/obstructive lung function impairment [20]. A Canadian study showed a significant lower FEV1/FVC among swine confinement workers than controls [21].

Lung function measured as FEV_1 or FEV_1/FVC seems to be reduced in farmers compared to controls. The increased annual decline in lung function has been associated with lung function, bronchial hyper-responsiveness, together with environmental exposures, such as smoking, disinfectants, automatic dry feeding systems and endotoxin [22].

There were statistically significant negative correlations between the duration of working in barns and FVC, FEV_1, MMFR. The mean predicted FEV_1, FVC, FEV_1/FVC, MMFR values was significantly different between barn workers with working duration less than 20 years and more than 41 years. In a Danish study with a 5-year follow-up, the annual decline in FEV_1 was highest in pig farmers (73 ml), second highest in farmers with both pig and dairy production (60 ml), and lowest in farmers with no animal production (30 ml); the differences, however, were non-significant [23]. In another study from the same group, 91 swine farmers and 38 dairy farmers participated in a 7-year follow-up study. The annual decline in FEV_1 but not in FVC was greater among swine farmers (53.8 ml) than dairy farmers (41.8 ml). For non-smokers, the increased annual decline in swine farmers was 17 ml, compared to dairy farmers [24]. In the presented study, working duration in barns, smoking and age had no independent effect on FVC and FEV_1, FEV_1/FVC and MMFR values.

Studies of the effects of occupation on farmers' health have mainly focused on the lower airways, whereas few studies have examined effects on the upper airways [3, 10]. Holmstrom et al investigated nasal functions in 3 groups of farmers (swine, milk and grain producers). Nasal blockage complaints were more common among farmers; while overall, nasal polyps were more frequent in grain producers. Objective parameters showed more pronounced mucosal swelling in farmers and higher concentrations biomarkers in nasal lavage (Myeloperoxidase, albumin and eosinophil cationic protein) [10]. A study from Europe showed that animal nasal irritation was 21 – 29% [3]. In the presented study, nasal eosinophilia was detected in 47.3% (71/150) of the subjects. Pulmonary functions of workers with nasal eosinophilia did not differ from the other workers.

In the presented study, cough and dyspnea were less common in barn worker with working duration less than 20 years. Mazan et al. found that being exposed to the equine barn environment for 10 h/week is a significant predictor of self-reporting respiratory symptoms in the past 12 months [25].

In conclusion, the pulmonary functions of barn workers have been found to be decreased related to the duration of barn working. Furthermore, respiratory complaints increased in relation with both barn working and biomass consumption. Therefore, it is necessary to improve the ventilation in both the work place and the house to protect the workers' respiratory system.

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