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# Evaluation of Respiratory Symptoms and Lung Function Disorders of Farmers and Non-farmers in Yazd Province

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**ABSTRACT**

**Introduction:** Respiratory disorders, as common problems in farmers, have a high mortality rate in Yazd City. The aim of this study was to evaluate and compare the respiratory parameters as well as the prevalence of respiratory symptoms in three age groups in farmers and non-farmers.

**Methods:** This case-control study was conducted on 300 farmers and 300 non-farmers in Yazd. The administered questionnaires included cognitive knowledge and symptoms of respiratory diseases. All participants completed the questionnaires and took the lung function tests. Data were analyzed using independent T-t test, Chi square test, or Fisher's exact test by SPSS $_{24}$.

**Results:** Spirometry results showed a significant reduction in the respiratory capacity of the farmer group compared to non-farmer. In all three age groups, the prevalence rates of respiratory symptoms in farmers were higher than non-farmer groups and the prevalence of symptoms increased by increase of age. In the age group of "over 55 years", the risk of cough, phlegm, dyspnea, and wheezing were 17,10.78, 3.58, and 6.61 times more than the non-farmers, respectively. Among the respiratory symptoms, cough had the highest prevalence, while shortness of breath had the lowest prevalence.

**Discussion and conclusion:** In order to prevent high prevalence of respiratory disorders in farmers, the mechanization of agricultural practices, promotion of farmers' health awareness by health professionals, appropriate implementation of training programs by the health department, and assistance of Jihad-e-Agriculture are necessary

**Keywords:** Respiratory parameters, Farmers, Pulmonary function test

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## Introduction

Respiratory disorders, as common problems in farmers, cause high mortality rates.in this regard, the most common effective factors are organic dust (grains, straw, alfalfa), which usually contain bacteria, flies, and their excrements, as well as the remains of animals (urine and feces). On the other hand, activities related to the soil (plowing, cleaning) may expose the farmers to silica dust. Agricultural activities also include some types of hazardous substances such as chemical misuses (pesticides, fertilizers, paints, preservatives, and disinfectants), gases, and flaps as well as biological agents (1-3). A large part of the farmers' exposure occurs when they are in contact with animals, dispose cereals or other products during harvest or when they plow the soil or stall with pesticides or disinfectants (4). These disorders are significantly overlapping; for example, in a worker with a farmer's lung disease, chronic bronchitis may be seen as a complication (5). Many other studies also considered exposure to agricultural products as a cause of chronic bronchitis (3, 6-8). Dust of vegetable seeds, thermophilic bacteria in alfalfa, and gases at the animal storage site play important roles in developing the respiratory disturbances. Long-term inhalation of organic dust may cause inflammation of the respiratory tract as a result of the specific non-specific allergic and immunological reactions (9-12). These reactions are mainly caused by micro-organisms associated with organic dust in particular gram-negative bacteria and endotoxins (13-15). These micro-organisms are the causative agents of respiratory disorders such as pneumonia, increased sensitivity, granulomatosis, asthma, toxic dusts of organic dust (ODTS), chronic bronchitis, and bisnitis (9, 14, 16-18). Chronic respiratory symptoms are common in agricultural workers and are largely dependent on the type of agricultural activity (19). Although most obstructive pulmonary diseases are due to smoking, up to 30% of the causes of these diseases can be due to occupational exposures. Generally, smoking is lower in farmers than in other businesses (20); this result was reported by the results of a general survey of health, cancer case studies, and studies of respiratory disease among farmers and rural populations.

Occupational exposure to obstructive pulmonary diseases has increased respiratory mortality, including decreased quality of life, and performance status (21). The large volume of epidemiological data from studies conducted in recent decades suggests that mortality rates and pathogens among respiratory infections are higher in comparison with the general population or other working groups, although pulmonary diseases are less prevalent among those who have tendencies to smoke (1, 22, 23).

The chronic obstructive pulmonary disease (COPD: Chronic Obstructive Pulmonary Disease) occurs along with increase of dyspnea, cough, and wheezing. According to the standards established by the World Organization for the Clinical Organization of Chronic Pulmonary Diseases (GOLD: Global Initiative for Chronic Obstructive Lung Disease) (24), chronic obstructive pulmonary disease is diagnosed by spirometry with obstruction (the FVC / FEV1 ratio is less than 70%). This disease is not reversible even with use of dilator drugs bronchial.

Chronic airflow limitation may be due to airway obstruction or elasticity loss of the parenchymal lung tissue (25). One of the early stages of pathology is inflammatory response in the airways. Farmers' exposure includes grain dust, animal and soil nutrients, gases, buttons, and microorganisms or their components such as endotoxins and fungi as potential initiators of the airways' inflammation for pathology (26).

A large number of chronic obstructive pulmonary disease studies have been reported among farmers (5, 27). Investigation of this group of infected people is very important since no study has ever investigated this group (28). Farmers typically work beyond the retirement age (29), accept the symptoms as part of their jobs, and do not go to the physician until these diseases progress and prevent them from working.

Yazd province with a total area of 74493 square kilometers is located in the center of Iran. Of the


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169115 hectares of the arable land in Yazd province, about 121827 hectares are under cultivation of agricultural crops. The share of crops and greenhouses is 47812 hectares with production of 811,367 tons and 74004 hectares of garden products with a production of 23,807 tons. In addition, the total animal and aquaculture production in Yazd province is 290077 tons. The share of employment for people aged 15 years or higher in the agricultural sector is 9.4%. In Iran, a large number of full-time or part-time employees work in the agricultural sector and no comprehensive study has ever studied them. Therefore, the present study was conducted to determine and compare the respiratory parameters in farmers and non-farmers and to investigate the prevalence of respiratory symptoms in three age groups of farmers and non-farmers.

## Methods

This case-control study was conducted on farmers of Yazd province in 2016. Of the 15,000 farmers in Yazd (31), 323 people were selected by simple random sampling using computer numbers. The farmers participating in this study had at least 2 years of insurance history in the agricultural sectors. Farmers who filled up the questionnaire incompletely or were unwilling to perform the spirometry test properly as well as those who were suffering from chronic respiratory diseases with medical records were excluded from data collection procedures. Finally, 300 farmers were randomly selected to participate in our study. Moreover, a total of 300 administrative staff were selected as the control group. The control group members had no history of agricultural activities and no respiratory disorders. All the workers participating in the study completed the questionnaires. The questionnaire included demographic information such as age, smoking, respiratory symptoms background of cough, phlegm, dyspnea, and wheezing. The reliability of the questionnaire was confirmed using a test-retest method with a Cronbach's alpha of 0.94 and its validity was also verified by several lung specialists.

At the beginning of the study, researchers provided all farmers with counseling and guidance. Then, the participants were asked to sign the informed consent forms for the Spirometric test. Since the spirometer method is a non-invasive method, it has been considered as a problem for the participants in question.

The lung function test was performed for the farmer and non-farmer groups using a Spirometric device (2120 model manufactured by the company Vitalograph UK). This was done according to the ATS criteria and the Spirometric indices such as: compulsory capacity, outlet volume in the first seconds of expiration. The mean flow rate was measured at a time when 25-75% of the lung was empty. The fraction of the vital output capacity was also measured in the first one-second expulsion. The spirometers were calibrated daily with syringe.

Data were analyzed using SPSS 24. T-t test independent was also run to compare the respiratory capacity between the farmer and non-farmer groups. To compare the frequency of respiratory symptoms between the two groups, Chi-square test or Fisher exact test was also appliued.

## Results

All participants in this study were male. The participants' demographic data o are presented in Table 1. Mean (SD) age of the farmers was 45.93 ± 11.1 and 44.7 ± 10.44 years in the case and control groups .Thus, no significant difference was observed in two groups with regard to age.


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**Table 1.** Frequency distribution of participants in two groups of farmers and non-farmers according to age variables

| age category | farmers | | no farmers | | P Value |
|---|---|---|---|---|---|
| | Number | Mean (SD) | Number | Mean (SD) | |
| 30-34 | 50 | 31.58±2 | 50 | 30.3±24.27 | 0.2 |
| 35-54 | 169 | 43.5±37.5 | 180 | 43.5±18.58 | 0.75 |
| 55-75 | 81 | 59.4±8.53 | 70 | 58.4±9.3 | 0.25 |
| Total | 300 | 74.8±45.1 | 300 | 44.1±7.42 | 0.23 |

Table 2 shows the results of pulmonary function test in both case and control groups. As shown in this table, farmers have a significant reduction in respiratory parameters.

**Table 2.** Results of lung function parameters in both farmer and non-farmer groups

| Variable | Category | Mean (SD) | Minimum | Maximum | *P Value* |
|---|---|---|---|---|---|
| *FVC (*Forced Vital Capacity*)* | farmers | 0.8 ( 3.69) | 0.79 | 7.14 | |
| | no farmers | 0.97(3.86) | 1.56 | 6.6 | 0.027 |
| | Total | 0.9(3.77) | 0.79 | 7.14 | |
| *FEV1 (*Forced Expiratory Volume in First Second*)* | farmers | 0.7(3.25) | 0.73 | 4.84 | |
| | no farmers | 0.79(3.39) | 1.48 | 5.47 | 0.022 |
| | Total | 0.74(3.32) | 0.73 | 5.47 | |
| *FEV1%* | farmers | 11.57(87.35) | 6.88 | 100 | |
| | no farmers | 8.3(88.49) | 39.9 | 100 | 0.16 |
| | Total | 10.08(87.9) | 6.88 | 100 | |
| *FEF25-75 (*Forced inspiratory flow 25–75%*)* | farmers | 1.25(3.87) | 0.75 | 7.92 | |
| | no farmers | 1.12(4.33) | 1.62 | 7.03 | 0.001< |
| | Total | 1.2(4.1) | 0.75 | 7.92 | |

Table 3 represents the frequency of respiratory symptoms in the two groups. As the table shows, the prevalence of cough, sputum, dyspnea, and wheezing in all three age groups was higher in non-farmer than the farmer group, except for dyspnea and wheezing in the age group of 20-34 years. This difference was statistically significant. In this study, the prevalence of symptoms increased with the increase in age, so that in farmers aged 20-34 years the prevalence rates were 16% for cough, 18% for confusion, 6% for dyspnea, and for 8% wheeze. With increase of age and in the age group of "over 55 years", the incidence rates of respiratory symptoms were 39.5%, 33.3%, 27.2%, and 35.8%, respectively. Among the symptoms of respiratory, cough had the highest and shortness of breath had the lowest prevalence.

Given the odds-ratio calculated in farmers aged 20- 34 years, the risk of coughing, fusion, dyspnea, and wheezing were 4.57, 5.26, 3.12, and 26.4 times higher than the non-farmer group, respectively. Moreover, in the age group of 35-54 years, the risk of coughing, phlegm, dyspnea, and wheezing were 6.10, 10.6, 1.64, and 6.6 times higher than the non-farmer groups, respectively. In the age group of 55-74 years, the risk of coughing, phlegm, dyspnea, and wheezing were 17, 78.58, 10. 3, and 61.6 times higher in the farmers group than the non-farmer group; the difference between the two groups was significant with 95% confidence interval (P-value <.05).


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**Table 3.** Frequency distribution of the respiratory symptoms in the two groups by age group

| Age category | signs | | (300) farmers number(percent) | (300)no farmers number(percent) | total (600) (percent)number | P value | Crude Odds Ratio |
|---|---|---|---|---|---|---|---|
| 1 | Cough | yes | 8(16) | 2(4) | 10(10) | 0/046* | 4/57 |
| | | no | 42(84) | 48(96) | 90(90) | | |
| | | total | 50(100) | 50(100) | 100(100) | | |
| 2 | Cough | yes | 50(29/6) | 7(3/9) | 57(16/3) | 0.001*< | 10/38 |
| | | no | 119(70/4) | 173(96/1) | 292(83/7) | | |
| | | total | 169(100) | 180(100) | 349(100) | | |
| 3 | Cough | yes | 27(33/3) | 2(2/9) | 29(19/2) | 0.001*< | 17 |
| | | no | 54(66/7) | 68(97/1) | 122(80/8) | | |
| | | total | 81(100) | 70(100) | 151(100) | | |
| 1 | Phlegm | yes | 9(18) | 2(4) | 11(11) | 0.025* | 5/26 |
| | | no | 41(82) | 48(96) | 89(89) | | |
| | | total | 50(100) | 50(100) | 100(100) | | |
| 2 | Phlegm | yes | 48(28/4) | 11(6/1) | 59(16/9) | 0.001*< | 6/1 |
| | | no | 121(71/6) | 169(93/9) | 290(83/1) | | |
| | | total | 169(100) | 180(100) | 349(100) | | |
| 3 | Phlegm | yes | 32(29/5) | 4(5/7) | 36(23/8) | 0.001*< | 10/78 |
| | | no | 49(60/5) | 66(94/3) | 115(76/2) | | |
| | | total | 81(100) | 70(100) | 151(100) | | |
| 1 | Shortness of breath | yes | 3(6) | 1(2) | 4(4) | 0.6** | 3/12 |
| | | no | 47(94) | 49(98) | 96(96) | | |
| | | total | 50(100) | 50(100) | 100(100) | | |
| 2 | Shortness of breath | yes | 14(8/3) | 5(2/8) | 19(5/4) | 0.001*< | 3/16 |
| | | no | 155(91/7) | 175(97/2) | 330(94/6) | | |
| | | total | 169(100) | 180(100) | 349(100) | | |
| 3 | Shortness of breath | yes | 28(34/6) | 9(12/9) | 37(24/5) | 0.002*< | 3/58 |
| | | no | 53(65/4) | 61(87/1) | 114(77/5) | | |
| | | total | 81(100) | 70(100) | 151(100) | | |
| 1 | rhonchus | yes | 4(8) | 1(2) | 5(5) | 0.36** | 4/26 |
| | | no | 46(92) | 49(98) | 95(95) | | |
| | | total | 50(100) | 50(100) | 100(100) | | |
| 2 | rhonchus | yes | 41(24/3) | 9(5) | 50(14/3) | 0.001*< | 6/1 |
| | | no | 128(75/7) | 171(95) | 299(85/7) | | |
| | | total | 169(100) | 180(100) | 349(100) | | |
| 3 | rhonchus | yes | 31(38/3) | 6(8/6) | 37(24/5) | 0.001*< | 6/61 |
| | | no | 50(61/7) | 64(91/4) | 114(75/5) | | |
| | | total | 81(100) | 70(100) | 151(100) | | |

** *Fisher's exact test*
* *Pearson chi-square*

## Discussion

Respiratory symptoms and respiratory disorders are currently among the most important issues of clinical health and public health for the farmers around the world (32). Several studies were carried out in this area in recent decades, which documented a significant increase in the risk of pathogenicity and mortality rates among farmers. Furthermore, the literature showed that the relationship between occupational exposure to respiratory risks and presence of the respiratory symptoms leading to the progress of the chronic diseases pulmonary arrest (1). Other studies showed that the particular occupational exposure of farmers can cause defects in the health of the individuals' respiratory system, which is generally preventable and has a close relationship with its length, characteristics, and severity (33, 34).

In the present study, prevalence of the respiratory symptoms and lung function


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parameters were compared between the two groups of farmers and administrative staff. We also evaluated the relationship of respiratory symptoms between smokers and non-smokers.

Stolsky et al. showed that the overall prevalence of chronic respiratory symptoms was 29.3%. Cough was prevalent in 20% of cases, while sputum, shortness of breath, wheezing, and chest tightness were prevalent among 10.7%, 12%, 10.7%, and 8% of the participants, respectively. This finding is similar to the study of self-reported symptoms in European livestock breeders (35). It should be kept in mind that Stolsky's study showed a strong association between agricultural exposure and development of the respiratory symptoms (32). Our study results indicated a higher incidence of respiratory symptoms of chronic bronchitis (cough, sputum, and wheezing) compared with asthma (dyspnea). With regard to the results of Dolphin et al., the slightly higher prevalence of asthma in farmers compared to the control group was in the same line with findings of our study (36). In the present study, cough had the highest prevalence rate, which is consistent with the studies of Stolsky and Dolphin. According to the most studies, the prevalence of asthma in agricultural workers is similar to that of other population. Although many farmers are aware of the substances in their work environment, no evidence exists about this idea that exposure to these substances causes asthma (5) and chronic bronchitis is the most commonly reported respiratory disease in farmers.

According to our findings, pulmonary capacity of the farmers was lower than that of the control group. In the same vein, studies conducted by Dolphin (1993 and 1998), Stolsky (2015), and Radon (2001) reported a significant difference in statistical data found for all respiratory parameters (32, 35, 37, 38). Similarly, animal studies conducted in North America, Europe, and New Zealand (39) showed increased respiratory symptoms associated with the agriculture occupation. It was also found that being in contact and working with horses were associated with a higher prevalence of chronic bronchitis, dyspnea, toxic organoleptic toxicity syndrome, and farmer's lungs relative to the other types of agriculture (35).

In a study in Turkey, Tatlucault et al. focused on the horse guards and observed the sensitivity of horse hair in 12.8% of the elderly (40%), in 24.6% of the obstructive obstruction pattern, 16% of the FEV1 / FVC ratio Less than 70% and 28.6% were found in the limited ventilation pattern. Heller et al. showed a lower FEV1 / FVC ratio in people daily exposed to dairy cows and silica compared to other farmers and control group (41). Descent et al. reported fewer FEV1 and FVC in exposed piglets compared to the control group, while with increasing average FEV1 / FVC ratio among poultry farmers, lung function impairment was impaired (42). In this context, a Canadian study found that FEV1 / FVC was significantly lower in pig-breeding workers than the control group (43). However, in our study, no significant difference was found in FEV1 / FVC ratio, because FVC decreases the normal FEV1 index and FVC decreases the FEV1 / FVC ratio (44 )

In contrast, Dolphin (1998) showed that except for FEV1 / FVC, no significant difference was observed between the farmers and control group with regard to the respiratory parameters (36). The contradictions in these studies can be related to the type of agricultural product, the concentration of dust, and the duration of exposure.

The results of this study showed that respiratory disorder increased with age. This finding is consistent with the results reported by Dansura, indicating a higher incidence rate in older people (45).

Considering the fact that no significant difference was found between farmer and non-farmer groups regarding age, smoking variables, and work experience, the increase rate of respiratory symptoms is most likely related to the agricultural occupation. In fact, this occupation is considered as a risk factor for cough, phlegm, dyspnea, and wheezing, which are evident in all three age groups. According to the viewpoint of Dolphin, agriculture is considered as a risk factor for chronic bronchitis and bronchial obstruction, especially in patients over the age of 40 years and


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in non-smokers (46). Recent studies have shown that the annual decline in lung function is usually associated with occupational and environmental exposures, such as smoking, dust, disinfectants, dry auto-feeding, and endotoxin systems (2).

A study in Canada showed a positive interactive effect of exposure to agricultural crops and smoking on lung function and prevalence of chronic bronchitis in women (47). The Stolesky's study, a correlation was found between obstructive pattern and daily smoking, the history of smoking drag and number of cigar packets smoked per year in smokers compared to non- smokers, as well as the effect of time of exposure, current smoking, smoking history and number of cigarette per- year in the development of obstructive pattern in agricultural workers did not show any significance. Stolesky also found a significant relationship between small airway obstruction changes in smoking participants and smoking history, as well as between modifications in small airway obstruction and the duration of exposure to cigarette smoking and the number of cigarettes smoked per- year. The combined effect of exposure time, daily smoking, smoking experience, and number of cigar packets smoked per- year on airway obstruction changes among the agricultural workers has also been remarkable. According to the research, no changes were found in small airway obstruction in passive smokers. In some other studies, cigarette and age were reported as the risk factors for respiratory symptoms in farmers (38, 48).The odds of a difference in chronic respiratory symptoms and pulmonary diseases may be related to the age range of the study population or to the heterogeneity of occupational exposure (49).

## Conclusion

Considering the significant reduction in respiratory capacity, the high prevalence of respiratory symptoms in farmers, and the fact that smoking habit has no significant effect on the symptoms, the farmers' exposure to these diseases should be reduced. So, it is essential to mechanize the agricultural means and methods, to promote the farmers' health awareness by implementing appropriate training programs, to familiarize the farmers with the harmful factors of their working environment, and to use personal protective equipment. To determine the effect of cigarettes on occurrence of the respiratory disorders and on the reduction of lung function, the combined effect of exposure time, current smoking, smoking records, and the number of cigarette packs on farmers must be considered more carefully in future studies.

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## Conflict of Interest

There are no conflicts of interest to declare.

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