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PULMONARY FUNCTION IN WORKERS EXPOSED TO TOBACCO DUST

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ABSTRACT

BACKGROUND: Exposure to vegetable dusts is probable in many industrial and agricultural industries. AIM: The aim of this study was to investigate the relation between exposure to tobacco dusts and lung capacities and airflows. MATERIALS AND **METHODS:** Two hundred thirty-one individuals who were exposed to tobacco dusts in a cigarette-manufacturing company were included in the study. One hundred individuals who were working in the same area but in other industries and were not exposed to harmful dusts were also selected as controls. Spirometry with American Thoracic Society (ATS) standards was performed for both groups. STATISTICAL ANALYSIS: Spirometry results were compared between the two groups using SPSS software by 't' test. **RESULTS:** The mean age of the exposed and unexposed groups was 36 ± 7 and 35 ± 7 years, respectively. Spirometry results showed that lung capacities and airflows in the exposed group were significantly less than those of controls (P < 0.001). Considering relative variation, the highest reduction was seen in peak expiratory flow (PEF), forced expiratory flow (FEF25%) and peak inspiratory flow (PIF). CONCLUSION: The results of this study show that exposure to tobacco dust would decrease lung capacities and airflows during the years.

Key words: Lung capacity, respiratory airflow, spirometry, tobacco dust

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INTRODUCTION

Many industrial processes produce airborne particles, and inhalation is the most common

Correspondence: Dr. Siavash Etemadinejad P.O. Box: 13185-1678, Tehran, Iran. E-mail: swt_f@yahoo.com way of their absorption. As a result of development and growth of industry and the corresponding increase in production, the volume and variety of contaminants also increase.^[1]

Many occupational diseases and related problems arise from contact with air pollutants. As many of these problems may be irreversible,

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assessment of the health status of workers and work environment in relation to airborne particles is essential.^[2]

Exposure to vegetable dust is probable in many industries, agricultural work and the general environment. The processing of various agricultural products such as cotton, flax, grains, tobacco, paprika and tea is often associated with exposure to vegetable dusts.

Vegetable dusts may cause a variety of harmful effects in the airways and lungs.^[3] Organic dusts may also cause acute or chronic respiratory symptoms and changes in lung function.^[4]

Tobacco dusts may be accompanied with bacteria, endotoxins, fungal spurs (molds), pollen, mite, insects, particulates and inorganic material such as quarts, and residues of pesticides and insecticides.^[5] Tobacco dusts may cause allergic reactions in the upper airways.^[3] Spirometry is a useful method for evaluation of pulmonary health and measurement of lung capacities and airflows.^[6]

As tobacco compounds, especially tobacco's additional contaminants, are affected by environmental factors and as results of previous studies are not exactly correspondent to each other, this study was designed to investigate the effect of exposure to tobacco dusts on lung capacities and airflows.

MATERIALS AND METHODS

In this historical cohort study, initially all individuals (273) exposed to tobacco dusts in a cigarette-producing factory were included. All the subjects were exposed to tobacco dusts for more than 8 years. Rate of exposure to dusts in all the subjects was the same according to the previous available records. Subjects with history of smoking, cardiovascular and acute or chronic respiratory disease, beta blocker usage; and those who refused to participate, those with poor cooperation and those with unacceptable spirogram were excluded. Finally 231 subjects (160 men, 71 women) completed the study.

One hundred healthy workers (67 men, 33 women) from a food stuff repackaging factory in the same area that were not exposed to the harmful dusts or any other air pollutants were chosen as controls, using the same exclusion criteria. Spirometry was performed in all subjects and controls from 8 to 12 a.m., in standing position and during the same winter.

Pulmonary function measurements were performed according to American Thoracic Society (ATS) criteria using a calibrated Spirolab II spirometer (MIR, Rome, Italy). Each one repeated the maneuver 3 to 8 times to obtain 3 acceptable spirograms (according to ATS standard). The spirogram with the highest value was used for statistical analysis and interpretation. The lung capacities and airflows were compared between the two groups using SPSS software by application of independent Student *t* test and correlation. P < .05 was considered significant.

RESULTS

The mean age of the exposed and unexposed groups was 36 ± 7 and 35 ± 7 years, respectively. Two hundred thirty-one

acceptable spirograms of the exposed group (69% men, 31% women) and 100 of controls (67% men, 33% women) were analyzed.

The two groups were matched for age, gender and height, and there was no significant difference in terms of age, gender and height between the groups [Table 1]. The results of pulmonary function test in workers exposed to tobacco dust and in unexposed workers are shown in Table 2.

In terms of parametric results, including lung capacities and airflows, there were significant differences between the two groups (exposed and unexposed workers) (P< .001). The relative variations in the parameters were as follows: forced vital capacity (FVC) (9%), forced expiratory volume in 1 second (FEV1) (16%), peak expiratory flow (PEF) (27%), forced

 Table 1: Demographic characteristics of the tobacco-exposed and unexposed groups

Group Parameters	Exposed (Case)	Unexposed (Control)	P-value
Age (years)	36±7	35±7	ns
Gender (%)			
male	160	67(67%)	ns
female	(69%)	33(33%)	
	71(31%)		
Height (cm)	171±3.5	171.9±4	ns

ns: not significant.

expiratory flow (FEF)_{25_75} (18%), FEF_{25%} (26%), FEF_{50%} (20%), FEF_{75%} (10%), peak inspiratory flow (PIF) (23%).

Prevalence of respiratory, eye-irritant and allergic symptoms in exposed and unexposed groups, obtained by history taking, was 20.5% and 6%, respectively, which indicates that prevalence in the exposed group was 3.5 times that in the unexposed group.

Considering relative variation, the highest reduction was seen in PEF, $\text{FEF}_{25\%}$ and PIF. $\text{FEF}_{50\%}$, $\text{FEF}_{25_75\%}$ and FEV1 were in the next indices that decreased, respectively. $\text{FEF}_{75\%}$ and FVC showed a little decrease. FEV1/FVC showed no significant differences between the two groups.

DISCUSSION

The results of this study show reduced lung capacities and especially airflows in the exposed group in comparison with the unexposed group. With the exception of FEV1/FVC ratio, reduction for all measured parameters was significant; however, decrease in PEF, PIF, FEF_{25%} was more obvious in comparison with all the other parameters, and

Group Parameters	Exposed (Case)	Percent Predicted of cases %	Unexposed (Control)	Percent Predicted %	P-value of controls	
FVC	3.8±1.1	91	4.3 ±0.9	98	<0.001	
FEV1	3.1±0.9	81	3.7±0.7	97	< 0.001	
FEV1/FVC%	82.6±12.4	90	84.1±8.8	89	>0.05	
PEF	5.3±2	78	7.3±1.9	105	< 0.001	
FEF25-75%	3.5±1.1	85	4.3±1.1	103	<0.001	
FEF25%	5.2±1.8	76	7.1±1.8	102	<0.001	
FEF50%	3.8±1.3	78	4.8±1.3	98	< 0.001	
FEF75%	1.7±0.6	87	1.9±0.6	97	< 0.001	
PIF	4.6±1.6	75	6±1.4	98	< 0.001	

Values are shown as mean±SD and percentage

Table 2: Pulmonary function test results of workers exp	oosed to tobacco dust (case	es) and unexposed workers
(controlo)		

reduction in FEF_{50%}, FEF_{25_75%} and FEV1 was in the next order. FEF_{75%} and FVC showed a little decrease.

These results may indicate involvement of medium and large airways. In a study in Turkey on 126 workers exposed to tobacco dusts and 55 controls, significant decrease was seen in FEV1, peak expiratory flow rate (PEFR) and maximal mid-expiratory flow (MMEF) in the subjects exposed to tobacco dusts in comparison with the control group.^[7]

Another study in USA on 121 workers that were exposed to tobacco dusts and 98 controls showed reduction in $\text{FEF}_{50\%}$, $\text{FEF}_{25\%}$ and $\text{FEV1.}^{[8]}$

The results of this study show involvement of airways, especially medium and large airways, in the exposed group. Exposure to tobacco dust, like other particles and dusts activates some protective reactions, which include increase in mucosal secretions and perhaps decrease in the diameter of respiratory ducts. This can be the reason for decrease in the parameters. However, more studies are necessary to provide verification of these results.

In addition, organic dusts may include other contaminants such as bacteria, endotoxins, fungi spur, mite, pollen, insects and inorganic particles such as quarts, residues of insecticides and pesticides.^[5] These contaminants may cause general irritant or specific allergic reactions in respiratory ducts and even lung tissue. In an immunologic survey in USA on 102 workers exposed to tobacco dusts and 30 controls, 12.7% of the exposed group had increased total serum IgE level and 26.7% of them had high level of specific serum IgE for tobacco allergens and positive skin test for extracted tobacco, but none of the controls had increased level of total or specific serum IgE.^[9] An investigation in China on 130 tobacco-processing workers and 112 control workers showed higher prevalences of chronic respiratory or nasal symptoms, lung function abnormalities and positive specific IgE reactions to fungi in tobacco-processing workers in comparison with those in control workers.^[10] A study in USA about the causes of occupational chronic cough stated agricultural and alimentary industries such as tobacco industry and exposure to tobacco dusts as a reason for occurrence of chronic cough.[11]

In the present study, irritant and allergic symptoms in the respiratory system (such as cough) and eyes were more frequent in the exposed group in comparison with the unexposed group (3.5 times).

The present study showed significant reduction in spirometric parameters, especially airflows, in the group exposed to tobacco dust. A part of this reduction may be due to added contaminants to tobacco dust. In an environmental study in 3 tobacco-producing factories in Finland, the level of endotoxins in the inhaling air was high. The level of gramnegative bacteria and fungi in a factory that used spray humidifiers was high; but in the one using steam humidifiers, no microorganism was detected.^[12]

Humid climate is a good condition for growth of fungi, bacteria, mite and insects. Residues of pesticides in organic matters and inappropriate usage of pesticides may be causative factors in the reduction of lung capacities and airflows.

In our study, the variance of the parameters in the control group was lower than in the case group; it can compensate for the imbalance in the sizes of the two groups. However, systemic error is possible and might have some effects on our findings, and so it is one of the limitations of this study.

Although this study only investigated the effects of tobacco exposure in workers, yet the same or even worse conditions may affect workers in other industries, especially in small workshops where workers are exposed to organic materials such as tea, grains, cotton. Probability of reduction of spirometric parameters in the workers in these environments is very high.

CONCLUSION

The results of this study show that exposure to tobacco dust would decrease lung capacities and airflows during the years.

Recommendation

Although more comprehensive, long-term prospective and specific studies are necessary, yet we recommend control of engineering in industries with high exposure to organic dust to reduce the dusts; storing organic material in better conditions to inhibit the growth of fungi, bacteria, mites and insects; avoiding overuse of pesticides and insecticides; providing standard and appropriate protective tools (mask) for workers who are exposed to dusts; and, finally, periodic assessment of pulmonary function by spirometry for workers who are exposed to organic dusts and assessment of other preventive action.

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