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Lung Functions in Workers Exposed to Tobacco Dust

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Abstract : Workers in the tobacco industry are exposed to tobacco dust, which has allergenic and irritative effects on airways. In this study, our aim was to determine whether tobacco dust has any effect on lung functions and volumes.

A questionnaire about working conditions was applied to 448 workers, some of which had been exposed to tobacco dust while others had not, and all workers underwent measurements of spirometric flow and volume.

Of the study group, 126 workers were exposed to tobacco dust for more than 10 years and 55 were not. All of these 181 workers were also nonsmokers. There were statistically significant differences between exposed and unexposed workers in FEV_1 ($p<0.05$), PEFR ($p<0.01$) and MMEF ($p<0.01$) percentages.

In conclusion, it is thought that exposure to tobacco dust for long periods affects the lung functions and some measurements should be taken in the working area to reduce the amount of tobacco dust and prevent its inhalation.

Key Words: Tobacco dust, Lung function, Exposure

Introduction

Many industrial processes produce airborne contaminants and their most common route of absorption is by inhalation. As world industry and the speed of production grow, the volume and variety of contaminants increase, so that potential risks, not always obvious or immediate, also increase (1). Many occupational diseases and related problems arise from contact with airborne contaminants. As the effects can be irreversible, preventive action is essential (2). Exposure to vegetable dusts is widely encountered in many industries, agricultural work and the general environment. The processing of various agricultural products such as cotton, flax, hemp, grains, tobacco, paprika and tea is often associated with exposure to vegetable dusts. Vegetable dust may be defined as an aerosol derived from plant material, regardless of the nature of the particles or the circumstances of their emission into the air. When inhaled as an aerosol, vegetable dusts may exert a variety of harmful effects on the airways and lungs (3). Exposure to organic dusts may also cause acute or chronic respiratory symptoms often accompanied by changes in lung function (4). Tobacco dust can contain bacteria, endotoxins, and fungal spores (molds), pollen, mites, insects, particulates of inorganic materials such as quartz, and residues of pesticides or insecticides (5). Tobacco dust causes an allergic response that occurs either in the upper airways or in the bronchi, or in both (3). In evaluating overall lung health, spirometry is a useful test that measures the volume of air expelled from fully inflated lungs over time. Many indexes, both inspiratory and expiratory, may be derived from the spirometric tracing; it is the indexes of forced expiration that are most commonly used to assess lung functions. The total volume forcibly exhaled is the forced vital capacity (FVC). The amount exhaled in the first second is the forced expiratory volume in one second (FEV_1). The ratio of the FEV_1 to FVC is often used to assess patients for airflow obstruction. It is normally 75 to 85 percent, depending on the patient's age (6). FEV_1 is diminished in obstructive lung diseases. Peak expiratory flow rate (PEFR) is the maximum flow rate during a maximum expiration and it is a useful test in determining the severity of the airway obstruction and in follow up

(7). PEFR values 80 l/min lower than predicted means are considered diminished (8). Maximum mid expiratory flow (MMEF) reflects the flow properties of small as well as large airways (9). Normal adults can achieve MMEF, which is typically 150 to 300 liters/min (10).

The aim of this study was to determine whether tobacco dust has any effect on lung functions and volumes in workers of the Ballıca Cigarette Factory in Samsun province.

Materials and Methods

In February 1998, a cross-sectional investigation of lung function was performed at the Ballıca Cigarette Factory in Samsun province. All 448 workers working on the day shift were included. A questionnaire was applied to the entire study group to ascertain some demographic features, habits and conditions of the work area, and spirometric measurements of lung functions (VC, FVC, FEV_1, PEFR and MMEF) were carried out (Fukuda Sangyo Spiro Analyzer ST-90). Spirometric measurements were carried out between $09^{\underline{00}}$ and $12^{\underline{00}}$ AM by the same method to the entire study group. Values lower than 80 percent of predicted VC, FVC and FEV_1, lower than 80 liters/min of predicted means of PEFR and lower than 150 liters/min (the lowest value accepted as normal) of MMEF were considered decreased. To evaluate the effects of tobacco dust on lung functions, the measurements of 126 nonsmoking workers exposed to tobacco dust more than ten years and 55 unexposed nonsmoking workers were compared. Results were evaluated with Student-t and Chi-square analysis by using Statistical Package for the Social Sciences (Version 5.0) and Epi Info 6 (Version 6.02).

Results

Of the participants, 181 (40.4 percent) were nonsmokers, 126 (69.6 percent) and 55 (30.4 percent) of them were exposed and unexposed to tobacco dust, respectively. Mean age was 42.2 ± 0.3 years in exposed and 28.7 ± 1.1 years in unexposed workers. Table 1 shows the means of the percentages of predicted values of exposed and unexposed workers. There were statistically significant differences between the two groups in terms of FEV_1 ($p<0.05$), PEFR ($p<0.01$) and MMEF ($p<0.01$) percentages. There were significantly higher prevalences of exposure to tobacco dust in workers with decreased FVC, FEV_1 and MMEF values than in workers with normal FVC, FEV_1 and MMEF values (Table 2).

Discussion

Obstruction of the airways of tobacco workers has been suggested by several research groups (11,12). Mukhtar et al. reported that workers exposed to tobacco dust had decreased ventilatory capacity values and a decrease in air flow of 20.8 percent at 25 percent FVC compared with age-matched unexposed workers (13). In the present study, there was no statistically significant difference between measured FVC percentages according to predicted values of exposed and unexposed workers. Uitti et al. reported a significant decrease in FEV_1 during the workshift and an excess of chest tightness among nonsmoking tobacco workers (11). Asrat et al. reported a decrease in FEV_1, MMFR and PEFR values in 11 percent of male cigarette workers exposed to tobacco dust (14). In the present study, it was found that 31.7 percent of exposed workers showed values of FEV_1 lower than their predicted values and also there was a statistically

Table 1. Means of the percentages of predicted values of exposed and unexposed workers at the Ballıca cigarette factory in Samsun province, in February 1998 (Mean ± SE).

Dust Exposure	Vital Capacity (VC)	Forced Vital Capacity (FVC)	Peak Expiratory Flow (PEFR)**	Maximum Mid Expiratory Flow (MMEF)**	Forced Expiratory Volume in 1 Second (FEV_1)*
Exposed(n=126)	85.6 ± 1.2	81.1 ± 2.1	59.2 ± 1.5	85.9 ± 2.4	87.3 ± 1.5
Unexposed (n=55)	84.6 ± 1.6	83.6 ± 1.6	69.4 ± 2.8	100.2 ± 3.5	93.4 ± 1.9

*$p<0.05$, **$p<0.01$

Table 2. Distribution of workers with normal and decreased FVC, FEV1 and MMEF measurements according to exposure to tobacco dust at the Ballıca cigarette factory in Samsun province, in February 1998.

	Lung Function								
	Normal			Decreased					
Spirometric Measure	Exposed	Unexposed	Total	Exposed	Unexposed	Total	OR	(95% CI)	P
FVC	61 (59.2%)	42 (40.8%)	103 (100%)	65 (83.3%)	13 (16.7%)	78 (100%)	3.4	(1.6 - 7.5)	0.0008
FEV1	86 (64.6%)	47 (35.4%)	133 (100%)	40 (83.3%)	8 (16.7%)	48 (100%)	2.7	(1.1 - 6.9)	0.02
MMEF	89 (70.6%)	50 (29.4%)	139 (100%)	37 (88.1%)	5 (11.9%)	42 (100%)	4.2	(1.5 - 14.3)	0.005

OR: odds ratio, CI: confidence interval

significant difference between exposed and unexposed subjects in terms of FEV_1 percentages according to predicted values. Exposed workers were also found to have statistically significant decreased values of PEFR and MMEF compared with unexposed subjects. As a decrease in FEV_1 or PEFR shows obstructive changes in large airways, a decrease in MMEF, especially, indicates obstructive changes in medium and small airways (15). Although our study is a cross-sectional study and we cannot say that the tobacco dust is a certain cause of lung dysfunction, these findings suggest that exposure to tobacco dust has negative health effects and that it is advisable to establish a threshold limit value for tobacco dust. In light of these findings, it is thought that a decline in lung functions may be prevented by taking some measures in working areas such as modification of the industrial processes, ventilation systems that can be reduce the amount of total dust, and use of respirators to provide temporary protection while dust control is being improved. On the other hand, periodic medical examinations, including lung function tests, of workers exposed to dust should be carried out at approximately yearly intervals and more frequently in those who may be at higher risk.

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