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M. Ghasemkhani
Department of Occupational Health,
School of Public Health,
Tehran University of Medical Sciences,
P.O. Box 14155-6145, Tehran,
Islamic Republic of Iran

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Pulmonary Function Status among Workers in Industries of South Tehran

[1]M. Ghasemkhani, [2]S. Firouzbakhsh, [3]M. Rezaei and [4]H.R. Sadeghipour

A cross-sectional study was conducted in a group of 880 workers employed in industries workers south of Tehran. Pulmonary function test was measured among 224 of suspected respiratory abnormalities workers. In pulmonary function test of subjects, 147(68.0%) had normal while 77 (32.0%) showed reduced. There were statistically significant differences between mean measured and predicted values in terms of FEV1 and FVC ($p<0.0001$), PEFR ($p<0.006$). The highest percent of respiratory disorders were among workers food, drink, tobacco, construction and metal industries with 24.7, 20.8 and 18.1%, respectively. It is recommended that engineering measures be adopted to reduce the harmful materials in industries, together with health monitoring of exposed employees. All workers who are exposed to harmful materials should be given regularly scheduled lung function tests. This exam is a valuable tool in a full program for detecting and preventing serious occupational lung diseases.

Key words: Pulmonary function test, respiratory, spirometry, harmful materials, industries

[1]Department of Occupational Health, School of Public Health
Tehran University of Medical Sciences P.O. Box 14155-6145, Tehran
Islamic Republic of Iran
[2]Division of Pulmonary Diseases, School of Medicine, TUMS
Tehran, Islamic Republic Iran
[3]Department of Community Medicine,
Kermanshah University of Medical Sciences, Islamic Republic of Iran
[4]Department of Physiology, School of Medicine, TUMS
Tehran, Islamic Republic of Iran

INTRODUCTION

Air pollution is a very important occupational problem in a various industries. Increasing amounts of potentially harmful gases and particles are being emitted from the workplace directly into atmospheric and as a result case severe damage to human health. Inhalation is probably the most important route of exposure in the workplace and is an inescapable route of exposure to toxins in the general environment as well[1,2]. The most contaminants take repeated or constant exposure over months or years to cause disease or permanent harm. The impact of pulmonary hazards is also influenced by air pollution in general, age, smoking history, nutritional status and other less well understood factors such as genetics and stress[3]. The World Health Organization has defined respiratory disability as a reduction in exercise capacity due to impaired lung function[4]. A critical element in determining respiratory status is an evaluation of pulmonary function[5]. Pulmonary Function Tests (PFT) can be used to help in disability determination. The PFT are the most useful indices in the assessment of disabling pulmonary impairment[6]. Exposure to vegetable dusts is widely encountered in many industries. The processing of various agricultural products such as cotton and tobacco is often associated with exposure to vegetable dusts[7]. Exposure to vegetable dust may also cause changes in lung function[8]. Ten different studies have found reduced forced expiratory volume in one sec in cement workers. There was no dose-response-related between cement dust exposure and decrease in lung function indices in cement workers[9].

The aim of this cross-sectional study was to examine the pulmonary function tests of suspected respiratory abnormalities workers employed in industries of south Tehran.

Table 1: Characteristics of the study population

	No. subjects (%) n = 880
Age (years)	x = 38.5 (SD±10.2)
<30	204 (23.2)
30-39	245 (27.8)
40-49	300 (34.1)
≥50	131 (14.9)
Duration of employment (years)	x = 14.2 (SD±9.17)
<10	298 (33.9)
10-19	261(29.7)
≥20	321 (36.5)
Marital status	
Single	105 (11.9)
Married	775 (88.1)
Educational status	
Illiterate	40(4.5)
Primary	289 (32.8)
Junior high school	195(22.2)
High school	51 (5.8)
Diploma	270 (30.7)
Diploma +	35 (4)
Cigarette smoking	
Smoker	252 (28.7)
Non- smoker	612 (69.6)
Smoked previously	15 (1.7)
Duration of smoking in smokers (years)	x = 14.6 (SD±9.39)
<5	59 (22.3)
5-15	91 (34.5)
15-25	86 (32.6)
≥25	28 (10.6)
Type of industry	
Food, drink and tobacco (7*)	201 (22.8)
Textile (3)	40 (4.5)
Chemical (6)	110 (12.5)
Construction (7)	169 (19.2)
Metal (7)	320 (36.4)
Miscellaneous (5)	40 (4.5)
Exposure with harmful material	
Dust	242 (27.5)
Fume	15 (1.7)
Gas	139 (15.8)
Dust and gas	273 (30.9)
Dust and fume	113 (12.8)
Fume and gas	55 (6.3)
None	44 (5.0)

*Number of enterprises

MATERIALS AND METHODS

This was a cross-sectional study in which by multistage random sampling, 880 workers in industries of south of Tehran, in 2003 were studied. Data collected by a modified questionnaire of Medical Research Council (MRC)[10] containing items on demographic characteristics, smoking habits and then were verified by physician's examination. Next pulmonary function was measured among 224 of suspected respiratory abnormalities workers by recording pulmonary function tests (PFTs), forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), peak expiratory flow rate (PEFR) and forced expiratory flow-rate at 25 to 75% of FVC (FEF25-75). All values were corrected according to conditions of body temperature and pressure saturated with water vapor (BTPS). Spirometry was performed between 8:30 am and 2:30 pm, which met the American Thoracic Society (ATS)[11] recommendations on the standardization of spirometry into a Vitalograph alpha spirometer (Vitalograph Ltd, Buckingham UK). The temperature was controlled and the spirometer was calibrated with a one-liter syringe each day and before each examination. The spirometry was taken with the subject sitting. All measurements were registered at least three times for each person and the best results were selected. Spirometric results were expressed both as a percentage of the predicted value for a normal person of corresponding age and height.

Table 2: Distribution of harmful materials in the industries

	Food, drink and tobacco	Textile	Chemicals	Construction	Metal	Miscellaneous	n*
Dust	33 (13.6)#	11 (4.5)	27 (11.2)	113 (46.7)	50 (20.7)	8 (3.3)	242
Gas	81 (58.3)	4 (2.9)	18 (12.9)	3 (2.2)	31 (22.3)	2 (1.4)	139
Fume	4 (26.7)	0	2 (13.3)	2 (13.3)	7 (46.7)	0	15
Dust and gas	55 (20.2)	25 (9.2)	36 (13.2)	20 (7.4)	121(44.5)	15 (5.5)	272
Dust and fume	7 (6.2)	0	8 (7.1)	12 (10.6)	83 (73.5)	3 (2.7)	113
Fume and gas	4 (7.3)	0	11 (20.0)	14 (25.5)	14 (25.5)	12 (21.8)	55
None	17 (38.6)	0	8 (18.2)	5 (11.4)	14 (31.8)	0	44

*: Total number, #: Number (Percentage)

Table 3: Spirometric findings in the examined workers

Spirometric parameter	Mean measured value	Mean predicted value	Percent measured/ predicted	No. of subjects with abnormal PFT	P-value
FVC	4.6±1.14	4.31±0.56	92.75±20.52	77	0.0001
FEV1	3.27±0.97	3.57±0.48	91.52±21.43	77	0.0001
PEF	466.00±223.47	504.36±118.33	89.70±33.99	77	0.006
FEF_{25-75}	3.96±1.90	4.15±0.54	93.66±41.33	69	NS

PFT - Pulmonary Function Test, FVC -Forced Vital Capacity,
FEV1-Forced Expiratory Volume in 1 sec, PEF-Peak Expiratory Flow,
FEF_{25-75} - Forced Expiratory Flow - Rate at 25 to 75% of FVC,
NS = Non significant

Statistical analysis: Data were statistically analyzed with the SPSS statistical programme. The results of PFT measurements were analyzed by paired t test when comparing baseline values to predicted values. A level of $p < 0.05$ was considered to be statistically significant.

RESULTS

The mean±SD age of the workers was 38.5±10.2 years: age ranged from 19 to 70 years, the mean±SD years employment was 14.2±9.17 and the mean±SD years of smoking 14.6±9.39. Of 880 workers under study, 252 (28.7%) were smoking. Also it has been observed that 95% of workers exposed in the workplace with harmful materials. The highest percent of workers were in metal, food, drink, tobacco and construction industries, respectively with 36.4, 22.8 and 19.2% (Table 1).

The highest percent in workers exposed to harmful materials dust, gas and fume were in construction, food, drink, tobacco and metal industries with 46.7, 58.3 and 46.7%, respectively. The workers of textile industry exposed the lowest level (Table 2).

The mean±SD PFTs predicted % of the workers were; FVC% 92.75±20.52, FEV1% 91.52±21.43, PEFR % 89.70±33.99 and FEF25-75% 93.66±41.33. In PFT of 224 subjects, 147 (68.0%) had normal while 77 (32.0%) showed reduced PFTs. There were statistically significant differences between mean measured and predicted values in terms of FEV1 and FVC ($p<0.0001$), PEFR ($p<0.006$) (Table 3).

The highest percent of respiratory disorders were among workers food, drink, tobacco, construction and metal industries with 24.7, 20.8 and 18.1%, respectively. The 40 (52.0%) subjects demonstrated findings of adverse respiratory disorders probability and 37 (48.0%) possibility respiratory disorders. Among workers, 65 (84.4%) demonstrated findings of lung pattern (obstructive) and 12 (15.6%) lung pattern (restrictive) (Table 4).

DISCUSSION

Spirometry is the most commonly used PFT because it is simple and reproducible. Studies such as spirometry only measure selected mechanical properties of the respiratory system[12]. Pulmonary function testing in workers is essential to determine the frequency, severity and pattern of airway disease resulting from occupational exposure. Pulmonary function testing has a three fold purpose: to identify preexisting pulmonary disorders for proper job placement, to detect early changes in pulmonary function in workers while intervention may still be effective and to accumulate data to evaluate how well the exposure controls are working[13]. In this study PEFR was the main parameter of lung function to show significant difference with age, working years and type of industry ($p<0.0001$, $p<0.005$, $p<0.04$, respectively). Whereas no differences were found between FVC, FEV1 and FEF25-75 age, working years and type of industry. Al-Neaimi *et al.*[14] reported that ventilatory function (VC, FVC, FEV1, FEV1/VC, FEV1/FVC and PEF) was significantly lower in the exposed workers a cement factory in a rapidly developing country compared with unexposed workers. These differences could not be explained by age, body mass index (BMI) or smoking. Keimig *et al.*[15] showed that FVC and FEV1 were not different in welders and controls. Özdemir *et al.*[16] reported that there was no significant differences in PFTs and occurrence of chronic bronchitis between welders with more or less than 20 years at work. Mukhtar *et al.*[17] studied tobacco factory workers and considered that the duration of exposure to tobacco dust did not appear to have any significant effect on ventilatory function. Viegi *et al.*[18] also reported that tobacco workers experienced a decrease ratio in forced end expiratory flows associated with work duration. We think that working conditions are

Table 4: Distribution of respiratory disorders in the workers by industries

Variables	Food, drink and tobacco	Textile	Chemicals	Construction	Metal	Miscellaneous	n*
Respiratory disorders (probability)	33 (32.5)#	6 (15.0)	3 (7.5)	6 (15.0)	8 (20.0)	4 (10.0)	40 (52.0)
Respiratory disorders (possibility)	6 (16.2)	4 (10.8)	6 (6.2)	10 (27.0)	6 (16.2)	5 (13.6)	37 (48.0)
Respiratory disorders(total)	19 (24.7)	10 (13.0)	9 (11.7)	16 (20.8)	14 (18.1)	9 (11.7)	77 (100)
Lung pattern(obstructive)	18 (27.7)	10 (15.4)	8 (12.3)	10 (15.4)	13 (20.0)	6 (9.2)	65 (84.4)
Lung pattern(restrictive)	1 (8.3)	0	1 (8.3)	6 (50.0)	1 (8.3)	3 (25.0)	12 (15.6)

*: Total number #: Number (Percentage)

important for respiratory health. Hayden *et al.*[19] showed that working in the engineering industry seemed to have no decreased PFTs and they emphasized that factories, which their subjects had worked, had been well ventilated.

Working in the construction, tobacco and metal industries are associated with numerous occupational health hazards. These industrial groups exposed with various harmful materials including numerous dust and other chemical substances for example, gases and fumes. Construction is one of the largest industries in the Iran. In this study identified several industrial subgroups, such as tobacco subgroup in food, drink and tobacco industries, cement subgroup in construction industries and welders in metal industries that has been observed the highest percent in workers exposed in the workplace with harmful materials. Also, our findings showed in tobacco, cement and metal workers with a more exposure with harmful materials, as the likely occurrence of their health risks has increasingly went up; the respiratory disorders has also grown up. On contrary, among the workers with lower exposure to harmful materials, this respiratory disorders was in its lowest level. Kalacic[20] reported that airflow obstruction in Yugoslavian cement workers higher than in controls. Fell *et al.*[21] described that there was no dose-response-related decrease in lung function indices in workers exposed to Portland cement dust. Mustajbegovic *et al.*[22] showed that FEV1, FEF50 and FEF25 were significantly decreased in relation to predicted values ($p<0.05$ or $p<0.01$) among tobacco workers. Kjaergaard *et al.*[23] described significantly decreased FVC and FEV1 values in tobacco workers compared to referents. Wolf *et al.*[24] reported that the significantly reduced flow values among the welders compared with the controls.

In conclusion, industries workers are exposed with various harmful materials, which may explain the higher respiratory indices. We could not evaluate the impact of probable risk into the group of workers in this study. In view of the deleterious effects of harmful materials on the respiratory system, we suggest that preventive measures need to be taken. These measures include control of dusty environment and wearing of personal protective masks. Medical surveillance should be part of this preventive program and should include lung function testing before starting employment and regularly during employment in these industries. Spirometry plays a key role in the assessment and management of workers with harmful exposures and detection of different pulmonary disorders. Workers with respiratory disorders or atopy should be closely monitored while working in the industries.

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