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Original Research Article

Comparision of Ventilatory Function Test among Non Smoker, Smoker and Smoker Brick Kiln Workers

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ABSTRACT

The objective of this study was to compare Ventilatory functions in nonsmokers, smokers and smoker brick kiln workers to analyze the extent of impairment in the airways. Parameters recorded were PEFR, FEV_1, FVC, $FEF_{25-75\%}$ and FEV_1/FVC%. For each participant chest x-ray was also taken. First, we have done comparison of ventilatory functions between nonsmokers and smokers. It was observed that values of PEFR, FEV_1, FEV_1/FVC and $FEF_{25-75\%}$ significantly decreased in smokers (p value<0.001) as compared to non smokers. Our results indicate that smokers are at high risk of developing narrowing of airways in comparison to non smokers depicted by lowering of FEF25-75% (p value<0.001).
Further we have compared the ventilatory functions between smoker brick kiln workers with non smokers and smokers individually. The result shows that there is more decrease in values of PEFR, FEV1,FVC, FEV1/FVC and FEF25-75% in smoker brick kiln workers(p value<0.001).
FVC is not significantly reduced in smokers as compared to smoker brick kiln workers.
Conclusion: Smokers are at high risk of developing obstructive airway diseases. But Smoker brick kiln worker whose duration of working in brick kiln is more than 10 years are susceptible of developing mixed pattern of obstructive or/and restrictive ventilatory impairment.

Key words: Ventilatory function test, brick kiln workers, smokers.

INTRODUCTION

Diseases and conditions of respiratory system are generally caused by inhalation of foreign bodies such as cigarette smoke, chemicals, allergens and other irritants. [1] Cigarette smoking clearly plays a major etiological role in chronic bronchitis. Individual who smoke are more prone to develop chronic bronchitis than non-smokers. Inhaled cigarette smoke contains thousands of particles, many of which are irritants that cause bronchial inflammation and destruction of ciliary activity. The excess mucus that accumulates because of decreased ciliary activity increases the patient's vulnerability to secondary bronchial infections, further compromising the already inflamed bronchial mucosa. [2]

With urbanization trend, brick making industries have flourished. Fuel used by brick kilns in baking the bricks adds up

to almost 31% of suspended matter. Other pollutants like carbon monoxide, sulphur dioxide, nitrous oxide too are added to environment. According to the study -Urban air quality management strategy in Asia carried out by World Bank (1996), common atmospheric pollutants such as sulphur dioxide, nitrogen oxides play a significant etiologic role in bronchial inflammation. [3-6]

SPM (Small particulate matter) in gases are generated due to incomplete combustion of fuel or comes from fine coal dust. Large or coarse particle are usually trapped in upper respiratory tract where as fine particle enter in small airways and alveoli. Coarse particle are produced during construction activities while fine particles originate from combustion of fuel. Inhalation of even low concentrations of fine particles affects the lung functions and hence leads to increase in respiratory diseases. [7]

Diseases of lungs caused at work place exposure have been recognized for centuries. Although lung diseases are not the most common occupational diseases, they are significant due to their severity. Pulmonary function tests and chest X-rays are common diagnostic tools for diagnosing respiratory diseases. The objective of this study was to compare Ventilatory functions in nonsmokers, smokers and smoker brick kiln workers to analyze the extent of impairment in the airways

MATERIALS AND METHODS

This study was conducted in department of Physiology Maharishi Markandeshwer Institute of Medical Sciences And Research, Mullana, Ambala in collaboration with department of Pulmonary Medicine and Radiology. The Pulmonary Function tests were conducted on 75 subjects of which 25 were taken as the control group and other 50 as the study group. The control group subjects were non smoker males randomly selected from general population. The study group was categorized into 2 major groups i.e. Group-1 or G1 included smoker males randomly selected from general population. Group-2 or G2 included smoker brick kiln workers who have worked in brick kilns for more than 10 years.

Inclusion criteria

- Non-smoker: who did not smoke at all.
- Smokers: who smoked any tobacco products daily for more than 10 years.
- Brick kiln workers: brick kiln workers who have worked in brick kiln for more than 10 years and smoked daily for more than 10 years.

Exclusion criteria

All subjects were examined and those with documented lung pathologies i.e. any type of lung cancer, cor-pulmonale, tuberculosis, pneumonia, pulmonary effusion were excluded from the study. Also ex-smoker or post smoker were excluded from study.

The equipment used was computerized Spiro-exel Medicaid system, Chandigarh. The patient was made to sit comfortably. The subject was then asked to breathe in and out to familiarize himself to the equipment. He was then asked to inhale to his maximum capacity and forcefully blow out into sensor (nose clipped) as hard as possible. The procedure was repeated and the best of three readings were considered for analysis. [8]

Parameter recorded were:

1. Peak expirtory flow rate (PEFR)
2. Forced expiratory volume in 1st second
3. Forced vital capacity
4. FEV1/FVC%
5. Forced mid expiratory flow [FEF25-75%]

For each participant chest x-ray (PA-view) 35*35cm were also taken. The chest films were read by experienced radiologist.

Statistical analysis

Each parameter of one group was compared individually with same parameter of another group by unpaired t-test. Results were significant at P<0.05 and highly significant at P<0.001.

RESULTS

Peak expiratory flow rate (PEFR)

PEFR in control group was significantly higher when compared with G1 and G2 (for both cases p<0.0001). Significant difference was also found between mean PEFR of G1 from that of G2 (p<0.01).

Forced Expiratory Volume in 1st second

FEV_1 in control group is significantly higher as compared to G1 and G2 (for both cases p<0.0001). The mean value of FEV_1 of G2 is significantly lower than that of G1 (P<0.001).

Forced vital capacity

FVC in control group is significantly higher as compared to G2 (p<0.01). No significant difference of values is observed when value of control group and G1 were compared.

FEV_1/FVC%

FEV_1/FVC% in control group is significantly higher as compared to G1 and G2 (for both cases p<0.0001). No significant difference of values is observed when value of G1 and G2 are compared.

$FEF_{25-75\%}$

$FEF_{25-75\%}$ of G2 is significantly lower than control and G1 group (for both cases p<0.0001).There is also significantly difference between the value of G1 and G2 (p<0.01).

X-ray finding

X-ray showed hilar lymph node enlargement and increase in bronchovascular marking in study group when compared to control. These changes were more significant in smoker brick kiln workers whose duration of exposure was more than 10 years in brick kilns.

Table-1 Anthropometric measurement including age, weight and height of control group, study groups including smoker and smoker brick kiln workers.

Parameter	Control	Smokers Group 1	Smoker brick kiln workers Group 2
Age (year) X±SD	36±4.83	35±14.5	40±7.9
Weight (kg)	63.8±6.19	56.28±7.9	52.0±8.7
Height(cm)	164.8±4.1	165.3±7.0	167.2±5.8

Table-2 Smoking index among smokers and smoker brick kiln workers.

Parameter	Smokers Group 1	Smoker brick kiln worker Group 2
Mean duration of smoking(years)	13.8±10.3	17.21±5.8
Average frequency of smoking per day	14±6.3	11±8.2
Smoking index (frequency×duration)	182	187

Smoking index is equal to multiplication of average number of cigarettes/bidis smoked per day and duration (in years) of tobacco smoking. [9]

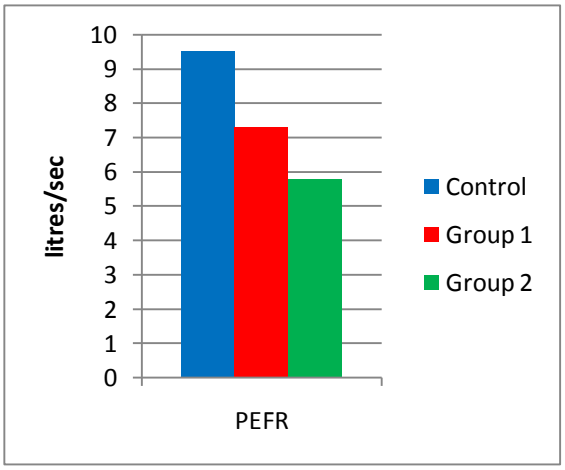

Figure 1 Peak Expiratory flow rate

Table-3 Pulmonary function test findings

Parameter	Control	Smokers (Group 1)	Smoker brick kiln workers(Group 2)
PEFR(l/s)	9.549±1.1084	7.362 ± 2.1072	5.828 ± 1.7785
FEV1(l)	3.527±0.2399	2.751 ± 0.7303	2.148 ± 0.4964
FVC(l)	3.863±0.252	3.165±0.693	2.564±0.6595
FEV1/FVC(%)	91.352±3.5515	85.873±7.5247	84.788±8.4522
FEF25-75%(l/s)	5.648±0.7342	4.207±1.621	3.001±1.1752

X=mean value, SD=standard deviation, l=litres, s=second

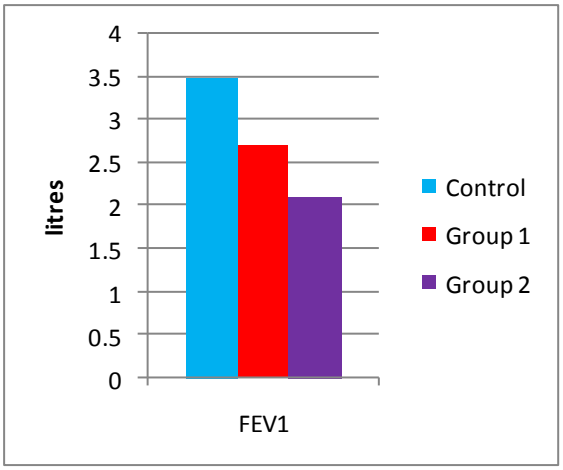

Figure 2 Forced Expiratory Volume in 1st second

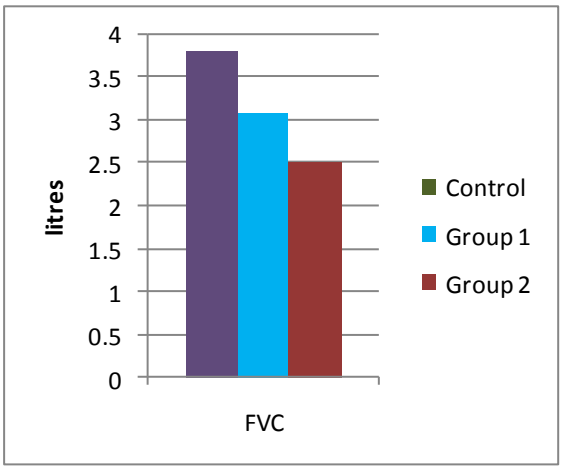

Figure 3 Forced vital capacity (FVC)

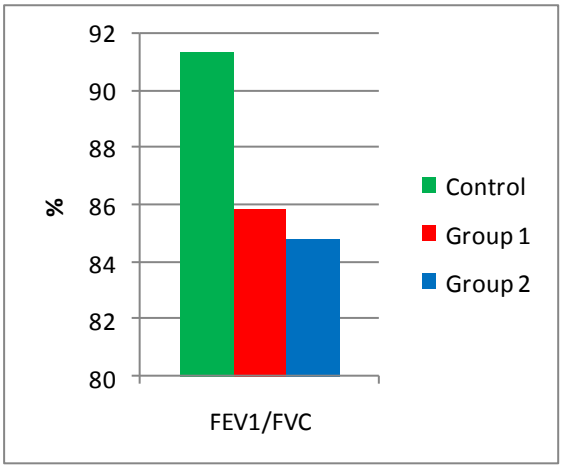

Figure 4 $FEV_1/FVC\%$

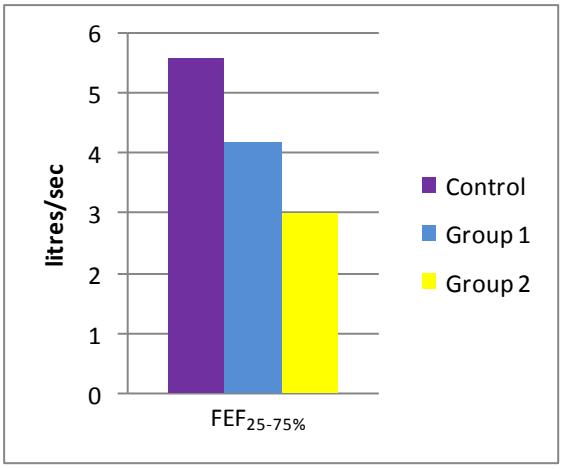

Figure 5 $FEF_{25-75\%}$

DISCUSSION

Ventilatory functions in nonsmokers and smokers

In this study all the parameter like PEFR, FEV_1, FEV_1/FVC, $FEF_{25-75\%}$ were significantly decreased in smokers when compared with non smokers by applying unpaired t-test of significance. Analysis of relation between smoking status and ventilatory functions revealed the significant decrease in PEFR, FEV_1, $FEF_{25-75\%}$. So it suggested that smoking may play a role in narrowing of airways. Fall in FEV_1, PEFR and $FEF_{25-75\%}$ indicate obstructive lung changes. Similar results were observed by Angelo et al. [10] and Malo et al. [11]

In smoker brick kiln workers

The pulmonary functions PEFR, FEV_1, FEV_1/FVC and $FEF_{25-75\%}$ were more decreased when compared with non smokers and smokers. In addition FVC were highly significantly decreased in G2 group when compared with the control. The fall in FEV_1, PEFR and other flow rates indicate obstructive lung disease and fall in FVC indicates restrictive lung disease. The result indicates restrictive nature of pulmonary involvement in addition to obstructive pattern hence suggestive of mixed pattern of ventilatory defects in smoker brick kiln workers. Similar results are comparable with

that of Yesar MH et al. [12] and Golshan et al. [13] They showed brick factory workers scored lower values of four spirometric variables i.e. PEFR, FEV_1, FVC AND FEV_1/FVC than the control subjects.

CONCLUSION

Smokers are at high risk of developing obstructive airway diseases. But Smoker brick kiln worker whose duration of working in brick kiln is more than 10 years are at high risk of developing mixed pattern of obstructive or/and restrictive ventilatory impairment.

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