**ABSTRACT**

**Background:** Cigarette smoking causes airflow limitation with lung hyperinflation being the primary cause of chronic obstructive pulmonary disease (COPD). Most of the smokers have subclinical parenchymal lung disease. Early diagnosis and treatment decrease the rate of morbidity and mortality.

**Aim and objective:** The aim of our present study was to assess the forced expiratory volumes like forced vital capacity (FVC), forced expiratory lung volume in 1 second (FEV1), percentage of FEV1 (FEV1%), forced expiratory flow during 25-75% of expiration (FEF 25-75%), and peak expiratory flow rate (PEFR) in asymptomatic smokers.

**Method:** The study was conducted in 50 asymptomatic smokers using computerized spirometer and the data was compared and analysed with the values of 50 non-smokers.

**Result:** All the forced expiratory lung volumes were decreased in smokers when compared to non-smokers.

**Conclusion:** Cigarette smoking cause a definite deterioration in lung function though the subjects were asymptomatic.

**Keywords:** Asymptomatic cigarette smokers, computerized spirometer, FVC, FEV1, FEV1%, FEF 25-75%, PEFR.
COPD. Early treatment and motivation to stop the habit of smoking decreases the morbidity and mortality. So, our present study was designed to study the effect of cigarette smoking on young asymptomatic smokers.

MATERIALS AND METHODS
This study was carried out in 50 male smokers (study group) with no symptoms of any respiratory illness and 50 male non smokers. Both the groups were within the age group of 18-35 years. The subjects were explained properly about the aim, methodology and implication prior to the commencement of the study. Written informed consents were obtained from all the subjects. A preliminary screening was done to exclude gross pulmonary diseases, anatomical deformity of the chest or spine and any infectious lung diseases like tuberculosis that may affect the respiratory parameter. Subjects with any of these were excluded from the study.

Both the study group and control group subjects were age, height, weight and BMI matched. The data sheet of the subject was collected in the form of questionnaire and was kept confidential.

Pulmonary function test (PFT) was carried out with the help of computerized spirometer (MEDIKRO WINDOWS SPIROMETER / MODEL – M 9831-1.8-0.4). Satisfactory demonstrations were given to the subjects regarding the procedure for recording the forced expiratory lung volume parameters like FVC, FEV1, FEV1%, FEF25-75%, PEFR using computerized spirometer prior to the test. The subjects were allowed to relax and familiarize the procedure. They were asked to hold the mouth piece of the spirometer with their lips tightly so as to prevent leakage of air during the procedure. The noses were clipped to allow airflow only through the mouthpiece. The subjects were asked to take deep inspiration and exhale forcefully and completely into the mouth piece. A minimum of three forced expiratory maneuvers were performed and the best of the three readings was selected/ accepted for analysis.

The acceptable criteria’s were,
- Full inhalation before the start of the test.
- Satisfactory start of exhalation: maximal effort exerted with no hesitation.
- No cough during the maneuver.
- No early termination of exhalation.
- A minimum exhalation time of 6 seconds is recommended.

The computer automatically analyses and displays the test value for all the expiratory lung parameters (FVC, FEV1, FEV1%, FEF25-75%, PEFR) by this forced expiratory maneuver.

RESULTS
The effect of cigarette smoking on lung function test parameters like FVC, FEV1, FEV1%, FEF25-75%, PEFR were assessed in 50 asymptomatic smokers (study group) by computer spirometer and the data compared with 50 non smokers (control group) of the same age, height, weight and BMI. (Table I)

The average age for both the study group & control group was 23.3 ± 7 years. The mean height for the study group was 174 ± 5.2 cm and for the control group 174 ± 5 cm. The mean weight for study and control group was 78 ± 12.2 kg and 79 ± 9.3 kg respectively. The BMI for smokers and non smokers were 25.5 ± 4.2 and 22.1 ± 3.2 respectively.

The changes in the lung function test parameters for forced expiratory lung volumes (FVC, FEV1, FEV1%, FEF25-75%, PEFR) using computer spirometer are discussed below. (Table:II)

For all the 100 subjects studied, the reference value (mean ±SD) for FVC, FEV1, FEV1%, FEF25-75%, PEFR adjusted to their age, height, weight & BMI were 5 ± 0.3 l, 4.2 ± 0.3 l, 82.4 ± 1 l, 4.9 ± 0.2 l/sec and 9.7 ± 0.4 l/sec respectively.

The mean ± SD for test value in non-smokers (control group) for lung function parameters were FVC = 4 ± 0.5 l, FEV1 = 3.9 ± 0.5 l, FEV1% =
98 ± 3.3, FEF 25-75% = 6.2 ± 1.1 l/sec and PEFR = 9.4 ± 1.4 l/sec. Whereas for smokers (study group) it was FVC = 3.5 ± 1.3 l, FEV1 = 3.3 ± 1.2 l, FEV1% = 94.2 ± 1.5, FEF 25-75% = 4.7 ± 1.7 l/sec and PEFR = 8.5 ± 3.3 l/sec. The ‘p’ value obtained from Wilcoxon signed rank test was statistically significant for FVC (0.005), FEV1 (< 0.001), FEF 25-75% (< 0.001) and PEFR (0.02).

When compared to non-smokers, all the expiratory lung parameters were decreased proving that smoking definitely deteriorates the lung function. According to ATS & ERS 2005 recommendation, based on FEV1 test value, the pulmonary function test results were analysed in smokers. (Table: III)

Out of the 50 asymptomatic smokers, 19 (38 %) subjects had normal lung function irrespective of their smoking habit. 13 (26%) smokers had mild decrease in their lung function. 5 (10%) of them had moderate decrease, 7 (14%) moderately severe decrease, 4 (8%) severe decrease and 2 (4%) had very severe decrease in lung function though they did not have any symptoms relating to respiratory illness.

DISCUSSION

Cigarette smoke causes an increase in the number of alveolar macrophages which release chemical substances that attract leukocytes to the lungs. The leukocytes in turn release proteases including elastase which attacks the elastic tissue in the lungs resulting in destruction of lung tissues impairing the lung function.

In the NHANES III survey, it was reported that COPD was found to be five times more common in smokers. In another study conducted by Lundback B et al, it was found out that 50% of smokers develop COPD and most of them are asymptomatic and undiagnosed until the disease get worst. In clinical practice we often find that some patients may even present with chronic hypercapnic respiratory failure who usually do not provide any clues of the history of chronic respiratory symptoms and had never been diagnosed as COPD, which confirms the existence of asymptomatic COPD patients.

Our present study was done to assess the effect of cigarette smoking on lung function parameters in asymptomatic smokers using computerized spirometer. We observed that all the forced expiratory lung volumes like FVC, FEV1, FEV1%, FEF25-75% and PEFR were reduced significantly in smokers when compared to non-smokers. FVC, FEV1 and FEV1% values are used to detect generalised airway obstruction and to differentiate obstructive and restrictive lung diseases. In our study, all the 3 above said parameters were reduced in smokers which indicate that there is a generalised airway obstruction which may be due to inflammation of the respiratory tract caused by the irritants in cigarette smoke leading to smooth muscle hypertrophy and bronchial hyper reactivity. Reduction in FVC, FEV1 & FEV1% indicates obstructive type of lung disease. Similar results were observed in the study conducted by Prieto F et al in 271 healthy smoking men and by Ming LU et al on a larger population in China. FEF25-75% is the average flow rate over the middle of vital capacity. This test indicates the patency of smaller airways less than 2 mm diameter. It was proved by Santos S et al that FEF 25-75% values are known to decrease in early COPD which was observed in our study too. A similar result was seen in the study conducted on smokers working in bus depot by Sreenivas B S et al in India. PEFR is largely the function of the calibre of larger airways. In our study, the PEFR test value was reduced in smoking group but it was not as much to the extent of FEF 25-75%. This proves that it is mostly the smaller airways than the larger airways which is affected due to smoking. In our study, the PFT results according to ATS and ERS 2005 recommendation based on FEV1
test value showed that, of the 50 smokers, 38% of them had normal lung function and the remaining 62% of smokers had mild to severe decrease in lung function though they were asymptomatic which means that they were completely free from cough, sputum production and dyspnoea.

Asymptomatic airway obstruction has raised the issue of non-perceiving variation in airway obstruction for many years. However, the mechanisms have not been clarified. The probable mechanisms for asymptomatic airway obstruction would be, subjective adaptation to slow increment in bronchoconstriction and blunted perception of symptoms due to habituation. Decreased cough reflex would be due to reduced afferent information, impaired perception of airway tone and brain centre defect caused due to the noxious constituents in cigarette smoke.

CONCLUSION
We conclude that though asymptomatic, most of the smokers will have deterioration in lung function which can be easily detected by using a spirometer. Screening a large population exposed to smoke will be useful in early diagnosis and treatment thereby improving their quality of life.

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REFERENCES


Table I: Anthropometric measurements for the study and control group

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>STUDY GROUP (n=50) (MEAN± SD)</th>
<th>CONTROL GROUP (n=50) (MEAN± SD)</th>
<th>WILCOXON SIGNED RANK TEST 'P' VALUE</th>
</tr>
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<tbody>
<tr>
<td>AGE (yrs)</td>
<td>23.3 ± 7</td>
<td>23.3 ± 7</td>
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</tr>
<tr>
<td>HEIGHT (cm)</td>
<td>174 ± 5.2</td>
<td>174 ± 5</td>
<td>0.921</td>
</tr>
<tr>
<td>WEIGHT (kg)</td>
<td>78 ± 12.2</td>
<td>79 ± 9.3</td>
<td>0.926</td>
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<tr>
<td>BMI</td>
<td>25.5 ± 4.2</td>
<td>22.1 ± 3.2</td>
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Table II: Forced Expiratory Lung Volumes in smokers and non smokers

<table>
<thead>
<tr>
<th>Lung function parameters</th>
<th>STUDY GROUP (n=50)</th>
<th>CONTROL GROUP (n=50)</th>
<th>WILCOXON SIGNED RANK TEST 'P' VALUE</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Ref.Value (MEAN ± SD)</td>
<td>Test.Value (MEAN ± SD)</td>
<td>% Ref. (MEAN ± SD)</td>
</tr>
<tr>
<td>FVC (litres)</td>
<td>5 ± 0.3</td>
<td>3.5 ± 1.3</td>
<td>70.8 ± 25</td>
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<tr>
<td>FEV1 (litres)</td>
<td>4.2 ± 0.3</td>
<td>3.3 ± 1.2</td>
<td>79.1 ± 29</td>
</tr>
<tr>
<td>FEV1%</td>
<td>82.4 ± 1</td>
<td>94.2 ± 1.5</td>
<td>115.8 ± 15.7</td>
</tr>
<tr>
<td>FEF 25-75% (litres /sec)</td>
<td>4.9 ± 0.2</td>
<td>4.7 ± 1.7</td>
<td>96 ± 34</td>
</tr>
<tr>
<td>PEFR (litres /sec)</td>
<td>9.7 ± 0.4</td>
<td>8.5 ± 3.3</td>
<td>88.9 ± 32.3</td>
</tr>
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</table>

Table III: Pulmonary function test results based on fev1 test value according to ATS & ERS recommendation 2005

<table>
<thead>
<tr>
<th>ASYMPOTOMATIC SMOKERS (N=50)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL (x &gt; -2 SD)</td>
<td>19 (38 %)</td>
</tr>
<tr>
<td>MILD DECREASE (70 ≤ x &lt; -2SD)</td>
<td>13 (26 %)</td>
</tr>
<tr>
<td>MODERATE DECREASE (60 ≤ x &lt; 70)</td>
<td>5 (10 %)</td>
</tr>
<tr>
<td>MODERATELY SEVERE DECREASE (50 ≤ x &lt; 60)</td>
<td>7 (14 %)</td>
</tr>
<tr>
<td>SEVERE DECREASE (35 ≤ x &lt; 50)</td>
<td>4 (8 %)</td>
</tr>
<tr>
<td>VERY SEVERE DECREASE (x &lt; 35)</td>
<td>2 (4 %)</td>
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