A COMPARATIVE STUDY OF PULMONARY FUNCTION TESTS AMONG SMOKERS AND NON-SMOKERS IN A RURAL AREA OF MADHUBANI, BIHAR, INDIA.

INTRODUCTION:
The World Health Organization (WHO) reported that tobacco smoking killed 100 million people worldwide in the 20th Century and warned that it could kill one billion people around the world in the 21st Century. By the early 2030, tobacco-related death would increase to about 10 million a year [2]. Tobacco has remained as one of the most important predisposing factors responsible for so many respiratory and cardiovascular diseases. Tobacco smoking is an intentionally invited health hazards. Smoking leads to rapid decline in pulmonary function test (PFTs) [3]. Chronic obstructive pulmonary disease (COPD) has been recognized as one of the most important causes of morbidity and mortality in chronic tobacco smokers worldwide [4]. Tobacco is the biggest external cause of non-communicable disease and is responsible for more deaths than adiposity, both in high income countries and globally [5, 6]. Tobacco smoking is an intentionally invited health hazards. The U.N Health agency reports that about 10 million a year. Tobacco smoking rates have decreased in industrialized countries since 1975, but there has been a corresponding 50% increase in smoking rates in low-income countries. The UN health agency reports that about 4.9 million people die each year across the globe due to cigarette smoking. AIMS AND OBJECTIVE: To study the differences in pulmonary function test values in smokers and non-smokers and their variation from other reported values for smokers by other studies. METHODS AND MATERIAL: - The study population comprised smoker group and non-smoker group and was carried out in the department of General Medicine at Madhubani Medical College, Madhubani, Bihar from September 2018 to August 2019 by using computerized spirometer in 100 male subjects comprising of 50 smokers and 50 non-smokers. RESULT: Almost all the pulmonary function parameters were significantly reduced in smokers and obstructive pulmonary impairment was commonest. The observed value of pulmonary functions in mean ± standard deviation, FVC was 2.98 ± 1.06 litres, FEV1 was 2.48 ± 0.02 litres, FEV1 % was 83.93±3.98, PEFR was 5.30±1.46 litres/minute and FEF25-75% was 2.99±0.02 litres. The observed value of pulmonary functions in rural non-smoker population in mean ± standard deviation, FVC was 3.13±0.98 litres, FEV1 was 2.81±0.86 litres, FEV1% was 89.49±10.54, PEFR was 6.80±3.44 litres/minute, and FEF25-75% was 3.59±1.74 litres. CONCLUSION: There was significant decrease in pulmonary function in the rural smoker population in comparison to the non-smoker population. KEYWORDS
Non-smoker, Smoker, Pulmonary Functions Test, Spirometry, Rural Area.

AIMS AND OBJECTIVE:
1. To study the influence of smoking on pulmonary functions.
2. To study the differences in pulmonary function test values in smokers and non-smokers and their variation from other reported values for smokers by other studies.
3. To study the type of ventilatory impairment caused by smoking viz. obstructive, restrictive or mixed type.
4. To establish normal standards in healthy non-smoker adults.
5. To use pulmonary functions test as a tool to identify the quantum of damage to the respiratory tree.

MATERIAL AND METHODS:
The study was carried out in the department of General Medicine at Madhubani Medical College, Madhubani, Bihar from September 2018 to August 2019 by using computerized RMS Med-Spirometer, weighing machine, measuring tape, blood pressure set and stethoscope in 100 male subjects comprising of 50 smokers and 50 non-smokers. The test was done between 10:00 a.m. to 05:00 p.m. to avoid diurnal variation. The subjects selected for present study were recruited from medical outpatient department at our institution. Prior consent was obtained from ethical committee. Informed consent was taken from the study participants before performing the pulmonary function tests. For this study computerized spirometer, RMS Helios 701 with a flow range of ±14 litres per second with overall accuracy of ± 1% using standard 3 litres calibration syringe was used.

Classification Criteria As Suggested By WHO (1998) [10]
- **Smoker**: Someone who, at the time of the study, smokes any tobacco product either daily or occasionally.
- **Non-smoker**: Someone who, at the time of the study, does not smoke at all.
- **Ex-smoker**: Someone who was formerly a daily or occasional smoker but currently does not smoke at all.
In this study a detailed record of smoking with reference to duration of smoking (in years) and number of cigarettes/bidis smoked per day was taken. None of individuals smoked tobacco in any form other than bidis or cigarettes. To evaluate dose and duration response relationship, quantification of tobacco smoking was performed by calculating smoking index for smokers.

**Smoking Index:**
The smoking index for an individual was equal to multiplication of the average number of cigarettes/bidis smoked per day and duration (in years) of tobacco smoking. Further, smokers were classified as per exposure level, on the basis of smoking index criteria [11,12].

**Habit**

**Smoking Index (Frequency x duration)**
- Non-smokers 0
- Light smokers 1-100
- Moderate smokers 101-200
- Heavy smokers more than 200

**Procedure Of Spirometry:**
The subject was asked to sit comfortably in a chair. The complete procedure was explained, all doubts if any are cleared. Subject was instructed to breathe in fully by deep inspiration with nostrils closed. Seal the lips around the sterile mouthpiece of spirometer and forcefully expire the air out, as fast and as far as possible. Best of three readings was recorded and interpreted.

**SELECTION CRITERIA:**
Selection criteria for non-smoker controls for the control group, 50 healthy non-smoker males belonging to almost same age and matching other characteristics with no history of smoking of any type. It was ensured that none of them had any significant present or past history of sickness particularly of the respiratory system.

1. **Non-Smokers:**
According to definition non-smoker is a Person who does not smoke tobacco (13). A passive smoker refers to exposure to tobacco consumption products from smoking of others (14).

2. **Cigarette Smokers:**
They are persons who are engaged in the inhalation and exhalation of fumes of burning tobacco in cigarettes. By definition cigarette smokers are the person who inhale, exhale and burn or carry any lightened cigarette. Every smoker must have been smoked at least five cigarette a day for a period of more than 10 years and subjects who did not smoke at all were included in non-smokers group.

**Exclusion Criteria:**
(1) Asthma and COPD Patients
(2) Chronic infections such as TB or other infections of lungs
(3) Recent MI less than one month old
(4) Subjects with respiratory symptoms such as cough
(5) Presence of an acute disease process that might interfere with test performance (e.g. Nausea, Vomiting etc.)
(6) Subject has not performed vigorous exercise within half an hour
(7) Subject has not smoked within an hour
(8) Subject has not consumed alcohol within four hours
(9) Females were not included in this study
(10) The person who worked in textile mills or other places where lungs are affected by dust or fumes
(11) The person who were morbid or full-fledged picture of cor-pulmonale on clinical examination.

A detailed history and general examination was done to rule out exclusion criteria before performing pulmonary function test. Each person was allowed to rest for about two minutes before the actual test. The details of the test were explained and demonstrated to each of them. All the measurements were recorded with the subject in standing position and wearing nose clips (15).

**STATISTICAL ANALYSIS:**
The data in expressed in mean ±S.D. Standard error of difference between two means z value and p value. Comparison between the two groups was done using the z test taking p value < 0.05 as significant. Results were analysed by statistical methods like percentages, chi square test and t-test of significance.

**RESULT:**

<table>
<thead>
<tr>
<th>Table 1: Physical Characteristics of Smokers and Non-Smokers.</th>
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<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>Age (Years)</td>
</tr>
<tr>
<td>Height (m)</td>
</tr>
<tr>
<td>Weight (Kg)</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
</tr>
<tr>
<td>Body surface area (m2)</td>
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</tbody>
</table>

Table-1 shows the present study of the age range of subjects was 30-60 years with mean age 48.26 years in smokers and 48.10 years in non-smokers. There was no significant difference in the means of other physical parameters like height, weight, body mass index and body surface area in smokers and non-smokers.

<table>
<thead>
<tr>
<th>Table 2: Type Of Tobacco Smoking In Smokers.</th>
</tr>
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<tbody>
<tr>
<td>Type of smoking</td>
</tr>
<tr>
<td>Only Bidi</td>
</tr>
<tr>
<td>Both Cigarette/ Bidi</td>
</tr>
<tr>
<td>Only Cigarette</td>
</tr>
<tr>
<td>TOTAL</td>
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</tbody>
</table>

Table-2, shows the present study, Bidi smoking was most common (62.0%), followed by both cigarette and Bidi smoking (24.0%) and only cigarette smoking (14.0%) in smokers.

<table>
<thead>
<tr>
<th>Table 3: Distribution Of Grade Of Smoking In Smokers.</th>
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<tbody>
<tr>
<td>Grade of smoker</td>
</tr>
<tr>
<td>Light smoker</td>
</tr>
<tr>
<td>Moderate smoker</td>
</tr>
<tr>
<td>Heavy smoker</td>
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<tr>
<td>Total</td>
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</tbody>
</table>

The distribution of grade of smoking is shown in Table 3. Light smokers were commonest (42.0%), followed by moderate (32.0%) and heavy smokers (26.0%).

<table>
<thead>
<tr>
<th>Table 4: Pulmonary Function Tests Among Smokers And Non-smokers.</th>
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</thead>
<tbody>
<tr>
<td>Pulmonary Function Tests (PFTs)</td>
</tr>
<tr>
<td>FVC</td>
</tr>
<tr>
<td>FEV</td>
</tr>
<tr>
<td>FEV, FVC</td>
</tr>
<tr>
<td>PEFR</td>
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<tr>
<td>FEF50-75%</td>
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<tr>
<td>MVV</td>
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</tbody>
</table>

Table-4 shows the mean values of all the pulmonary function tests are significantly reduced in smokers compared to non-smokers. The association of impaired PFTs in smokers was found to be statistically highly significant by applying unpaired t test of significance.

Cigarette smokers have higher prevalence of respiratory symptoms, pulmonary function abnormality and greater annual rate of decline in FEV and greater COPD mortality rate than non-smokers. The ratio of FEV to FVC is significantly reduced in smokers. Smoking leads to rapid decline in pulmonary function test specially those indicating diameters of airways such as forced expiratory flow in one second (FEV). Even in teenagers who have smoked only for few years, maximum expiratory flow volume curves demonstrate decrease in flow rate at small lung volumes yet another expression of airway obstruction.

Almost all the pulmonary function parameters were significantly reduced in smokers and obstructive pulmonary impairment was commonest. The observed value of pulmonary functions in mean± standard deviation, FVC was 2.98 ± 1.06 litres, FEV1 was 2.48 ± 1.02 litres, FEV1 % was 83.93±23.98, PEFR was 5.30±3.46 litres/minute and FEF50-75% was 2.99±2.02 litres. The observed value of pulmonary functions in rural non-smoker population in mean± standard deviation, FVC was 3.13±0.98 litres, FEV1 was 2.81±0.86 litres, FEV1% was 89.49±10.54, PEFR was 6.80±3.44 litres/minute, and FEF50-75% was 3.59±1.74 litres.
DISCUSSION:
There was no significant difference in the mean physical parameters like age, height, weight, body mass index and body surface area by calculating mean and standard deviation in smokers and non-smokers thereby showing proper matching of smokers and non-smokers (Table 1). Most of the smokers smoked only Bidi (62.0%) followed by both cigarette and Bidi mixed (24.0%) and only cigarettes (14.0%). None of individuals smoked tobacco in any form other than bidis or cigarettes. All Pulmonary function parameters like FVC, FEV1, FEV1 /FVC, PEFR, FEF25-75% and MVV showed statistically highly significant association between smokers and non-smokers by applying unpaired t-test of significance (p < 0.001). Similar, observations showing lung function impairment in smokers were reported by Burrows et al [16], Pandya et al [17], Dhand et al [18], Gosavi et al [19] and Gupta et al [20]. However, several researchers like Angelo [21], Malo [22] and Indian workers Gupta et al [23] and Mahajan et al [24] observed that there was no change in FVC in smokers and non-smokers.

CONCLUSION:
Pulmonary function test were markedly lower with increasing age in smokers compare to that in non-smokers. There is decline in all parameters of pulmonary function tests when there is an increase in number of cigarettes smoked per day as well as increase duration of smoking. This suggests that severity of COPD directly proportional to number of cigarettes smoked per day and duration of smoking. Finally it may be concluded that smoking causes definite pulmonary function impairments specially the obstructive type.

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17. Pandya KD, Duhdani AC, Chandwani S. Effect of physical trainings, age, sex, posture and smoking on peak flow rates; Indian. J. Physiol & Pharmacol 1984; 28: 3,38.