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Comparative Assessment of Lung Function using Peak Expiratory Flow Rate (PEFR) Between Tobacco Smoking and Non Smoking Students of the University of Jos

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Abstract
Tobacco smoking in the form of cigarette is a common habit prevalent among undergraduates in higher institutions. Chronic tobacco smoking remains the primary risk factor for chronic obstructive pulmonary disease (COPD). Pulmonary function test provide an objective quantifiable measure of lung function. This study was undertaken to assess lung function using PEFR among smokers and non smokers. In this study 100 male students within the age range of 18- 35 years were recruited, 50 were smokers forming the case group and 50 were non smokers forming the control group. The result showed no significant difference in mean physical parameters between smokers and non smokers. The smokers were mainly mild smokers. There was a significant decrease at $P< 0.05$ in PEFR of smokers when compared to non smokers. The actual value of PEFR decreased with increased quantity of smoking but this decrease was not statistically significant, indicating that airway obstruction may occur irrespective of the quantity or duration of cigarette smoking.
Keywords: PEFR, COPD, smokers, non smokers.

INTRODUCTION

Smoking is a known risk factor for cardiovascular disease, chronic obstructive pulmonary disease (COPD), cardiovascular disease and certain cancers, especially the lung cancer. The morbidity and mortality with tobacco use is entirely preventable.

Cigarette is produced from tobacco. Tobacco plant is believed to have originated in the western hemisphere. The plant is grown for its leaves which can be smoked, chewed or sniffed for a variety of effects. It is considered as an active substance especially because of its nicotine content.

It is interesting to note that though the prevalence of cigarette smoking in rural areas is lower than in urban areas, the number of cigarette smoker in rural areas is higher than in urban areas. A quarter of smokers develop chronic obstructive pulmonary diseases and is the fourth commonest cause of death worldwide. OPD is characterized by airflow limitation that is not fully reversible. Air flow limitation may be due to inflammation or due to increase in the thickness of the wall. PEFR is a useful parameter to monitor airway obstruction, assess its severity and variation and evaluate the effects of treatment. Earlier studies have reported that the PEFR is an effort dependent parameter emerging from large airways and it does not detect small airway obstruction. Several studies have reported that PEFR was significantly lower in smokers than in non-smokers.It is estimated that a third of world's population, aged 15 years and above are smokers (Corrao et al, 2000. In the twentieth century, the tobacco epidemic was estimated to have killed 100million people worldwide, but unless urgent action is taken, the number of deaths could increase to one billion in this century (2008).

In Nigeria, the prevalence of adults smoking in 2002 was 8.6% (Shatey et al).The primary objective of the present study was to measure and compare the peak expiratory flow rate (PEFR) among smokers and non-smokers in University of Jos, to study the role of possible associated factors and relation of quantity and duration of smoking on the peak expiratory flow rate in University of Jos students.

MATERIALS AND METHODS

The study was carried out in Jos, Plateau state, Nigeria, using students of the University of Jos. The study population included 100 male subjects. They were divided into two groups. The test group included 50 subjects who were smokers, and controls included 50 healthy non-smokers (in the age group of 18-35 years). Groups were matched for age, height, weightand chest circumference. Prior to any measurement, questionnaires eliciting information on age, medical history and smoking habit was administered to all the selected subjects.

Inclusion Criteria:

Individuals aged between 18-35 years with history of smoking cigarettes daily for atleast one year were considered as smokers (Gupta *et al*, 1995). All the subjects were registered male students of various Departments in University of Jos, Nigeria.

Exclusion Criteria:
Inability or unwillingness to take part in the study; history of major cardiopulmonary diseases like acute myocardial infarction, pulmonary tuberculosis e.t.c. Also ex-smokers or past smokers were excluded from the study.

The subjects were subjected to anthropometry at the point of entry using the standard procedures and instruments. Age was recorded from birthday by calendar to the nearest of year (<6 months and >6 months). Standing height was recorded without shoes and with light clothes on a wall mounted measuring tape to the nearest of centimeter (<5mm and >5mm). Weight was recorded without shoes and with light clothes in kilograms to the nearest 0.5kg using a potable bathroom weighing scale. (Hana B.R., 9012).

Chest circumference was recorded using a measuring tape to within 0.1cm.

A peak flow meter (Vitalograph,Ennis,Ireland) was used. Briefly, the mouth of this apparatus was constantly disinfected with methylated spirit before each use by the subject. The subjects took maximal inspiration and then give out a maximal expiration and the PEFR was read directly from the meter scale. A reset was made to return the pointer to zero and maneuver was repeated. The best of the three broadly reproducible attempts was taken as the PEFR.

The quantification of tobacco smoking was done by calculating the smoking index.
Smoking Index: It is equal to multiplication of the average number of cigarettes smoked per day and duration (in years) of tobacco smoking (Gupta *et al*, 1995; Sanjay *et al,* 2006).

Habit	**Smoking Index (Frequency X duration)**
Non-smokers	0
Light/mild smokers	1-100
Moderate smokers	101-200
Heavy Smokers	More than 200

Statistical Analysis
Graph pad prism version 5.02 was used to analyze data obtained and these were expressed as mean ± standard deviation.

The differences between means were compared using unpaired t-test. "P" Value <0.05 is taken as significant. Analysis was also done by one way ANOVA.

RESULTS

Physical Characteristics of Smokers and Non-Smokers

There was no significant difference in mean physical parameters like age, height, weight and chest circumference by calculating mean and standard deviation in smokers and non-smokers (Table 1).

Table 1: Physical Characteristics of Smokers and Non-smokers

Characteristics	**Smokers**	**Non-smokers**	**P-value**
Age (Years)	26.46±2.581	26.16±3.096	0.4946
Height (m)	1.669±0.0924	1.686±0.05866	0.2668
Weight (kg)	66.42±7.530	67.10±8.765	0.6782
Chest circumference (cm)	88.32±8.726	88.56±6.837	0.8786

Data presented as mean± SD

Peak Expiratory Flow Rate (PEFR) among smokers and non-smokers

Table 2, showed a statistically highly significant association in peak expiratory flow rate (PEFR) between smokers and non-smokers by applying unpaired t-test of significance (p<0.0001)

Table 2: Peak Expiratory Flow Rate (PEFR) among smokers and non-smokers

	Smokers	**Non-smokers**
PEFR (L/min)	430.0±67.10***	527.6±99.95

P<0.0001

Frequency and Percentage of subject According to Smoking Index

Most smokers were light or mild smokers (66%) followed by moderate (28%) and heavy smokers (6%) (Table 3)

Table 3: Frequency and Percentage of subject according to Smoking Index

Smoking Index	**Frequency**	**Percentage**
1 – 100	33	66%
101 – 200	14	28%
>200	3	6%
Total	50	100%

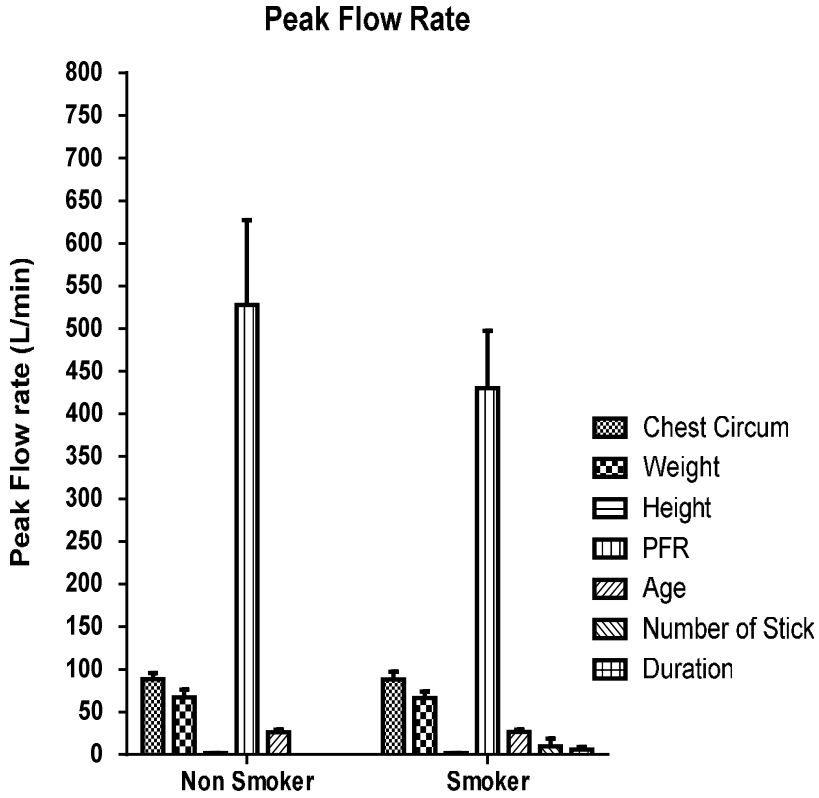
Association of Grade of Smoking with Peak expiratory Flow rate (PEFR).

Table 4 showed no statistical significant difference in peak expiratory flow rate among the different grade of smokers when compared with non-smokers

Table 4: Association of Grade of Smoking with PEFR

Grade of Smoking	PEFR Parameters
Mild	443.30± 69.76
Moderate	40.12± 12.00
Heavy	363.30± 51.32
Non smoker	430.0+67.10

Data presented as mean± SD. Analysis of data was done by one way ANOVA $p<0.05$



Discussion

Tobacco has remained as one of the most important predisposing factors responsible for so many respiratory and cardiovascular diseases. Chronic Obstructive Pulmonary Disease (COPD) has been recognized as one of the most important causes of morbidity and mortality in chronic tobacco smokers all over the World (Prasad *et al*, 2003).

Smoking is responsible for more than 90% of the chronic obstructive airway disease within one to two years of smoking regularly and many young smokers will develop inflammatory changes in their small airways. After twenty years path, physiological changes in lung develop and progress in proportion to intensity and duration of smoking (Madison *et al,* 1998).

During the last few decades, lung function tests evolved from tools for physiologic study of clinical investigations in assessing respiratory status. They also became a part of routine health examination in respiratory, occupational, sport medicine and in public health screening. Tests have been designed to indicate the extent of the narrowing of the airway.

Narrowing of the airways reduces the ability to move air in and out of the lungs. The narrower the tubes, the lower will be the PEFR (Diner *et al,* 2000).

In the present cross sectional comparative study, 100 subjects were randomly selected to study the effect of smoking habits on pulmonary function by using PEFR measurement. It was observed that there was no significant difference in the mean physical parameters like age, height, weight and chest circumference thereby showing proper matching of smokers and non-smokers (table 1). Most of the smokers were mild smokers (66%) (Table 3). This could be attributed to the fact that they study population were young adult and have been smoking cigarette for a short duration. Pulmonary function parameter (PEFR) showed no statistical significant association among the different grade of smokers when compared with Non smokers by one way ANOVA (Table 4). Also, the result showed that the peak expiratory flow rate was statistically highly significantly less ($p<0.0001$) in the cigarette smokers than in the non-smokers by applying unpaired t-test (table 2). This finding is

consistent with the report of (Tanko *et al,* 2012; Ebomoyi *et al,* 2005; Hussain*et al,* 2007 and Wafaa*et al,* 2010) who observed a reduced PEFR in smokers than non-smokers.

Cigarette smoke increase airway resistance and decrease PEFR several mechanisms. It can be attributed to rapidly responding receptors within the airway causing bronchoconstriction. A possible reason for the decrease in PEFR could be inflammation which is a common and constant pathological finding in cigarette smokers. There is usually increase in airflow limitation as a result of bronchial constriction used by mediators of inflammation. This inflammation either directly increases smooth muscle tone or indirectly cause airway fibrosis. All these processes cause wall thickness leading to airway narrowing and flow limitation.

The accumulated effect of tobacco smoke is an increased load on oxidants in the respiratory tract, both directly by inhalation of oxidants in the smoke and indirectly by activation of inflammatory cells (Kucoks*et al,* 1999). Smoking significantly increases progressive deterioration of the lung functions and is a risk factor in chronic obstructive pulmonary diseases. In which pulmonary mechanics deteriorates and causes loss of elastic recoil of the lungs and slowing forced expiration (Gold *et al.,* 1996). With nicotine, mucus producing cells grow in size and number, so that the amount of mucus secreted is more and also thicker (Gold *et al.,* 1996). Cigarette smoke slows the movement of cillia on the airway epithelium and also reduces their number, making mucocilliary clearance difficult and further clogging up the airway (West *et al,* 1995).

Furthermore, nicotine promotes tumor growth and angiogenesis in adults. It can induce angiogenesis by activating nicotinic acetylcholine receptors (nAchRs) on the surface endothelial cells which stimulates their proliferation and the subsequent formation of blood vessels (Zhu *et al.,* 2003). Cigarette smoke also increases levels of chemo attractant protein and vascular endothelial growth factor which also aid angiogenesis and tumor growth (Flintoft L., 2003). It is also known that cigarette smoke can induce remodeling in the trachea in the absence of inflammation (Andrew *et al,2008*).

Conclusion

It can be concluded that the smokers among the undergraduates of university of Jos are mostly mild smokers.Also the value of PEFR is lower in active tobacco smokers than non-tobacco smokers.The actual value of PEFR decreases as the number of tobacco smoking product increases and peak flow lower in moderate smokers than in mild smokers and lower in heavy smokers than in mild and moderate smokers.These differences in PEFR among the grade of smokers is not significant indicating that airways obstruction occurs irrespective of the duration of smoking.

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