

Effect of Cigarette Smoking on Peak Expiratory Flow Rate

Naznin R¹, Nessa A², Nazrina S³DOI: <https://doi.org/10.3329/jafmc.v15i2.50826>

Abstract

Introduction: Cigarette smoking is an intractable public health problem that carries a threat to the health of the entire population. Smoking is a known risk factor for chronic obstructive pulmonary diseases, cardiovascular diseases, certain cancers especially lung cancer.

Objectives: To assess the effect of cigarette smoking on peak expiratory flow rate (PEFR) among cigarette smokers and examine whether PEFR differs between cigarette smokers and non-smokers.

Materials and Methods: This is cross-sectional comparative study was done for one year from July 2014 to June 2015. A total of 150 subjects were recruited from the medicine and allied outpatient departments of Mymensingh Medical College Hospital and Mymensingh locality. They are divided into 50 non-smokers (Group I) and 100 smokers (group II) with a duration of smoking 5-10 years (group IIA) and more than 10 years (Group IIB). PEFR was recorded by using Wright's mini Peak flow meter. A questionnaire including demographic data was completed in all cases. The data were collected and analyzed using SPSS version 11.5.

Results: Mean PEFR among non-smokers was 449.20±6.83 L/min whereas among smokers of 5-10 years duration (Group IIA) and above 10 years duration (Group IIB), it was 301.20±2.17 L/min and 297.80±2.54 L/min respectively. Mean PEFR values were significantly lower in smokers than non-smokers of both groups.

Conclusion: Cigarette smoking has deleterious effects on lung function causing a significant reduction of PEFR in smokers compared to nonsmokers. Coordinated national strategies for tobacco prevention, cessation, and control are essential for the establishment of a smoke-free environment.

Key-words: Peak expiratory flow rate, Cigarette smoking, Wright's mini Peak flow meter

Introduction

Cigarette smoking is a widely recognized health hazard and a major cause of mortality. In the 20th century, 100 million death occurred due to tobacco and it is predicted to kill one billion people around the world in the 21st century¹. Bangladesh ranks among the top ten heaviest smoking countries in the world estimating 37.8 million (35.3%) adult tobacco users with a prevalence of 46.0 % among men². Current cigarette smoking is defined as person 18 years and older who reported having smoked 100 or more cigarettes during their lifetime and who currently smoke every day or some day³. Cigarettes contain up to 3000- 4000 chemicals including nicotine, carbon monoxide, arsenic, methane, butane, cadmium, formaldehyde, and hydrogen cyanide, which at an early age increases the risk of lung cancer. Smoking habit is a physical

addiction to nicotine which revealed its direct or indirect toxicity all over the body organ and comprising of different kind of diseases such as cancer, cardiovascular diseases, lung diseases like chronic obstructive pulmonary diseases (COPD) (emphysema and chronic bronchitis) and variety of other disorders⁴. Cigarette smoke is a recognized cause of airway changes, such as mucous hypersecretion, airway inflammation, and increase in airway wall thickness, and increased inflammatory cells, which can persist after smoking cessation. Approximately one-quarter of smokers can be affected by COPD which is the third commonest cause of death worldwide^{5, 6}. COPD is characterized by airflow limitation and inflammatory response by the lungs to inhaled substances such as cigarette smoking and air pollutants. Airflow limitation may be due to inflammation or due to an increase in the thickness of the wall⁷. Peak expiratory flow rate (PEFR) is a suitable parameter to monitor airway obstruction, assess its severity, and evaluate the effect of treatment⁸. The objectives of this study were to estimate the effect of cigarette smoking on PEFR and to investigate whether PEFR differs between cigarette smokers and non-smokers.

Materials and Methods

This cross-sectional comparative study was conducted in the Physiology Department of Mymensingh Medical College, Mymensingh for one year from July 2014 to June 2015 with due permission from the institutional ethical committee. Subjects were recruited from the medicine and allied outpatient departments of Mymensingh Medical College Hospital and Mymensingh locality. This entire study was conducted in healthy male smokers and non-smokers in the age group of 25-55 years willing to participate in the study. Female, persons with known hypertension, asthma, COPD, and disorders that affect airflow and unwilling to participate in the study were excluded from the study. Total one hundred and fifty voluntary subjects were selected conveniently based on history and clinical examination and categorized into two groups. Among them, 50 participants were taken as control (Group-I) who had no experience with cigarette smoking or other forms of tobacco consumption (Betel leaf with jarda, snuff tobacco). Group-II (study group) consisted of 100 cigarette smokers smoking ≥ 20 cigarettes per day for 5 years or more and free from other forms of tobacco use except cigarette smoking. They were again subdivided into 2 groups (group-IIA & group-IIB) according to the duration of smoking. Group IIA included 50 cigarette smokers smoking for 5- 10 years and Group-IIB comprised 50 participants who were smoking cigarettes for more than 10 years. After the entire procedures involved in the study were explained to the participants, written informed consent was obtained. A questionnaire was developed which included sociodemographic features and parameters i.e., height, weight, BMI, Respiratory rate, PEFR, systolic blood pressure & diastolic blood pressure in mm of Hg, etc. Measurements like PEFR, anthropometry, blood pressure were recorded in the morning hours

1. **Dr. Rubait Naznin**, MBBS, M Phil, Assistant Professor, Department of Physiology, Community Based Medical College, Mymensingh (Email: rubiataznin@gmail.com) 2. **Professor Akhtarun Nessa**, MBBS, MPhil, Head of the Department of Physiology, Mymensingh Medical College, Mymensingh 3. **Lt Col Sayeda Nazrina**, MBBS, M Phil, Associate Professor, Department of Pharmacology, AFMC, Dhaka.

between 8 am to 10 am. Subject's body weight was measured in kilogram and height in meter. PEFR was measured with the Wright's mini Peak Flow Meter⁹. Each participant made three efforts with a gap of 2 minutes between each effort and the mean value was calculated. It was taken as the data for the subject. Statistical analyses were done by using Statistical Package for the Social Sciences (SPSS) for windows version 11.5. Data were expressed as mean (\pm SE) and statistical difference among the group was calculated by unpaired "t" test. P-value < 0.05 was considered as significant.

Results

Table I shows the age distribution of the study subjects. Among non-smokers, Group-IIA and Group-IIB smokers, maximum study subjects were found in the age group of 35-45 years (44%, 50%, and 46 % respectively). Table II shows the physical parameters of the groups. There was no significant difference ($P>0.05$) regarding age and BMI. Mean (\pm SE) values of systolic and diastolic blood pressure were increased gradually with the duration of smoking in comparison with the control group but the result was within a physiological limit and statistically highly significant. ($P<0.0001$). Mean PEFR among non-smokers (Group-I) was 449.20 ± 6.83 L/min whereas among smokers of 5-10 years duration (Group IIA) and above 10 years duration (Group-IIB), it was 301.20 ± 2.17 L/min and 297.80 ± 2.54 respectively. The mean PEFR in smokers of both groups was significantly lower compared to non-smokers ($P<0.001$). Mean

Table-III: Comparison of mean value of PEFR among study Groups

	Group-I n=50 PEFR (L/min)	Group-IIA (n=50) PEFR (L/min)	Group-IIB (n=50) PEFR (L/min)	Mean Difference	T-Value	p-Value
PEFR(L/min)	449.20 ± 6.83	301.20 ± 2.17	-	-148.00	20.66**	.000
PEFR(L/min)	449.20 ± 6.83	-	297.80 ± 2.54	-151.40	20.78**	.000
PEFR(L/min)	-	301.20 ± 2.17	297.80 ± 2.54	-3.4000	1.017 ^{NS}	.312

All values expressed as mean (\pm SE), NS = Not Significant, $p<0.05$ = statistically significant.

** = Highly significant, T-Value = Test statistic value, P-Value = Level of significance

Discussion

The present work was carried out to study the effects of cigarette smoking on PEFR in male cigarette smokers. The study population was divided into a control group (Group I) and study group (Group II) depending on smoking habits that means non-smoker and the smoker respectively. Again smokers (Group II) were divided into 5-10 years smoking duration (Group IIA) and >10 years smoking duration (Group IIB). Many factors can affect the reading of PEFR. Among them, age, sex, and height are the main factors upon which PEFR depends¹⁰. In this study, two groups of subjects (smokers and non-smokers) were matched for age and BMI. However, mean (\pm SE) blood pressure (systolic and diastolic) in different study groups (cigarette smokers) were significantly increased in comparison to the control (non-smokers) (Table II). A similar study observed by Primates et al¹¹ also found increased blood pressure among cigarette smokers. Disturbance of blood flow occurred by smoking has an important role in the pathogenesis of the arterial disease. Cigarette smoking cause increases intraluminal pressure that changes the physical properties of the arterial wall may contribute to decrease arterial compliance and increase pulse wave velocity.

PEFR values decreased with increasing duration of smoking and the difference in PEFR values between group IIA and IIB were not statistically significant (Table-III& fig-1).

Table-I: Distribution of study subjects as per their age

Age (years)	Group-I (n=50)	Group-IIA (n=50)	Group-IIB (n=50)	TOTAL
25-35	13(26)	11(22)	12(24)	36(24)
35-45	22(44)	25(50)	23(46)	70(46.67)
45-55	15(30)	14(28)	15(30)	44(29.33)

*Figures in the parentheses indicate percentages

Table-II: Comparison of study groups regarding physical parameters (values are in mean \pm SD)

Characteristics	Group-I (n=50)	Group-IIA (n=50)	Group-IIB (n=50)
Age	45.14 ± 0.93	45.2 ± 0.90	45.8 ± 0.9
BMI	23.39 ± 0.44	23.47 ± 0.34	23 ± 0.38
Systolic BP	115.80 ± 0.97	127 ± 0.98	132 ± 1.18
Diastolic BP	75.40 ± 1.11	84.50 ± 0.94	89.20 ± 1.15

PEFR was measured with Wright's mini Peak Flow Meter which is an inexpensive, easily portable, and reproducible device. Measurements with this instrument match well with PEFR measurements from the larger Wright's peak flow meter (AirMed, Ltd., Harlow, England), with an observed correlation generally higher than 0.90¹². The present study reveals mean PEFR in the control group (Group I) and study groups (Group IIA and IIB) were 449.20 ± 6.83 , 301.20 ± 2.27 , and 297.80 ± 2.54 respectively. In the present study mean (\pm SE) PEFR was significantly lower in study groups in comparison to the control group. These findings are consistent with the findings of previous studies¹³⁻¹⁶.

The present study also revealed mean PEFR values decreased with increasing duration of smoking though the difference in PEFR values between group IIA and IIB were not statistically significant. Mistry et al declared in their study that PEFR was significantly reduced in smokers with increased duration of smoking¹⁷. This could be due to accumulated adverse effects of tobacco smoke on the respiratory tract over a while.

PEFR is a simple parameter for assessing lung functions¹⁸. It is a sensitive indicator to measure the strength of muscles of respiration

and an accurate index for airway obstruction¹⁹. The major clinical value of PEFr is to help to grade the degree of control in patients with asthma exacerbations and to rule out clinically important COPD in adult smokers²⁰. It has been recognized that exposure to cigarette smoke is associated with airway inflammation. The combination of the direct effect of cigarette smoke and indirect damage caused by the effect of the inflammatory cell leads to a series of epithelial changes including squamous metaplasia, hyperplasia of the mucous gland, changes in mucociliary clearance, and fibrotic changes²¹. All these changes promote thickness of bronchial wall leading to airway narrowing and restricted flow²².

Conclusion

According to this study, cigarette smoking has deleterious effects on lung function causing a significant reduction of PEFr in smokers compared to non-smokers. Cigarette smoking remains the leading cause of preventable death in the world. Use of any tobacco product must be discouraged. Coordinated national strategies for tobacco prevention, cessation, and control are essential for the establishment of a smoke-free environment. Awareness about the ill effect of smoking is urgent and essential for healthy people in Bangladesh.

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