

Influence of Cigarette Smoking on Forced Expiratory Volume in the First Second (FEV₁) among Male Smokers

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Abstract

Cigarette smoking is an intractable public health problem that carries threat to the health of entire population. Smoking is a known risk factor for chronic obstructive pulmonary disease, cardiovascular diseases and certain cancers specially lung cancer. This cross-sectional, comparative study was conducted in the outpatient department of Mymensingh Medical College Hospital, Bangladesh, from July 2014 to June 2015, to examine whether the forced expiratory volume in the first second (FEV₁) differs between cigarette smokers and non-smokers and also estimate the effect of duration of cigarette smoking on lung function. FEV₁ was recorded in total 150 subjects, in which non-smokers were 50 (as control, group I) and numbers of smokers were 100 with duration of smoking was 5-10 years (group IIA) and >10 years (group IIB). FEV₁ was measured by using Spiromaster PC-10 Spirometer. A questionnaire including participants' history and physical examination was completed. FEV₁ decreased gradually with the duration of smoking in both study groups i.e., group IIA (5-10 years duration of smoking) and group IIB (>10 years duration of smoking) as compared to the control group (non-smokers, group I) ($p < 0.001$). FEV₁ was also found lower in group IIB (>10 years duration of smoking) as compared to group IIA (5-10 years duration of smoking) ($p < 0.05$). Our study showed that cigarette smoking has a strong impact on airway obstruction that is reflected through a reduction in FEV₁.

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Introduction

Cigarette smoking is widely recognized health hazard and major cause of mortality.¹ In the 20th century 100 million death occurred due to tobacco and it is predicted to kill one billion people around the world in 21st century.² Bangladesh ranks among the top ten heaviest smoking countries in the world estimating 21.9 million adult tobacco smokers with smoking prevalence of 23% among adults.³ Current cigarette smoking is defined person 18 years and older who reported having smoked 100 or more cigarettes during their life time and who currently smoke every day or some day.⁴ 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.⁵ Lungs are directly affected by

cigarette smoking, various respiratory diseases, including lung cancer, chronic obstructive pulmonary diseases (COPD) and bronchial asthma, are caused and worsened by cigarette smoking.⁶ Smoking habit is a physical addiction to nicotine which revealed its direct or indirect

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toxicity in all over the body organ and comprising of different kind of diseases such as cancer, cardiovascular diseases, lung diseases and variety of other disorders.⁷ Cigarette smoke is a recognized cause of airway changes, such as mucous hyper secretion, airway inflammation, and increase in air way wall thickness and increase inflammatory cells, which can persist after smoking cessation.⁸ Approximately one quarter of smokers can be affected by COPD⁹, which is the fourth commonest cause of death worldwide.¹⁰ COPD is characterized by air flow limitation and inflammatory response by the lungs to inhalant substances such as cigarette smoking and air pollutants.^{11,12} Airflow limitation may be due to inflammation or due to increase in the thickness of the wall.^{13,14} Reduce forced expiratory volume in the first second (FEV₁) is more than a measure of air flow limitation, but a marker of premature death with broad utility in assessing baseline risk of chronic obstructive pulmonary disease, lung cancer, coronary artery disease and stroke, collectively accounting for 70%-80% of premature death in smokers.¹⁵ It is well known that continuing smokers have an average rate of decline in FEV₁, that is substantially greater than that of people who have never smoked.¹⁶ For the assessment of airflow obstruction, FEV₁ is the quite essential variable derived from spirometry. Hence, we proposed this study to investigate whether FEV₁ differs between cigarette smokers and non-smokers and also to estimate the intensity of cigarette smoking on FEV₁.

Methods

The present study was conducted in the outpatient department (OPD) of Mymensingh Medical College Hospital, Bangladesh, from July

2014 to June 2015. This entire study conducted in male subjects due to less availability of female smokers. A total 150 voluntary subjects were selected on the basis of history and clinical examination with an age-range of 20-55 years. Among them 50 participates were non-smokers who never smoked any type of tobacco before (group I as control). Intensity of cigarette smoking determined in 100 smokers – 50 were smokers for 5-10 years (group IIA), and the rest 50 were smoking for >10 years (group IIB). All the subjects were selected on the basis of history and clinical examination; after a written informed consent was obtained. Subjects body weight measure in kilogram and height in meter. FEV₁ was measured by using Spiromaster PC-10 Spirometer. Each participant made three efforts with a gap of 2 minutes between each effort and mean value was calculated. It was taken as the data for the subject. Statistical analysis was done by using Statistical Package of Social Sciences (SPSS) for windows version 11.5. Data were expressed as mean (\pm SE) and difference among the group was determined by unpaired Students-t test. A p-value <0.05 was considered as significant. This study was approved by the Ethical Review Committee of Mymensingh Medical College, Mymensingh, Bangladesh.

Results

Table-I shows the results of FEV₁ among the participants. FEV₁ decreased gradually with the duration of smoking in both study groups i.e., group IIA (5-10 years duration of smoking) and IIB (>10 years duration of smoking) as compared to the control group (group I). All the differences were statistically highly significant ($p < 0.001$). FEV₁ was found lower in group II B (>10 years duration of smoking) as compared to group IIA

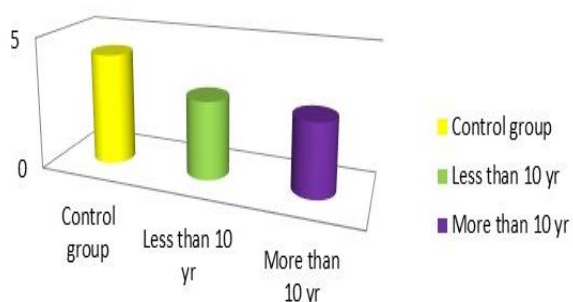
(5-10 years duration of smoking). This result was also statistically significant ($p < 0.05$) (see also Fig. 1).

Table-I: Mean values of forced expiratory volume in first second (FEV₁) for non-smokers and different group of smokers

Group I n=50	Group II n=100		Mean Difference	t-Value	p-value
	Group IIA n=50	Group IIB n=50			
4.23±0.06	2.94±10.07	-	-1.2932	13.97**	.000
4.23±0.06	-	2.74±0.06	-1.4954	16.87**	.000
-	2.94±10.07	2.74±0.06	-.2022	2.089*	.039

All values are the mean ± SE; P value reached from unpaired Students-t test; $p < 0.05$ = statistically significant; ** = Highly significantly different from control < 0.001 ; * = significantly different from control < 0.001 ; t-Value = Test statistic value; P-Value = Level of significance.

Fig.1: Bar diagram showing comparison of mean value of FEV1 between control and study groups (group I = control group; group IIA = study group, smoking duration 5-10 years; group IIB = study group, smoking duration >10 years)



Discussion

In the present study, in control group (group I) and in study group (group IIA and IIB), the mean values of FEV₁ were found 4.23±0.06, 2.94±10.07 and 2.74±0.06 respectively. The mean FEV₁ was significantly lower in two study groups in comparison to the control group. Statistical difference was also observed between two study groups. Similar results were observed by Dwarakanth *et al.*¹⁶ and Mistry *et al.*¹⁷ as they reported that FEV₁ got significantly reduced in smokers with increase duration of smoking and increase number of cigarette smoke per day. Similar observations were reported by Nawafleh *et al.*,¹⁸ Karia *et al.*,¹⁹ and Banu *et al.*²⁰. FEV₁ is an effective tool for assessing the lung functions.²¹ It is a sensitive indicator to measure the strength of muscles of respiration and an accurate index for airway obstruction.²² The major clinical value of PEF is to help to grade the degree of control in patients with asthma exacerbations and to rule out clinically important COPD in adult smokers.²³ Cigarette smoke and other noxious irritants incite a vigorous inflammatory reaction in the airways leading to the recruitment and activation of pro-inflammatory cells such as leucocytes which, in turn, propagate inflammatory cascade through the release of various cytokines and reactive oxidative species. Reactive oxidative species may also directly activate various oncogenes in the surrounding cells and tissues, which may further increase the risk of lung cancer.²⁴ It has been recognized that exposure to cigarette smoke is associate with air way inflammation. The combination of direct effect of cigarette smoke and indirect damage cause by effect of inflammatory cell leads to a series of epithelial changes including squamous metaplasia, hyperplasia of mucous gland,

changes in mucociliary clearance and fibrotic changes.²⁴ All these changes promote thickness of bronchial wall leading to airway narrowing and restricted flow,^{22,25} which is reflected in lung function tests, e.g., FEV₁.

Conclusion

Reduced FEV₁ value in smokers is an indicator of risk factor for the development of COPD, which can be prevented by early identification and proper counseling in asymptomatic smokers. According to our study, cigarette smoking has its deleterious effects on the lung function causing reduction in FEV₁ with duration and intensity of smoking habits. Tobacco use remains a very serious public health problem. Use of any tobacco product must be discouraged. Coordinated national strategies for tobacco prevention, cessation and control are essential for establishment of tobacco free environment.

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