

Comparative Study on Pulmonary Function Tests and Electrocardiographic Alterations in Smokers and Non-Smokers

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Abstract

Original Research Article

Background: Tobacco consumption is the most common cause of the preventable deaths globally. Tobacco is often consumed in the form of cigarettes. Deleterious effects of tobacco are seen in all body systems but most markedly on respiratory and cardiovascular systems. Smoking is responsible for 25% of all death in Bangladeshi men aged 25-69 years. Cardiovascular diseases are on the progressive rise in developing countries. **Objective:** To compare the variation in ECG waves and pulmonary function tests values in smokers and nonsmokers. **Method:** In this study, changes in ECG and pulmonary function tests were evaluated in apparently healthy adult male smokers and nonsmokers. This comparative cross sectional study was carried out in the department of Physiology, Rajshahi Medical College, Rajshahi from January 2018 to December 2018. **Result:** A total number of 184 healthy subject aged between 20 to 45 years were divided into two groups – Group A considered of 92 adult male nonsmokers and Group B considered of 92 apparently healthy adult male smokers. Group B are subdivided into light smokers (1-10 stick/day), moderate smokers (11-20 stick/day), and heavy smokers (>20 stick/day). Analysis of data was done with the help of computer by SPSS 12.0 programmer and significant tests were done by unpaired student's "t" test. PFT parameters FVC, FEV₁, PEFR, FEV₁ and FVC ratio were significantly reduced in smokers compared to nonsmokers (P< 0.001). The values of FVC, FEV₁, PEFR were significantly reduced with increase number of cigarette smoke per day (P < 0.001) while FEV₁/FVC ratio did not show much difference (P>0.05). **Conclusion:** This study showed that pulmonary function tests and ECG abnormalities indicate pulmonary and cardiovascular risk in term of COPD, Cardiac arrhythmia, pulmonary arterial hypertension, heart blocks in such subjects. This might be used by physicians as a tool for counseling the smokers to stop smoking as early as possible.

Keywords: Cigarette smoking, FVC, FEV₁, PEFR, FEV₁/FVC%, ECG, blood pressure, smokers and nonsmokers.

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INTRODUCTION

Cigarette smoking and its health consequences represents one of the most serious public health problems and represents an important health challenge worldwide (Centers for Disease Control and Prevention., 2014), it carries major health risks with the most cause specific mortalities being those of respiratory and cardiovascular diseases [1, 2].

Bangladesh is one of the top 10 countries that make up two-thirds of the world population of smokers [3]. It is estimated that around 13% of cardiovascular

disease death are due to tobacco smoking [4]. The prevalence rate of current smoking in our country is 25% on adult population. The prevalence of current smoking of manufactured cigarettes and bidis were reported as 14% and 11% respectively. Current cigarette smoking has been reported to be very high among males as compared to females [5]. The prevalence of cigarette smoking has peaked among high school students [6].

Smoking is the leading known risk factor for the development of chronic obstructive pulmonary

disease and 50% of smokers develop clinically significant airflow obstruction [7]. According to the Bangladesh NCD risk factor Survey 2010, the prevalence is 51.0% for any form of tobacco. 26.2% for smoking and 31.7% for smokeless tobacco (SLT) [8]. Current tobacco use is 43.3% in Bangladesh, exclusively smoking is 16.1%, exclusively using SLT 20.3% and dual use of smoking and SLT is 6.8% according to the Global Adult Tobacco Survey [9]. The prevalence of smoking among men in Bangladesh is higher than The World average of daily smoking among men (37% Vs 31.1%) [10].

Tobacco smoke contains more than 4000 chemicals and around 40 carcinogens [11]. These include nicotine, carbon monoxide (CO), oxidative gases, polycyclic aromatic hydrocarbons, carbonyls, butadiene, minerals, carbon disulphide and benzene.

Smoking ranks among the top causes of cardiovascular disease, Ischemic stroke, peripheral vascular disease and abdominal aortic aneurysm [12]. It is also associated with an increased risk of certain type of cancer and is a major cause of chronic obstructive pulmonary disease [13].

Smoking leads to rapid decline in pulmonary function tests specially those indicating diameter of the airways such as forced expiratory flow in first second (FEV₁) [14]. Various authors have used multiple regression analysis to explore the relationship between PEFr and age, height and weight [15].

Experimental studies have shown that prolong cigarette smoking impairs ciliary movements, inhibition of function of alveolar macrophages leads to hypertrophy and hyperplasia of mucus secreting glands. It is probable that smoke also inhibits antiproteases and causes polymorphonuclear leucocytes to release proteolytic enzymes activity [16].

It is well known that the acute effects of smoking produce an increase in systolic and diastolic blood pressure, tachycardia, cardiac output and vasoconstriction, increase in coronary artery occlusion and sometimes instantaneous MI [17].

In a community-based study showed, Smoking is the risk factor for the development of major abnormal Q/QS wave patterns, T wave abnormalities and development of ST segment depression [18].

Searching different articles, no recent study has yet been done in our country regarding the effect of smoking on pulmonary function tests or electrocardiographic changes. It is important to identify the effects of smoking on these parameters. So, the present study has been designed to determine the effect of smoking on pulmonary functions and Electrocardiographic changes.

OBJECTIVES

General objectives

To compare the variation in ECG waves and pulmonary function tests values in smokers and nonsmokers.

Specific objectives

1. To observe ECG wave forms in smokers and nonsmokers.
2. To measure lung function test (FEV₁, FVC, FEV₁/FVC ratio, PEFr) among smokers and nonsmokers.
3. To find out socio demographic characteristics of smokers and nonsmokers.

METHODOLOGY

Type of study: Cross sectional comparative study.

Place of study: Department of Physiology, Rajshahi Medical College.

Period of study: January 2018 to December 2018.

Study population: Healthy adult Smokers and non-smokers of 20-45 years in Rajshahi city.

Sampling technique: Purposive sampling technique will be applied to select each study subject.

Sample size: A total number of 184 male persons were selected for the study whose ages were between 20 - 45 years. Among them 92 persons were smokers & 92 persons were nonsmokers. BMI matching was considered among smokers & nonsmokers.

Statistical analysis: The significance of difference was calculated by unpaired t-test.

Criteria for Subject Selection

Inclusion Criteria

1. All individuals should be apparently healthy.
2. Age: 20 – 45 years who are living in Rajshahi city.
3. For cases minimum duration of smoking of 3 years.
4. Participants having no current or past history of smoking are not included.

Exclusion criteria

1. Females were not included in this study due to cultural reason.
2. Industrial workers.
3. Known case of tuberculosis, chronic obstructive pulmonary disease, asthma, any other cardiopulmonary diseases.
4. Patients with acute respiratory illness, severe systemic illness, chest trauma and dementia were excluded.

5. Known case of ischemic heart disease or other cardiac disease.

Data Collection

The healthy adults who fulfilled the inclusion criteria were enrolled in this study. After taking informed consent complete history taking and physical examination had been done and recorded in a preformed data sheet. Prior to pulmonary function testing, the required maneuver was demonstrated by the operator

and subjects were encouraged and supervised throughout the test performance. Pulmonary function testing was performed using the acceptability standards outlined by the American Thoracic Society (ATS) with subjects in a standing position and wearing nose clips in a spirometer.

RESULTS

Table-I: General characteristics of the respondents (n=184)

Variables	Smokers (N=92) (mean±SD)	Non-Smokers (N=92) (mean±SD)	P-value
Age (years)	33.60±5.88	33.18±6.09	0.641
Weight (kg)	63.90±5.07	66.61±4.47	0.001(s)
Height (mt)	1.64±0.04	1.65±0.04	0.037(s)
Body mass index (BMI)	23.67±1.36	24.36±1.19	0.001(s)
Body surface area (m ²)	2.70±0.15	2.73±0.15	0.100

Table I shows general characteristics of the respondents. Weight (mean) was more among non-

smokers (66.61kgs) compared to smokers (63.90 kgs) and this difference was statistically significant.

Table II: Comparison of forced vital capacity (FVC) among smokers and non-smokers (n=184)

Pulmonary function test (FVC)	Smokers (N=92) (Mean±SD)	Non-Smokers (N=92) (Mean±SD)	P-value
Forced vital capacity (FVC)	2.65±0.43	3.83±0.50	0.001(s)

s=significant

Table II shows comparison of forced vital capacity (FVC) among smokers and non-smokers. The mean FVC value of smokers was 2.65±0.43 and non-smokers was 3.83±0.50. The mean forced vital capacity

(FVC) level was lower in smokers compared tonon-smokers. This difference was statistically significant (P-value<0.001).

Table III: Comparison of FEV₁ and FVC ratio among smokers and non-smokers (n=184)

Pulmonary function test	Smokers (N=92) (Mean±SD)	Non-Smokers (N=92) (Mean±SD)	P-value
FEV ₁ and FVC ratio	78.36±2.02	81.03±1.64	0.001(s)

s=significant.

The test of significance was calculated using unpaired t-test.

Table III shows comparison of forced expiratory volume in 1st second and forced vital capacity ratio (FEV₁/FVC%) among smokers and non-smokers. The mean FEV₁/FVC% value of smokers was

78.36±2.02 and non-smokers was 81.03±1.64. The mean FEV₁/FVC% level was lower in smokers compared to non-smokers. This difference was statistically significant (P-value<0.001).

Table-IV: Comparison of variations in pulmonary function tests (PFTs) among smokers and non-smokers (n=184)

Pulmonary function tests	Smokers (n=92) (Mean±SD)	Non-Smokers (n=92) (Mean±SD)	P-value
Forced vital capacity (FVC)	2.65±0.43	3.83±0.50	0.001(s)
Forced expiratory volume in 1 st second (FEV ₁)	2.09±0.37	3.10±0.44	0.001(s)
Peak expiratory flow rate (PEFR)	407.17±63.01	567.71±48.69	0.001(s)
FEV ₁ and FVC ratio	78.36±2.02	81.03±1.64	0.001(s)

s=significant.

The test of significance was calculated using unpaired t-test.

Table IV shows the mean values of all the pulmonary function tests were significantly reduced in smokers compared to non-smokers.

Table-V: Comparison of pulmonary function tests (PETs) among smokers based on Grade of smoking

Parameters	light smoker N=52	Moderate smoker N=34	Heavy smoker N=6	P-value
FVC(L)	2.86±0.29	2.50±0.35	1.70±0.03	0.001(s)
FEV ₁ (L)	2.27±0.27	1.94±0.29	1.32±0.02	0.001(s)
PEFR (L/min)	439.67±48.06	402.00±56.02	286.66±15.05	0.001(s)
FEV ₁ /FVC (%)	78.77±2.37	77.77±1.41	78.05±0.22	0.074

s=significant.

The test of significance was calculated using unpaired t-test.

Table V shows the mean values of forced vital capacity (FVC), Forced expiratory volume in 1st second (FEV₁) and Peak expiratory flow rate (PEFR) were lower in heavy smokers compared to moderate and light smokers. These differences were significantly decrease among smokers based on grade of smoking.

DISCUSSION

In the present study, 92 smokers and 92 non smokers were studied for their pulmonary function tests and Electrocardiographic changes. Age, sex, BMI, these parameters were matched in smokers and nonsmokers.

It we have found that all the pulmonary function tests like forced vital capacity (FVC), forced expiratory volume in 1st second (FEV₁), peak expiratory flow rate (PEFR), FEV₁ and FVC ratio are significantly reduced in smokers compared to nonsmokers. The mean Forced vital capacity in smokers were lower when compared to nonsmokers, which was statistically significant (p<0.001).

In this study, mean (±SD) BMI was comparatively less among smokers (23.67±1.36) than non-smokers (24.36±1.19) and this difference was found statistically significant.

This observation was compatible with that of Abbas A H, (2018) and Shukla *et al.*, (2002) revealed that smokers have lower BMI than non-smokers [19]. In addition, the study showed significant difference between both groups regarding BMI. Smoking caused decrease in weight which most likely due to loss of appetite in smokers.

In this study, mean (±SD) forced vital capacity was lower in smokers (2.65±0.43) in comparison to nonsmokers (3.83±0.50) which was statistically significant.

This observation was compatible with that of Sivangailakshmi V and Rajkumar D, (2017) which revealed lower forced vital capacity in smokers (2.34±1.56) than nonsmokers (3.67±0.33) which was statistically significant [20].

In this study, mean (±SD) Forced expiratory volume in 1st second was lower in smokers (2.09±0.37) in comparison to nonsmokers (3.10±0.44) which was statistically significant.

Similar results were obtained from the study of Malathi R M *et al.*, (2017) where mean forced expiratory volume in 1st second in smokers (2.46) was significantly lower than nonsmokers (2.97) [20].

This result was consistent with the results of Patil S S *et al.*, (2018) and Shreen L A *et al.*, (2017), where forced expiratory volume in 1st second were found significantly lower in smokers as compared to nonsmokers²¹.

In this study Blood pressure and ECG changes are compared between smokers and nonsmokers and results are analyzed.

In this study, mean (±SD) Heart rate was higher in smokers (90.46±11.53) in comparison to nonsmokers (79.13±17.30) which was statistically significant (p<0.001). Sharma N K *et al.*, (2017) found smokers had (90.98±12.65) whereas nonsmokers (72.74±3.92) [22]. Karakaya O *et al.*, (2005) also found smokers had (72±8) in comparison to nonsmokers (67±7) and was statistically significant [23]. This result was consistent with the results of Singh K, (2014) and khoury Z *et al.*, (1996) [24].

The increase in heart rate could be due to stimulation of sympathetic ganglia and discharge of catecholamine's from adrenal medulla. Nicotine causes an increase in heart rate by stimulating release of endogenous adrenergic neurotransmitters. Within minutes of cigarette smoking, nicotine receptors in adrenal medulla are stimulated triggering the release of epinephrine and nor – epinephrine i.e.

CONCLUSION

The study observed that Pulmonary function test and electrocardiography are an effective and easy method for detection of pulmonary and cardiovascular diseases in risk group population like smokers and thus promotes smoking cessation efforts to reduce the

burden of non-communicable diseases in the community.

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