Original Article

Influence of smoking on lung functions in young adults

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Abstract

Objectives: To determine the effect of smoking on forced vital capacity, forced expiratory volume in 1 sec. and the ratio between the two.

Methods: The cross-sectional study was conducted in two Karachi-based medical colleges, Dow International Medical College and Bahria University Medical and Dental College between March 2010 and February 2011. The study comprised 244 male students (aged 19-25 years) who were selected by simple random sampling. A detailed questionnaire was got filled up by each participant to assess the smoking status and respiratory disease symptoms. Spirometry was performed by power lab spirometer according to the recommended guidelines of the American Thoracic Society and the European Respiratory Society by highly trained power lab instructor. Data was analysed using SPSS version 16. Means and standard deviations were worked out for continuous variables, while analyses of variance was done to see the difference among various categories.

Results: A statistically significant difference was found in the mean spirometric values of forced expiratory volume, forced expiratory capacity and their ratio between the smokers and the non-smokers. The first two factors were significantly lower among those who smoked > 10-20 cigarettes/day. But there was no statistically significant difference in the mean ratio of passive smokers and former smokers.

Conclusion: The deterioration of lung functions and habitual cough is directly related to the number of cigarettes smoked per day in young smokers.

Keywords: Smoking, Spirometry FEV1, FVC and FEV1/FVC ratio. (JPMA 62: 772; 2012)

Introduction

Smoking is widely prevalent among young adults of 20-30 years all over the world. In Pakistan, it is estimated that the prevalence of tobacco smoking is 36%-39%[1,2] in males and 9% in females. Among young adults, especially the university students in Pakistan, the prevalence of smoking is 15% with the majority being male smokers.[1]

Cigarettes contain up to 3000 to 4000 chemicals, including nicotine, arsenic, methane, butane, cadmium, carbon monoxide, formaldehyde and hydrogen cyanide.[3] With the highly addictive nature of nicotine in cigarettes, smoking cessation is extremely difficult. It is the major cause of decline in ventilatory functions and physical fitness in terms of both performance and endurance. Smokers complain of shortness of breath three times more than the non-smokers and it is one of the leading causes of co-morbidities due to inhalation of poisonous chemicals. Smoking at an early age increases the risk of lung cancer which continuously rises with the increase in the number of smokes/day.[4-6] Teenage smokers are two to four times more likely to develop coronary heart disease, stroke, and 10 times more likely to get chronic obstructive lung diseases. According to World Health Organisation (WHO), tobacco use is currently responsible for the death of one in ten adults worldwide.[4,7] Forced expiratory volume in 1 sec. (FEV1) and forced vital capacity (FVC) are measurements of air forced out of the lungs. These measurements are used to gauge the pulmonary function. Several studies have shown reduced spirometric parameters, FVC and FEV1, in young smokers.[5,8,9] FVC is the maximal volume of air exhaled with maximally forced effort from a maximal inspiration, i.e. vital capacity performed with a maximally forced expiratory effort, expressed in liters.[10] FEV1 is the maximal volume of air exhaled in the first second of a forced expiration from a position of full inspiration, expressed in liters.[10]

The aim of this study was to investigate the effects of smoking on FVC, FEV1 and the FEV1/FVC ratio.

Subjects and Methods

The cross-sectional study was conducted at the Karachi-based Dow International Medical College and the Bahria University Medical and Dental College from March 2010 to February 2011. Potential participants were chosen by simple random sampling based on their registration in medical colleges. A sample of 260 male students within the age group of 19-25 years was recruited from the college campus. The sample size was calculated by open epi sample size calculator with prevalence (p) of 38%,[1,2] confedence interval (C.I) 95%, and the error of margin (d)0.05. The participants were asked to fill a questionnaire which was designed to get information about their age, place of residence, age at which they began smoking etc. to assess the smoking status and respiratory symptoms like chronic cough, asthma, chronic obstructive lung diseases, mild respiratory symptoms according to the International Union Against Tuberculosis and the Lung Disease and the Global Initiative for Obstructive Lung Disease and other relevant benchmarks. Complete confidentiality was assured to all the participants. A detailed medical history, including past medical and surgical history, was taken and a thorough physical examination was done to rule out the presence of any other abnormality. Subjects with known history of acute or chronic respiratory infections, tuberculosis, asthma, neuromuscular disease, malignancy, cardiopulmonary disease, previous abdominal or chest surgery and subjects who were using bronchodilators and female students were excluded from the study. Out of 260, only 244 (93.3%) students were finally included in the study.

Smoking status was assessed using three questions: "Have you ever smoked a whole cigarette?" Have you smoked 100 or more cigarettes in your lifetime? "Did you smoke a whole cigarette in the last 30 days? (1 = Everyday, 2 = Almost every day, 3 = Someday, 4 = 1 or 2 days, 5 = I have never smoked)". Respondents were classified as never-smokers if they had never smoked a cigarette and/or if they had not smoked at least 100 cigarettes in their lifetime. The rest were defined as smokers. Passive smokers were defined as non-smokers who were regularly exposed to smoke over the preceding 12 months. Ex-smokers were defined as those who reported smoking more than 100 cigarettes during their lives but had quit smoking at least 1 month before the evaluation.[8,11] After taking their consent and explaining the procedure and purpose of the study, all the participants were measured for lung function FEV1, FVC and FEV1/FVC ratio with power lab spirometer.

Spirometry was performed by power lab spirometer (AD instruments) according to the guidelines recommended by the American Thoracic Society (ATS) and the European Respiratory Society (ERS). It was performed by highly-trained power lab instructor. For converting the voltage signal to L/s. system, the software requires calibration by using an approximate conversion factor, or injecting a known volume and integrating by 3-litre MLA5530 calibration syringe. Calibration done by using conversion factor (conversion is given approximately by 0 V = 0 L/s; 1 V = 40.1 L/s) .After volume correction and zeroing spirometry pod, the tests were performed with the subjects seated in upright position, and using a nose clip and breathing through a non-compressible mouthpiece to record normal tidal breathing for 1 to 2 minutes After the tidal breathing period and at the end of a normal tidal expiration, the volunteers were asked to inhale as deeply as possible

and then exhale as deeply as possible at least for 6 seconds, as 99% of the air bursts out forcefully in the first six seconds. A minimum of three acceptable manoeuvres were performed to minimise the errors.[10] Highest levels for FEV1and FVC were taken for data analysis.

Data was analyzed by using SPSS16. Data was expressed as mean and standard deviation for continuous variables or frequency (n) and percentage (%) for categorical variables. The analysis of variance (ANOVA) was applied to compare the means of different groups of the study. P value of <0.05 was considered statistically significant.

Result

The demographic characteristics of all subjects were noted (Table-1). The results showed a dose response relation between history of smoking and decline in FVC, FEV1 and the FEV1/FVC ratio. There were 157 (64.34%) current smokers, while the rest were non-smokers (n=67; 27.5%), passive smokers (n=10; 4%) or ex-smokers (n=10; 4%). Statistically strongly significant difference was found in the mean spirometric values of FEV1, FVC and FEV1/FVC of the subjects with different smoking history. The mean FEV1 values were the highest in non-smokers (3.18). However it was the lowest (2.38) among current young smokers with more than 20 cigarettes per day. Also, mean values of FVC were higher in the non-smokers, but was the lowest in current young smokers with >20 cigarettes per day. The same slope of decline was observed in FEV1/FVC ratio in the same group (Table-2).

Table-1: Demographic characteristics of population.

Variables	Mean ± SD
Mean Age (years)	20.24 ± 1.87
Mean Height (cm)	174.4 ± 64.2
Mean Weight (kg)	73.9 ± 1.069
Mean BMI (kg/m^2)	24.3 ± 3.5

BMI: Body Mass Index.

Table-2: Comparison of lung functions in smokers/non smokers.

Smoking Status	Cigarette Qty:	No (n)	%	FEV1 mean ± SD	FVC Mean ± SD	FEV1/FVC Ratio Mean ± SD
Non-Smokers	-	67	27.5	3.18 ± 0.67	3.64 ± 0.85	90.50 ± 7.17
Current Smokers	1-20 cigarette/day	108	43.7	2.38 ± 0.71	3.01 ± 0.88	81.06 ± 1.06
Current Smoker	>20 cigarette/day	49	19.8	1.83 ± 0.68	2.88 ± 0.91	66.39 ± 1.3
Passive Smokers	-	10	4.0	2.75 ± 0.28	3.21 ± 0.55	88.20 ± 4.85
Ex-Smokers	-	10	4.0	2.60 ± 0.47	3.31 ± 0.82	87.60 ± 1.03
P value				0.0005	0.0001	0.000

FEVI= Forced Expiratory Volume in 1 second. FVC= Forced Vital Capacity.

Discussions

Smoking is a community health problem which unfortunately has become part of our youth culture. The success of the Community Intervention Trial for Smoking Cessation (COMMIT) in changing smoking attitudes is to know the priority of smoking as a public health problem and to make efforts to limit and eradicate smoking, which is considered to be one of the foremost causes of avoidable death.[12] The goal can be achieved by comparing victimised individuals with the comparison group and educating them about the physiological disturbances occurred in them due to smoking. The study aimed to see the association of the lung functions in smokers and compared them with the non-smokers.

The lung age is the age of the average person who has an FEV1 equal to that individual. A typical middle-aged smoker has the lung age someone 10 years older than a non-smoker of the same age. A study[6] showed that 14% smokers quit smoking when the effects of smoking on lung function was explained compared to 6% who were explained by standard methods. The higher frequency of habitual cough in most of the young smokers was found to be directly related to the number of cigarettes smoked/ day. Studies have found that smoking especially current smoking, is associated with low Broncho alveolar Lavage (BAL) and pulmonary surfactant D (SP-D) which play important regulatory functions for innate immunity[13,14] and, hence, turn out to be a potent risk factor for habitual cough and chronic expectoration. The FEV1 in our study was not related to age, height and weight of the individuals. Other results of our study indicated association of smoking with deterioration of lung functions directly related to the number of cigarettes smoked/day. The results are supported by a cross-sectional survey among the 20 to 40 years old smokers which showed association of cigarette smoking with deterioration in FEV1/FVC ratio and the onset of respiratory complaints which was dosage dependent.[8]

Another study showed the significant difference in the mean spirometric values of FEV1/FVC of the smokers and the non-smokers of age 18-30 years.[15] Age group of our study is similar, but we did not measure for maximal oxygen consumption (VO2max; parameter of pulmonary functions) in smokers and non-smokers which is a limitation of our

study. There are other studies which can also demonstrate the direct associations of respiratory symptoms and decline in FEV1 and FEV1/FVC ratio.[15,16] Among the passive smokers, the decline in FEV1 and FEV1/FVC ratio as compared to the non-smokers was not significant. The strength of the study was its standardised protocol like the questionnaire and procedure to assess the association between the smoking habit and lung functions. As this was a cross-sectional study, we could not establish a casual association between smoking and the extent of decline in lung functions. Other limitation is that the spirometric measurements are not always valid because of difficulties in expiring fully in order to provide FVC.[8]

The study, however, proves the association of smoking with deterioration of lung functions and health compromise. It has been documented that cessation of smoking at any age can slow down the decline in lung functions and improves respiratory symptoms.[17,18] Early diagnosis of chronic obstructive pulmonary disease with communication of lung damage to patients could improve the execution of smoking cessation programmes and increase quit rates in individuals most vulnerable to lung damage.[6]

Conclusion

The study, like many others before it, proved beyond doubt that smoking deteriorates ventilatory functions in young adults.

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