Effects of Cigarette Smoking and Age on Pulmonary Function Tests in ≥ 40 Years Old Adults in Jordan

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Pulmonary function testing is a physiological test that measures the air volume that an individual inhales or exhales as a function of time. Smoking is greatly associated with reduction of pulmonary function. The aim of the present study was thus to estimate forced expiratory volume in first second (FEV1), forced vital capacity (FVC), and maximum voluntary ventilation (MVV) in adults aged e" 40 years with smoking history. Smoking is often related to obstructive disorders, as indicated by low FVC, FEV1, and MVV values. These pulmonary functions were analyzed based on several variables, such as number of cigarettes smoked per day, smoking duration and age. The study sample comprised of 100 healthy adult smokers. All participants were interviewed to obtain information related to their lifestyle and smoking habit. After analyzing the FVC, FEV1, and MVV results using SPSS software, we noted that their values were conversely related to participant age and smoking duration.

Keywords: Cigarette Smoking, Pulmonary Function, Adults, Jordan.

Cigarette smoking is an unhealthy habit that has spread all over the world as an epidemic. Tobacco use in the developing world has dramatically increased in the last decades, and is expected to result in 10 million deaths annually by 2030. Smoking causes a wide range of serious diseases, including chronic obstructive pulmonary disease, coronary artery disease, and many types of cancer[1].

Studies conducted in the Middle East indicate that at least 30"40% of Arab men are regular smokers. In Jordan, 30% of adult men (aged > 18) are smokers, compared with 26% noted for the USA. In addition, more than 50% of the Jordanian population is considered regular smokers and this habit has been cited as the chief cause of deaths in the country[2].

Findings yielded by many studies indicate that smoking has a direct and adverse effect on the respiratory system function by altering lung volume and respiratory muscle strength[3-5].

Moreover, many researchers have demonstrated a link between cigarette smoking and extensive exposure histories and other respiratory system conditions, such as lung cancer, COPD, and asthma[6].

Lungs are directly affected by cigarette smoking. Various respiratory diseases, including lung cancer, chronic obstructive pulmonary disease and bronchial asthma, are caused and worsened by cigarette smoking.

Pulmonary function test (PFT) is typically employed to measure the air volume during

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individual inhalation or exhalation process. In many studies, the peak forced expiratory volume in the first second (FEV1), forced vital capacity (FVC) and FEV1/FVC ratio are the main parameters measured[7].

The findings yielded by a study involving youth aged 15 to 18 years conducted in Thailand indicate that FVC values in nonsmokers were significantly greater than in smokers. Thus, the authors concluded that early exposure to cigarette smoke could lead to respiratory system problems in youth[8]. Moreover, authors of a study conducted in India reported that smokers had 17.3 times greater risk of having impaired pulmonary function as compared to nonsmokers. They also found much greater prevalence of obstructive pulmonary impairment among smokers[9]. This assertion is supported by the results obtained in a study conducted in Iran, where smoking was posited to lead to increased respiratory symptoms (cough, wheezing and tightness) and a reduction in the PFT value[10].

However, limited information about the relationship between respiratory symptoms, smoking duration and age presently exists[11].

Cigarette smoking is linked directly with a reduction in pulmonary function parameters. Although the effects take time to progress and become clinically apparent, an irreversible decrease in pulmonary function with cumulative cigarette smoking was noted in several studies[12].

In adolescent (boys and girls) smokers, decreased pulmonary function was measured by FEV1 and FEV. The authors noted that girls who smoked exhibited decreased lung capacity growth that normally occurs during adolescence, thus confirming that smoking reduced lung function in adolescents[13].

Aging plays an important role in decreasing PFT. Two hypotheses have been put forth in an attempt to explain the relationship between age and pulmonary cancer. For example, some authors argued that age alone does not modify biological susceptibility to cancer, but merely allows the exposure to accumulate with time. In addition, as an individual ages, genetic damage occurs and tumors start to manifest[14]. Others theorize that aging impairs immunity, reduces DNA (deoxyribonucleic acid) repair, and causes loss of cell regulation, which may amplify injury by carcinogens[15]. Understanding the relative effects of age and smoking duration is particularly important in an era when many cigarette smokers begin smoking in adolescence and continue through life.

The concept that age and smoking might accelerate the carcinogenic processes has potential implications for both cancer prevention and research emphasis. Thus, the aim of the present study was to elucidate the effect of smoking duration in adult smokers aged e” 40 years on lung function.

Aim

The objective of the present study was to determine the effects of smoking duration in adult smokers e” 40 years on lung function, as measured by forced vital capacity (FVC), forced expiratory volume in the first second (FEV1) and maximum voluntary ventilation (MVV) tests.

Methodology

Sample size and smoking behavior

The study sample comprised of 100 male adults aged 40"70 years old who had reported smoking for at least 15.

Inclusion criteria

For participation in this study, the following criteria had to be met:

1. Age ≥ 40 years
2. Smoking duration e”15 years
3. Cooperative

Measurements

Pulmonary function tests were carried out by using spirometer to determine FVC, FEV1 and MVV. Subjects had to remain in the straight sitting or standing position throughout the test, with a nose clip that was tightly attached to the nostrils allowing no air to escape during the test. A mouthpiece was placed at least two centimeters into the subject's mouth with lips closed around it.

FVC Maneuver: Each subject was asked to inhale completely and rapidly with a pause of < 1 s at total lung capacity (TLC), then exhale as quickly and completely as possible to blow all the air out. This allowed forced vital capacity (FVC) and forced expiratory volume in the 1st second (FEV1) values to be obtained and recorded by the apparatus.

MVV maneuver: Subjects were tested in the sitting position wearing a nose clip. Each participant was instructed to breathe as rapidly and deeply as possible for 12 seconds after obtaining at least three resting tidal breaths with airtight seal around the mouthpiece.

Statistical analyses

All measured values are reported as mean ± standard deviation. Statistical analyses were conducted using SPSS software version 16. Spearman rho correlation was conducted to assess the association between lung function parameters, duration of smoking and number of cigarettes smoked per day.

RESULTS

Table 1 shows the predicted values measured by spirometry that based on patient specific properties (like age, gender, ethnicity, weight and height) alongside those measured by lung function tests (M ± SD, based on the 100 subjects). The mean predicted FVC, FEV_1 and MVV values were 3.92 L ± 0.55, 3.70 L ± 0.65 and 147.80L ± 18.06, respectively. Their corresponding measured values were 2.72 L ± 0.87, 1.56 L ± 0.80 and 82.28 L ± 10.60. All mean predicted values of lung function tests (FVC, FEV_1 and MVV) were higher than the measured ones.

Table 2 shows that the study sample had the mean of age of 51.47 years ± 9.50, the mean smoking duration of 24.65 years ± 7.33, the mean number of cigarettes smoked per day of 20.81 ± 5.98,the mean of height 175.68cm ±0.67 and the mean of weight 80.69 kg ±1.48.

Table 3 provides the results of the Spearman's rho correlation analysis to determine the correlation between lung function parameters and the number of cigarettes smoked per day, duration of smoking and age. There was a significant correlation between smoking duration

Table 1. Mean + standard deviation (SD) of lung function tests involving 100 subjects

	Predicted FVC (L)	Predicted FEV_1 (L)	Predicted MVV (L)	Measured FVC (L)	Measured FEV_1 (L)	Measured MVV (L)
Mean	3.92	3.70	147.80	2.72	1.56	82.28
SD	0.55	0.65	18.06	0.87	0.80	10.60

Table 2. Mean + standard deviation (SD) of smoking duration, number of cigarettes smoked per day and anthropometric characteristics data of hundred subjects

	Age (yrs)	Duration of Smoking (yrs)	Number of Cigarette/day	Height (cm)	Weight (kg)
Mean	51.47	24.65	20.81	175.68	80.69
SD	9.50	7.33	5.98	0.67	1.48

Table 3. Spearman's rho correlations between lung function parameters and the number of cigarettes smoked, smoking duration and age

		FVC	FEV_1	MVV
Age	Rho	-0.279**	-0.288**	-0.276**
	P-value	0.005	0.004	0.006
Smoking Duration	Rho	-0.238*	-0.225*	-0.241*
	P-value	0.018	0.025	0.016
Number of Cigarettes Smoked per Day	Rho	0.068	-0.027	0.124
	P-value	0.501	0.790	0.223

Spearman's rho correlations**, Correlation is significant at the 0.01 level (2-tailed) and FVC values (rho = -0.238, p = 0.018), as well as FEV_1 (rho = -0.225, p = 0.025) and MVV (rho = -0.241, p = 0.016).

A significant correlation was also found between age and FVC values (rho = -0.279, p = 0.005), FEV_1 (rho = -0.288, p = 0.004) and MVV (rho = -0.276, p = 0.006). These results indicate that a decrease in lung function (FVC, FEV_1 and MVV values) is correlated conversely with smoking duration and participant age. On the other hand, non significant correlation was found between number of cigarettes smoked per day and FVC values (rho = 0.068, p = 0.501), FEV_1 (rho = -0.027, p = 0.790) and MVV (rho = 0.124, p = 0.223

DISCUSSION

In this study, the relationship between smoking duration, number of cigarettes smoked per day, age and pulmonary function parameters was evaluated.

Investigation of pulmonary function among adults with a history of smoking for at least 15 years showed that means of measured pulmonary function values were below the means of predicted spirometer values that based on patient specific properties (like age, gender, ethnicity, weight and height) . This finding may reflect obstruction of the airways and respiratory muscle weakness.

In addition, a significant correlation was found between duration of smoking, participant age and lung function parameters (FVC, FEV_1 and MVV values).These results indicate that a decrease in lung function parameters (FVC, FEV_1 and MVV values) is correlated conversely with smoking duration and participant age. On the other hand, non-significant correlation was found between number of cigarettes smoked per day and lung function parameters (FVC, FEV_1 and MVV values).

The above findings suggest that smoking duration and participant age could adversely affect lung capacity by reducing the volume associated with the FVC, FEV_1 and MVV test.

Aging with smoking history for at least 15 years could affect the respiratory muscles through the influence of free radicals with time on vascular system, leading to a reduction in respiratory muscle blood supply, which adversely impacts respiratory function. Thus, the reduction in FVC of smoker's e" 40 years old may be explained by the reduction in strength of the respiratory muscles since the FVC test relies on the strength of respiratory muscles[16].

The above phenomena could also explain the reduction in MVV and FEV1 e" 40 years old due to respiratory muscle reduction and smaller airways in smokers.

The above findings are consistent with those reported by other authors[17,18], thus confirming that smoking compromises lung function. It should be noted, however, that the average age recorded in our study was older compared to that in other studies and duration of cigarette smoking was greater too. Thus, the lower values of lung parameter function test recorded in our study compared to that in other studies may indicate a higher prevalence of COPD and other respiratory symptom in older persons with a history of longer smoking duration.

Indeed, the health benefits of smoking cessation with regard to the rate of decline in FVC, FEV_1 and MVV may appear to be most significant for smokers who quit before 40 years of age. Hence, our research findings may encourage earlier smoking cessation.

CONCLUSION

Investigation of pulmonary function in adults aged e"40 years with a history of e" 15 years of smoking showed that the pulmonary function values of smokers were decreased compared to the predicted values. In addition, a significant correlation was found between age as well as smoking duration and the decrease in FVC and FEV1 and MVV values. On the other hand, non-significant correlation was found between number of cigarettes smoked per day and lung function parameters (FVC, FEV_1 and MVV values). In conclusion, the concept that age and smoking might accelerate the decreasing of pulmonary function test has potential implications for both smoking cessation and research emphasis

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