ORIGINAL ARTICLE

Association of demographic variables and smoking habits with the severity of lung function in adult smokers

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Background: This study aims to evaluate the association between demographic and smoking variables with the severity of lung function loss (Stage I to IV) and spirometry data in smokers. **Materials and Methods:** Three hundred and fifty smoker men over the age of 20 who had visited in AL-Zahra hospital were involved. Spirometry tests were performed for measuring forced vital capacity (FVC), FEV1, and FEV1%FVC. COPD was categorized into four stages by the (Global Initiative for Chronic Obstructive Lung Disease) criteria of postbronchodilator FEV1/FVC <0.70. FEV1/FVC <70%, in combination with FEV1 ≥80% (Stage I), or 50%≤FEV1 <80% (Stage II), or 30%≤FEV1 <50% (Stage III), or FEV1 ≤30% (Stage IV). Independent *t*-test, Spearman correlation analysis was used for data analysis. To determine the predicting factors for pulmonary function multiple regressions analysis was performed. **Results:** 43 (19.5%) of men were defined as Chronic Obstructive Lung Disease (COPD) which 7% of them were Stage I, 23.3% were Stage II, 39.5% were III and 30.2% were stage IV. In 60 (27.1%) of men, the index of Fev1/FVC was <80%. The criteria of PRIS in 74 (33.5%) of the patients and BDR in 59 (26.7%) of participation was positive. There were significant differences in the mean of FEV1 with respect to history of lung disease in relatives ($P = 0.035$), lung disease hospitalization ($P < 0.001$) and previous diagnosis of asthma variables ($P < 0.001$). The mean of FVC was significantly different in patients categorized based on lung disease hospitalization ($P < 0.001$) and previous diagnosis of asthma ($P = 0.018$). Furthermore, there was a significant difference in the mean of FEV1/FVC for variables as follows: Time to start smoking after waking up ($P = 0.007$), lung disease hospitalization ($P < 0.001$) and previous diagnosis of asthma ($P < 0.001$). There was a significant association between stages of lung function loss and age of onset of smoking (β-0.355 $P = 0.019$) and pack per year (β = 0.354 $P = 0.02$). A linear regression model showed that lung disease hospitalization and age were the influential variables on FEV1 with (B = −21.79 confidence interval [CI]: −28.7, −14.87, $P < 0.001$and B = −0.418 CI: −0.63, −0.21, $P < 0.001$), respectively. The only significant influential variable on FVC was lung disease hospitalization (B = −15.89 CI: −21.49, −10.296, $P < 0.001$). Body mass index, lung disease hospitalization, time to start smoking after waking up in the morning and age had significant relationship on FEV1/FVC with (B = 0.71CI: 0.32, 1.11, $P < 0.001$, B = −14.29, CI: −19.61,-8.97, $P < 0.001$, B = 6.54, CI: 2.26, 10.82, $P = 0.003$ and B = −0.44, CI: −0.59, −0.28, $P < 0.001$), respectively. **Conclusion:** The age of onset of smoking and pack-year appears to be associated with the severity of COPD. Hospitalization history due to lung disease, age, the time between waking up in the morning and first cigarette use, BMI, lung disease history in relatives, previous diagnosis of asthma have a negative relationship with lung function.

Key words: Demography, respiratory function tests, smoking

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INTRODUCTION

The main reason for chronic obstructive pulmonary disease is smoking.[1,2] COPD is a chronic lung disease characterized by persistent airflow restriction. COPD is a progressive disease and is caused by a combination of small airway diseases and parenchymal damage, commonly called emphysema.[3] The prevalence of COPD worldwide is estimated at 210 million.[4]

COPD is a leading cause of morbidity and has even been estimated as the third leading cause of death in 2010.[5] Spirometry is the most common test of lung

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function in the diagnosis and monitoring of COPD.[6] According to the Global Initiative for Chronic Obstructive Pulmonary Disease, a postbronchodilator FEV_1/forced vital capacity (FVC) <0.70 confirms the presence of COPD and is an essential element in the diagnosis of COPD.[3] Postbronchodilator spirometry is not only required when detecting COPD; it is also an essential tool in assessing the severity of COPD because the classification of severity of airflow limitation in COPD is based on postbronchodilator FEV_1.[3] Previous studies showed that smoking reduces pulmonary function, including FVC, forced expiratory volume per second (FEV_1), and FEV_1/FVC.[7] The use of FEV1/FVC is a traditional amount of obstruction in airways to detect airways obstruction during spirometry testing.[8] Smoking burden is regularly measured in pack-years, a product of the average number of packs of cigarettes smoked a day and smoking length in years.[9] Walter *et al*. detailed that more seasoned smokers with histories of expansive numbers of pack-years had lower FVC levels than nonsmokers, whereas youthful adult smokers had FVC levels similar to or higher than age-equivalent nonsmokers.[10] A study of 100 male smokers, age ranging from 18 to 60 years appeared that those who smoked more than 10 pack-year are related with accelerated decrease in lung function.[11] Smoking duration and participant's age might unfavorably influence lung capacity by declining the FVC and FEV1 test. On the other hand, nonsignificant correlation was found between the number of cigarettes smoked per day and lung function parameters FVC and FEV_1.[12] In addition to smoking, history of respiratory diseases in the family, poor financial status, aging, body mass index (lower BMI), age, regular of hookah use, and history of seasonal allergies are other risk factors for COPD.[13,14]

Few studies also have reported the association between lung function loss and a range of smoking burdens consisting of demographic and nondemographic factors in smoking patients.[15,16]

In this cross-sectional study, we evaluated the association of demographic variables and smoking habits with the severity of lung function and spirometry data in adult smokers visiting the Al-Zahra Hospital of Isfahan University.

METHODS

Design and population

This cross-sectional study was performed in AL Zahra hospital, the main referral hospital of Isfahan University of Medical Sciences from November 2019 to April 2020. This study was approved in Isfahan University of medical sciences with ethics code IR.MUI.MED.REC.1398.710.

There were originally 350 men smokers over the age of 20 who had visited AL Zahra hospital, however, 129 participants were removed according to the exclusion criteria of this study. Therefore, 221 participants were involved in this study. Each participant signed a self-written consent to take part in the study. The exclusion criteria of the study were as followed: (a) presence of acute Respiratory Infection, (b) presence of lung disease counting lung cancer, interstitial lung disease, Tuberculosis, Neuromuscular Disorders, Pneumothorax, (c) unable to perform technically acceptable respiratory function tests.

All participants filled out a checklist requesting information on demographic data, smoking habits, and a history of diseases and respiratory symptoms. And then, they were tested for their lungs function. The demographic data included age, level of education (Illiterate, High school, Diploma, Associate Degree, Bachelor's, Master's degree), and BMI. The following variables of smoking habits were also recorded in the checklist including the age of the onset of smoking, duration of smoking (years), number of cigarette packs consumed daily, pack-year (was defined as the number of years of daily smoking multiplied by the number of cigarettes smoked daily divided by 20,[9] amount of time between getting up in the morning and the first cigarette. Other requesting information were questions with yes/no answers including the use of hookah, addiction, a history of chronic lung disease in first-degree relatives, seasonal allergies, previous lung disease hospitalizations, and previous diagnosis of asthma

Pulmonary function assessment

Spirometry was performed before and 15 min after 400 micrograms of salbutamol managed by a trained technician in accordance with the American Thoracic Society (ATS) and European Respiratory Society standards.[17] While the participants were sitting they were asked to make a forced exhalation followed by a forced inhalation. FVC, forced expiratory volume in1s (FEV1), and FEV1 percent in relation to the maximal FVC (FEV1%FVC) were registered. FVC was characterized as the biggest of either forced expiratory or forced inspiratory vital capacity from technically acceptable curves. The reported FEV1 is considered to be a good biological marker of the risk of obstructive pulmonary disease. If the Spirometric quality was not satisfactory, the maneuver would be repeated until the best quality was obtained. The highest value of FVC and the highest value of FEV1 were selected from the measurements for which the repeatability criteria were met. A pulmonologist reviewed the quality of all the tests. Bronchodilator responsiveness (BDR) was calculated change of >12% of the baseline forced expiratory volume in 1 s (FEV1) if this also exceeds 200 mL according to ATS guidelines.[18] COPD was defined by the Global Initiative for Global Initiative

for Chronic Obstructive Lung Disease (GOLD) criteria of postbronchodilator FEV1/FVC <0.70. FEV1/FVC <70%, in combination with FEV1 ≥80% (Stage I), or 50%≤FEV1 <80% (Stage II), or 30%≤FEV1 <50% (Stage III), or FEV1 ≤30% (Stage IV).[19] Participants with normal ratio but postbronchodilator FEV1 <80% predicted were categorized to have the GOLD unclassifiable disease or Preserved Ratio Impaired.[20] Postbronchodilator FEV1/FVC <80% were predicted to be considered unclassifiable airway obstruction.[21] For evaluation of bronchodilator response (BDR), we used ATS guidelines (post FEV1– preFEV1/preFEV1 × 100 more than 12%).

Statistical analysis

Data are presented as mean (standard deviation) or frequency (percent). For comparing the mean of pulmonary functions in categories of variables, independent *t*-test is used. Spearman correlation analysis was performed to get the association between the severity of long loss and study variables. Further analysis using multiple regressions was conducted to confirm the predictors of the pulmonary functions. The level of significance is taken as $P < 0.05$. Statistical analysis was conducted using the SPSS software version 16 (SPSS Inc., Chicago, Illinois, USA).

RESULTS

Two hundred and twenty-one men participated in the study. -Forty-three men (19.5%) had COPD so most of them were in stage III [Table 1]. In 27.1% of men, the index of FEV1/FVC was <80%. The criteria of PRIS in 74 (41.6%) were positive. BDR was positive in 59 (26.7%) of participation 53 (24.0) of participants were used short-acting beta-agonist inhalers, 16 (7.2) used long-acting muscarinic antagonist, 27 (12.2) used short-acting muscarinic antagonist, 2 (0.9) used inhaled corticosteroids and 16 (7.2) used long-acting beta-agonist and inhaled corticosteroids.

The mean of FEV1, FVC, and FEV1/FVC after use of bronchodilator with respect to different categorization is shown in Table 2. The mean of FEV1 for men without a history of lung disease in relatives ($P = 0.035$), without lung disease hospitalization ($P < 0.001$), without previous diagnosis of asthma ($P < 0.001$) was significantly more than others. Also the mean of FVC between categories of variables lung disease hospitalization ($P < 0.001$), without previous diagnosis of asthma ($P = 0.018$) was statistically different. Finally the mean of FEV1/FVC for men who started smoking after waking up in the morning after 30 min ($P = 0.007$), without lung disease hospitalization ($P < 0.001$), without previous diagnosis of asthma ($P < 0.001$), was more and according to independent *t*-test these differences were statistically significant.

Table 1: The information of studied patients

Variables	Categories	Count (%)/ mean±SD
Education	Illiterate	25 (11.3)
	High school	116 (52.5)
	Diploma	41 (18.6)
	Associate degree	10 (4.5)
	Bachelor	12 (5.4)
	MA	4 (1.8)
Time to start smoking after waking up in the morning (min)	Before 30	78 (35.3)
	After 30	143 (64.7)
Hookah	No	210 (95.0)
	Yes	10 (4.5)
History of lung disease in relatives	No	172 (78.3)
	Yes	47 (21.3)
Allergies	No	194 (87.8)
	Yes	26 (11.8)
Lung disease hospitalization	No	175 (79.2)
	Yes	46 (20.8)
Previous diagnosis of Asthma	No	162 (73.3)
	Yes	53 (26.7)
Opioid	No	130 (58.8)
	Yes	88 (39.8)
COPD*	No	176 (80.4)
	Yes	43 (19.5)
Severity (GOLD)	Mild	3 (7)
	Moderate	10 (23.3)
	Severe	17 (39.5)
	Very severe	13 (30.2)
FEV_1/FVC <0.8 (%)†	No	161 (72.9)
	Yes	60 (27.1)
PRIS (FEV_1 <0.8) (%)‡	No	104 (58.4)
	Yes	74 (41.6)
BDR	No	162 (73.3)
	Yes	59 (26.7)
Pre FEV_1 (%)§	-	70.55±24.41
Pre FVC (%)‖	-	76.98±19.90
Pre FEV_1/FVC (%)¶	-	88.73±17.77
Post FEV_1 (%)**	-	75.36±23.44
Post FVC (%)††	-	80.73±18.12
Post FEV_1/FVC (%)‡‡	-	91.23±18.76
Age (year)	-	54.75±13.44
BMI (kg/m^2)***	-	24.8±25.24
Age of onset of smoking (year)	-	20.97±7.06
Pack year	-	48.98±163.80

*Chronic obstructive lung disease, †FEV in 1s percent in relation to the maximal FVC, ‡Preserved ratio impaired spirometry, §Prebronchodilator FEV in1s, ‖Prebronchodilator FVC, ¶Prebronchodilator FEV in 1s percent in relation to the maximal FVC, **Postbronchodilator FEV in 1s, ††Postbronchodilator FVC, ‡‡Postbronchodilator FEV in 1s percent in relation to the maximal FVC. BMI: Body mass index, GOLD: Global Initiative for Chronic Obstructive Lung Disease, COPD: Chronic obstructive pulmonary disease, FEV_1: Forced expiratory volume$_1$, FVC: Forced vital capacity, BDR: Bronchodilator responsiveness, SD: Standard deviation

The relationship between stages of lung function loss and other variables in the study, is shown in Table 3. According this table there was a significant association between stages of lung function loss and age of onset of smoking ($\beta = -0.355$ $P = 0.019$) and pack per year ($\beta = 0.354$ $P = 0.02$). When the age of onset smoking decreases, the stages of lung function

Table 2: Comparison of the mean of spirometery data in patients with respect to different categories of variables

	Variables	*n*	Mean±SD	*P*
Post FEV_1 (%)**	Time to start smoking after waking up in the morning (min)			
	Before 30	77	70.7792±25.33233	0.41
	After 30	142	77.8521±22.05311	
Post FVC (%)††	Time to start smoking after waking up in the morning (min)			
	Before 30 min	77	77.7403±20.08233	0.71
	After 30 min	142	82.3662±16.82470	
Post FEV_1/FVC (%)‡‡	Time to start smoking after waking up in the morning (min)			
	Before 30	77	86.5974±18.81996	0.007
	After 30	142	93.7465±18.31034	
Post FEV_1 (%)**	Hookah			
	No	208	75.1875±23.23080	0.177
	Yes	10	85.3000±18.99737	
Post FVC (%)††	Hookah			
	No	208	80.6010±17.93599	0.184
	Yes	10	88.3000±15.91680	
Post FEV_1/FVC (%)‡‡	Hookah			
	No	208	91.2404±18.52091	0.399
	Yes	10	96.3000±17.48682	
Post FEV_1 (%)**	History of lung disease in relatives			
	No	171	77.3743±22.93316	0.035
	Yes	47	69.3830±22.92384	
Post FVC (%)††	History of lung disease in relatives			
	No	171	81.5614±17.13855	0.340
	Yes	47	78.7447±20.43597	
Post FEV_1/FVC (%)‡‡	History of lung disease in relatives			
	No	171	92.4327±18.44355	0.143
	Yes	47	87.9787±18.32258	
Post FEV_1 (%)**	Allergies			
	No	192	75.6615±23.10538	0.986
	Yes	26	75.5769±23.63755	
Post FVC (%)††	Allergies			
	No	192	80.6667±17.70389	0.520
	Yes	26	83.0769±19.43177	
Post FEV_1/FVC (%)‡‡	Allergies			
	No	192	91.7083±18.66930	0.609
	Yes	26	89.7308±17.13606	
Post FEV_1 (%)**	Lung disease hospitalization			
	No	174	80.3793±19.69756	0.000
	Yes	45	55.9778±26.72715	
Post FVC (%)††	Lung disease hospitalization			
	No	174	84.0057±15.37978	0.000
	Yes	45	68.1111±22.19666	
Post FEV_1/FVC (%)	Lung disease hospitalization			
	No	174	95.2069±16.58862	0.000
	Yes	45	75.8667±18.92761	
Post FEV_1 (%)**	Previous diagnosis of Asthma			
	No	162	79.2593±20.96449	0.000
	Yes	57	64.2982±26.60690	
Post FVC (%)††	Previous diagnosis of Asthma			
	No	162	82.8210±15.51233	0.018
	Yes	57	74.8246±23.22031	
Post FEV_1/FVC (%)‡‡	Previous diagnosis of Asthma			
	No	162	94.8889±16.94786	0.000
	Yes	57	80.8421±19.90135	

Contd...

Table 2: Contd...

	Variables	*n*	Mean±SD	*P*
Post FEV_1 (%)**	Opioid			
	No	130	77.9385±22.76191	0.092
	Yes	87	72.5402±23.50102	
Post FVC (%)††	Opioid			
	No	130	82.4769±17.76732	0.154
	Yes	87	78.9425±17.98407	
Post FEV_1/FVC (%)‡‡	Opioid			
	No	130	92.1615±18.45329	0.518
	Yes	87	90.4943±18.82717	

**Postbronchodilator FEV in 1s, ††Postbronchodilator FVC, ‡‡Postbronchodilator FEV in 1s percent in relation to the maximal FVC. FEV_1: Forced expiratory volume$_1$, FVC: Forced vital capacity

Table 3: Correlation between stages of chronic obstructive lung disease and studied variables

	Stage I	Stage II	Stage III	Stage IV	Correlation coefficient	*P*
Education						
Illiterate	1 (2.4)	3 (7.1)	3 (7.1)	3 (7.1)	−0.002	0.992
High school	1 (2.4)	6 (14.3)	5 (11.9)	8 (19)		
Diploma	1 (2.4)	1 (2.4)	7 (16.7)	1 (2.4)		
Associate degree	0	0	1 (2.4)	0		
Bachelor	0	0	1 (2.4)	0		
Time to start smoking after waking up in the morning (min)						
Before 30	1 (2.3)	3 (7)	9 (20.9)	7 (16.3)	1.87	0.316
After 30	2 (4.7)	7 (16.3)	8 (18.6)	6 (14)		
Hookah						
No	3 (7.1)	10 (23.8)	16 (38.1)	12 (28.6)	0.017	1.00
Yes	0	0	1 (2.4)	0		
History of lung disease in relatives						
No	3 (7.1)	5 (11.9)	15 (35.7)	7 (16.7)	0.067	0.752
Yes	0	5 (11.9)	2 (4.8)	5 (11.9)		
Allergies						
No	3 (7.1)	10 (23.8)	16 (38.1)	10 (23.8)	0.236	0.194
Yes	0	0	1 (2.4)	2 (7.1)		
Lung disease hospitalization						
No	2 (4.7)	4 (9.3)	11 (25.6)	4 (9.3)	0.131	0.411
Yes	1 (2.3)	6 (14)	6 (14)	9 (20.9)		
Previous diagnosis of asthma						
No	0	5 (11.6)	12 (279)	4 (9.3)	−0.024	1.000
Yes	3 (7)	5 (11.6)	5 (11.6)	9 (20.9)		
Opioid						
No	3 (7.1)	5 (11.9)	9 (21.4)	8 (19)	0.034	0.865
Yes	0	5 (11.9)	8 (19)	4 (9.5)		
Age (years)	58 (1.73)	65 (11.79)	68.82 (9.87)	59.69 (5.105)	−0.104	0.506
BMI (kg/m^2)	24.12 (5.19)	20.96 (4.32)	21.97 (5.38)	23.12 (5.79)	0.042	0.805
Age of onset of smoking (year)	18 (2)	23.30 (6.41)	23.12 (8.06)	16.54 (6.01)	−0.355	0.019
Pack - year	35 (7)	41.05 (26.28)	42.48 (18.96)	65.19 (33.64)	0.354	0.02

BMI: Body mass index

loss increases. Also when the pack per year increases the stages of lung function loss increase.

We used linear regression model for evaluating the effect of study variables on FEV1, FVC, and FEV1/FVC. FEV1, FVC, and FEV1/FVC were dependent variables. At first, we entered all variables in each model. Then, we used Hosmer *et al*. (2013) method to the selection of significant variables. The information of the final three models are in Table 4. In first model, lung disease hospitalization and age were the influential variables on fev1 with (B = −21.79 CI: −28.7, −14.87 $P < 0.001$ and B = −0.418 CI: −0.63, −0.21 $P < 0.001$), respectively. With regards to B coefficients when age increases the FEV1 decreases and there was an inverse relationship between the lung disease hospitalization and FEV1.

Table 4: linear regression models for determining factors predicted the forced expiratory volume$_1$, forced vital capacity, and Forced expiratory volume$_1$/forced vital capacity

Dependent variable	Independent variables	*B*	SD	β	*P*	95% CI for B		R^2
						Lower bound	Upper bound	
FEV_1 (%)**	Constant	102.607	5.856		0.000	91.064	114.149	0.233
	Hospitalization history	−21.786	3.509	−0.377	0.000	−28.703	−14.868	
	Age	−0.418	0.106	−0.240	0.000	−0.626	−0.210	
FVC (%)††	Constant	84.006	1.288		0.000	81.468	86.544	0.126
	Hospitalization history	−15.895	2.841	−0.355	0.000	−21.493	−10.296	
FEV_1/FVC (%)‡‡	Constant	96.523	7.160		0.000	82.404	110.642	0.345
	BMI	0.715	0.201	0.205	0.000	0.319	1.112	
	Hospitalization history	−14.288	2.699	−0.309	0.000	−19.610	−8.967	
	Time to start smoking after waking up in the morning	6.539	2.171	0.172	0.003	2.259	10.820	
	Age	−0.437	0.079	−0.324	0.000	−0.593	−0.280	

**Postbronchodilator FEV in 1s, ††Postbronchodilator FVC, ‡‡Postbronchodilator FEV in 1s percent in relation to the maximal FVC. FEV_1: Forced expiratory volume$_1$, FVC: Forced vital capacity, BMI: Body mass index, CI: Confidence interval

The only significant influential variable on FVC were lung disease hospitalization and there was an inverse relationship between this variable and FVC (B = −15.89 CI: −21.49, −10.296 $P < 0.001$).

In model 3, BMI, lung disease hospitalization, Time to start smoking after waking up in the morning and Age had a significant relationship on FEV1/FVC. B coefficients for BMI, hospitalization history, and time to start smoking after waking up in the morning age was (B = 0.71 CI: 0.32, 1.11, $P < 0.001$, B = −14.29, CI: −19.61, −8.97, $P < 0.001$, B = 6.54, CI: 2.26, 10.82 $P = 0.003$, and B = −0.44, CI: −0.59, −0.28 $P < 0.001$) respectively. When BMI increase and age decreases and the mean of FEV1/FVC increases. Furthermore, there were a negative association between FEV1/FVC and lung disease hospitalization.

Entered variables

Education, time to start smoking after waking up in the morning, Hookah, History of lung disease in relatives, Allergies, lung disease hospitalization, Asthma, Saba: Short-acting beta-agonist, Lama: Long-acting muscarinic antagonist, Sama: Short-acting muscarinic antagonist, Icslaba: Inhaled corticosteroids and long-acting beta-agonist, Ics inhaled corticosteroids, Addiction, Age, BMI, Age of onset of smoking, Pack year

DISCUSSION

In this cross-sectional study of a population of male adult smokers, we found that age of onset of smoking and pack-year was closely associated with the severity of lung function loss The present study demonstrates that the mean of onset of smoking was 16.54 (6.01) in Stage IV, 23.12 (8.06) in Stage III, 23.30 (6.41) in Stage II, and 18[2] in Stage I of COPD smokers. This means that the age of onset of smoking is connected to poorer pulmonary function. Furthermore, the smokers on Stage IV of COPD had the mean pack-years of 65.19 (33.64), Stage III with the mean of 42.48 (18.96), Stage II with the mean of 41.05 (26.28), and Stage I with the mean of 35.[7] It was found that more smoking measured as pack-year was associated with poorer pulmonary function. The impact of cigarette smoking on lung function is dose dependent, so it is expected that the sooner smoking begins the worse the lung function becomes. A finding that seems to be of secondary importance is that people who started smoking earlier are more likely to continue smoking and are heavier smokers.[22] Kurmi *et al*. examined the relationship between smoking and airway obstruction in men and women found that airway obstruction was strongly associated with smoking and the onset of smoking at an early age. In both sexes, the OR was more extreme in those who started to smoke at a younger age ($P < 0.0001$ in men and 0.0063 in women).[23] A previous study by Ballah, *et al*. that compared the lung function between smokers and nonsmokers indicated that there is a statistical relationship between pack-year of smoking and FEV1 levels. They also found out that the onset of smoking at a younger age is associated with a lower value of FEV1.[24] A study was also conducted involving 10,187 participants that showed a significant correlation between airflow obstruction (FEV1/FVC) and pack-year (regression coefficient β = −0.023 ± SE0.003; $P = 0.003$).

The present study demonstrates that The mean of FEV1, FVC andFEV1/FVC for smokers without previous diagnosis of asthma and without any history of pulmonary disease hospitalization was significantly higher compared to smokers with these variables according to independent *t*-test. Accordingly, the linear regression model to evaluate the effect of study variables on FEV1, FVC, and FEV1/FVC showed that the history of hospitalization for pulmonary diseases in the present study is inversely related to FEV1, FVC, and FEV1/FVC. Hunter, *et al*. examined the risk factors for subsequent admission to COPD and found that prior admission to COPD or respiratory

disease was a risk factor that agrees with the present study.[25] Prognosis in patients with COPD indicated that Increasing age, low BMI, decreased FEV1, and prior respiratory or cardiovascular admission hospitalization were predictors of poor outcome.[26] Polese *et al*. Evaluated the lung function, and pulmonary diffusion for carbon monoxide (DLCO) in patients between 15 and 30 days after discharge admission for severe COVID-19 showed a restrictive pattern with a reduction in FVC in 54% of individuals.[27]

Lange, *et al*. compared lung function in people with asthma and people without asthma who identify themselves as asthmatics, there were substantially greater declines in FEV1 levels over time than those who did not. Subjects with asthma and smokers had a more noteworthy decrease in FEV1 than those without asthma and nonsmokers, respectively.[28] In the current study, the average fev1 level for smokers without a history of lung disease in relatives was significantly higher than smokers with a history of lung disease in relatives. In addition, the mean of FEV1/FVC for smokers who started smoking within 30 min after waking up was significantly higher in comparison with those who started smoking at least 30 min after waking up. Accordingly, linear regression model demonstrated started smoking ≤ 30 min after waking more decreased FEV1/FVC. A recent study indicated that compared to current smokers with a late start of smoking cigarettes, those who smoked their first cigarette at an early age had a higher risk of chronic obstructive pulmonary disease.[29] According to the linear regression model, age was inversely related to FEV1 and FVC as well as BMI as directly related to FEV1/FVC. Rewashed, Rawashdeh *et al*. calculated the connection between the smoking duration, the number of cigarettes smoked per day, age, and pulmonary function parameters that suggested smoking duration and participant age could reduce the volume associated with the FVC, FEV1.[12] An increase in FEV1/FVC among participants with a high BMI in our study may be due to elasticity loss because of gaining weight has a greater effect on FVC than FEV1.[30] Our results are in contrast to a study that showed that FEV1/FVC was lower in the obese group than in the other groups.[31]

CONCLUSION

In a population of male adult smokers, age of onset of smoking and pack-year appears to have a strong relationship with the stages of lung function loss. History of pulmonary disease hospitalization, age, amount of time between getting up in the morning and the first cigarette, BMI, history of lung disease in relatives, previous diagnosis of asthma have a negative impact on lung function.

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Conflicts of interest

There are no conflicts of interest.

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