Original Article

Comparison of Forced Expiratory Volume in Six Seconds and FEV1/FEV6 ratio among Smokers and Non Smokers

Aneel Aslam, Abdul Waheed

ABSTRACT

Objective: To evaluate and compare force expiratory volume in six seconds (FEV6) and FEV1/FEV6 among the smokers and nonsmokers

Methodology: This cross sectional study of 200 subjects with age 18-25 years was carried out at Karachi Institute of Medical Sciences (KIMS),KHI from September to December 2020. Prior the study ethical approval was taken. Male smokers and nonsmokers were included in the study. Male subjects with pulmonary diseases, cardiovascular diseases and any other skeletal deformities affecting respiration and females were excluded from the study. Height, weight and BMI were calculated. FEV6 was recorded by a calibrated digital spirometer following the protocol with three readings and highest reading was taken for analysis

Results: This study was composed of 200 male participants. Of the total study population 83 (41%) were smokers and 117(59%) were non -smokers. Mean age of the study participants was 21.89 ± 4.8years Smokers have lower FEV6 and FEV1/FEV6 values as compared to nonsmokers. Significant difference was observed in mean FEV6 of smokers and nonsmokers(p- value =0.002). Mean FEV1/FEV6 was also significantly different among smokers and nonsmokers (p- value = 0.000*)

Conclusion: FEV6 and FEV1/FEV6 values were lower in smokers as compared to nonsmokers reflecting decline in lung function.

KEYWORDS: Force Expiratory volume in Six seconds, FEV1/FEV6, Smokers, Non-Smokers

INTRODUCTION

Cigarette smoking is believed as one of the leading health concerns and major cause of avoidable deaths especially in developing countries. According to world health organization (WHO) estimation more than eight million deaths annually are attributed to tobacco consumption worldwide.[1] Around 50% of the cigarette smokers ultimately develop to airflow obstruction and decline in lung functions due to repetitive inflammation caused by the reactive oxidative substances generated by smoking.[2] Spirometric parameters including force expiratory first second (FEV1), force vital capacity(FVC) and FEV1/FVC are most commonly used parameters for assessing lung function test. FVC maneuver requires active participation and is technically demanding. Due to inability to comprehend directions or reluctance to follow the instructions and difficulties in expiring fully in order to provide maximum FVC usually lead to submaximal test results, So these spirometric measurements are not always valid. Moreover entire exhalation time can be prolonged in subjects with airflow limitation requiring more physical effort and increased myocardial demand that might cause syncope.[3,4]Even most of these subjects faced difficulty to put sufficient effort at the required period of atleast twenty seconds to obtain reliable FVC and FEV1/FVC. FVC is usually underestimated due to poor expiratory effort of subjects, as air flow toward the end of FVC is reduced and not detected by the spirometer.[3]Furthermore, during the procedure, if the subject cannot exhale long enough to clear the lungs to the residual volume, Pattern of "pseudo-restriction" is observed, that means concurrently reduction in FEV1 and FVC resultant in giving normal picture of FEV1/FVC and underestimating airflow obstruction.[3] Keeping this limitations in mind now researchers are focusing on spirometry maneuvers of shorter duration, forced expiratory volume in first six seconds (FEV6) that allowing subjects to stop after short duration of six seconds.[3] Some studies have suggested that it can be used as surrogate for FVC.[5] Global Initiative for Chronic Obstructive Lung Disease (GOLD) also recommended new researches to explore validate substitute of FEV1 and FVC for the diagnosis of asymptomatic patients of airflow obstruction.[2] With

Dr. Aneel Aslam *MBBS,FCPS*
Professor
Karachi Institute of Medical Sciences (KIMS),KHI
Dr. Abdul Waheed *MBBS, MSc,DMJ*
Assistant Professor
Karachi Institute of Medical Sciences (KIMS),KHI

Correspondence:
Dr. Abdul Waheed
Email: chundrigarwaheed@yahoo.com

this background this study was designed to compare the FEV6 and FEV1/FEV6 ratio among smokers and nonsmokers.

METHODOLOGY

This cross-sectional study was conducted at Karachi Institute of Medical Sciences (KIMS),Karachi from September to December 2020. Ethical approval was taken from the Ethical Research Committee. It was composed of 200 male subjects of age ranging 18 to 25 years. Prior to study, ethical approval was taken from institutional ethical committee. Two hundred medical students from 1st year to 3rd year MBBS were selected by convenience sampling technique. Relevant information concerning about lifestyle, history of smoking including duration and pack years (number of cigarettes per day by years), medical history about the cough, sputum, chest pain, various allergies, frequent respiratory infections, asthma, chronic obstructive pulmonary diseases (COPD), tuberculosis and lung cancer were recorded on structured proforma. Participants who smoke more than 100 cigarettes/year in their life regularly were considered smokers and who never smoke or smoke less than 100 cigarettes in their life were enrolled as nonsmokers.[6] Subjects with cardiorespiratory diseases like tuberculosis, asthma, COPD, congestive cardiac and deformity of spine and the thoracic cage such as kyphosis, scoliosis and fused ribs were excluded from the study.

Informed consent from each participant was taken and then height in meters (m) and weight in kilogram (kg) were obtained by stadiometer. BMI was calculated using formula, weight in kg/height in m^2. FEV6 was recorded by calibrated digital spirometer following standard guidelines of American thoracic society (ATS) and European respiratory society (ERS).[4] Each participant was asked to sit erect, and to breathe normally for about one minute and then asked to breathe as hard as possible and holds the breath. Participants while using nose clip, to avoid air leakage, breathes out as quickly and as forcibly as possible into the spirometer through a mouthpiece for the first six seconds to obtain FEV6. The maneuver for FEV6 and FEV1/FEV6 was repeated for three times and highest reading was recorded for analysis.

Statistical analysis Statistical analysis was conducted on SPSS 22 version. Descriptive variables including age, height, weight, BMI and FEV6 was presented as mean ± standard deviation (SD). Mean values for FEV6 among smokers and nonsmokers were compared by independent t-test. p-value ≤0.05 considered significant.

RESULTS

This study was composed of 200 male participants. of the total population 83 (41%) were smokers and 117(59%) were non -smokers(Figure 1). Mean age of the study participants was 21.89 ± 4.8. Smokers have lower FEV6 and FEV1/FEV6 values as compared to nonsmokers. Significant difference was observed in mean FEV6 of smokers and non-smokers. (p-value =0.002). Mean FEV1/FEV6 was also significantly different among smokers and nonsmokers (p- value = 0.000*, (Table 1)

Figure 1: Distribution of Study Participants

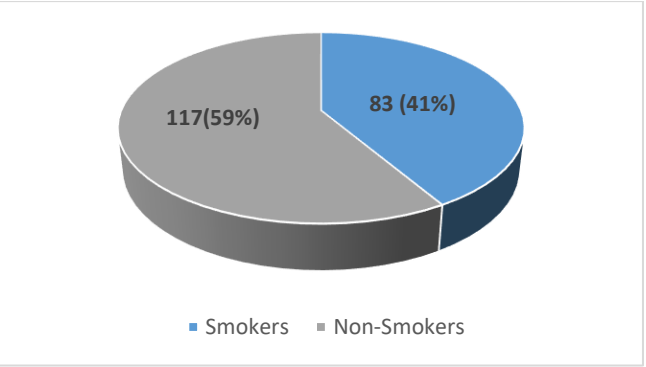

Table 1: Comparison of Spirometric Parameters among Smokers and Nonsmokers

Variables	Smokers (n=83)	Non smokers (n=117)	P value	95% Confidence Interval
	Mean ±SD	Mean ±SD		
FEV6(L)	3.23±0.616	3.43±0.28	0.002*	0.07964 - 0.33645
FEV1/FEV6	0.75±0.97	0.77 ± 0.14	0.000*	0.05438 - 0.01239

FEV6= forced expiratory volume in 6 second, FEV1 = forced expiratory volume in first second p value ≤0.05 considered significant

DISCUSSION

Trend of smoking is continuously rising all over the world. Airway obstruction as a consequence of smoking is well evident. Early stages of airway obstruction in smokers can be asymptomatic and cannot be picked by FEV_1 and FVC, so misdiagnosis of airway obstruction is not uncommon in smokers causing significant morbidity and adverse prognosis.[7] Previous studies have highlighted the importance of FEV1/FVC as a screening tool of airway obstruction but new researches have pointed out the submaximal

determination of FVC value due to failure of subjects to follow proper technique and not exhaling to full extent for a longer time to get validate value for FVC.[3] FEV6 is now proposed as a reliable substitute tool for FVC and FEV1/FEV6 ratio can conveniently be used as a viable alternative to FEV1/FVC. The benefits for performing this procedure is its shorter duration for performing spirometry tests for FEV6 which are also easily executed by patients, hence making it ideal for objectively diagnosing pulmonary disorders and even mild airway obstruction. Moreover shortening each forced exhalation manoeuvre to six second would reduce the overall testing time, patient's effort and fatigue, similarly decrease chance of complication like syncope that is commonly associated with FVC maneuver.[8]

This below mentioned Indian study have proved that the FEV6 can be used as a surrogate for FVC and reported 0.75 (75%) as a fixed cut of points for FEV1/FEV6 for the diagnosis of airway obstruction.[8] PLATINO studies, also documented fixed cut off value of 0.75 for FEV1/FEV6 for airway obstruction.[9] In contrast to this, slightly more lower limit of the normal range for FEV1/FEV6 smokers was about 0.72, reported from the china and 0.73(73%) was reported by 3rd National Health and Nutrition Examination Survey (NHANES III) from united states.[10,11] Current results show that the smokers have lower FEV6 values and FEV1/FEV6 ratio as compared to the nonsmokers. Smokers have border line FEV1/FEV6 ratio of 0.75 (75%) reflecting airway limitation, as these similar fixed cut of points were reported by Singh et al from India and PLATINO studies for airway obstruction.[8,9] Our results are in line with Enright et al study that also reported decline in FEV1/FEV6 ratio upto 69% in smokers indicating reduced lung functions.[11]

Current results are also confirmed by Layoun et al who also reported reduced FEV6 and FEV1/FEV6 in smokers reflecting decline in lung functions.[12] It is evident from the previous studies that smoking results in worsening of lung functions and compromised health. However it is preventable morbidity which can be improved with cessation of smoking at any age. Early diagnosis of airway obstruction by FEV1/FEV6 ratio helps in motivation of smokers to quit smoking and to prevent lung damage for spending quality life.

Limitations: Small sample size and short duration of the study is our limitation. It should be conducted on a broader scale for a long duration with control group following strict protocol to validate the results to be implemented on overall population.

CONCLUSION

FEV6 and FEV1/FEV6 values were lower in smokers as compared to nonsmokers reflecting decline in lung function in smokers.

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Conflicts of Interest: None.

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Author's Contribution:

Dr. Aneel Aslam	Study design, data collection, and Data analysis interpretation of results, critically revise the manuscript for all intellectual content and make all necessary revision in manuscript. Check and correct all the references carefully and approved the article.
Dr. Abdul Waheed	Study design, data collection, manuscript writing, revise and approve the article.
	All authors are equally accountable for research work and material provided

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