

Original Article

Comparison of Pulmonary Function Tests in Smokers and Non-Smokers

1. Waseem Shafqat 2. Mahmood Nasir Malik 3. Shariq Sohail 4. Asaad Madni

1, 2. Assoc. Prof. of Medicine 3. Asstt. Prof. of Cardiology 4. PGR Medicine,
Allama Iqbal Medical College, Lahore

ABSTRACT

Purpose of Study: To compare the lung function tests in healthy non-smoker with age and sex matched smokers who are asymptomatic of respiratory impairment.

Materials and methods: This cross sectional analytic study was carried out from June 2009 to November 2009 in Department of Medicine and Pulmonology, Jinnah Hospital, Lahore. A total of 200 subjects were included in the study. All individuals were selected from healthy general public visiting Jinnah hospital Lahore as attendants of the patients. FVC, FEV1 and FEV1/FVC were measured and recorded in Performa. Data was entered and analyzed in SPSS 10.

Results: Mean age was 36.77±6.58 years. It was 34.11±7.38 in smokers and 33.43±5.39 in non-smokers group. Mean FEV1 was 2.55±0.79 in smokers and 3.52±0.55 in non-smokers. Mean FVC was 3.94±0.69 in smokers and 4.35±0.69 in non-smokes.

Conclusion: Smoking causes significant reduction in lung functions in asymptomatic smokers which can be prevented by quitting smoking.

Key Words: Pulmonary function test, Smoking, Lung diseases

INTRODUCTION

Smoking is quite prevalent in our society.¹ It is a serious public health problem in Pakistan. It declines pulmonary functions slowly and progressively and eventually causing COPD. It is estimated that smoking causes some 114,000 premature deaths every year², of which about a quarter are from lung cancer and around one fifth are from chronic obstructive lung disease -chronic bronchitis and emphysema.

Cigarette smoking is associated with a tenfold increase in the risk of dying from chronic obstructive lung disease. About 90% of all deaths from chronic obstructive lung diseases are attributable to cigarette smoking³.

Around 90% of lung cancer cases in the UK are caused by tobacco smoking and in addition, tobacco smoking can also cause cancers of the following sites: upper aerodigestive tract (oral cavity, nasal cavity, nasal sinuses, pharynx, larynx and oesophagus), pancreas, stomach, liver, lower urinary tract (renal pelvis and bladder), kidney, uterine cervix and myeloid leukaemia³. Overall smoking is estimated to be responsible for approximately 30% of cancer deaths in developed countries.

Cessation of smoking, even for people who have been smoking for many years, has very significant health benefits. The cumulative risk of dying of lung cancer by

age 75 for a life-long male smoker is 15.9%. For men who cease smoking at ages 60, 50, 40 and 30 years, their cumulative risk of dying from lung cancer falls to 9.9%, 6.0%, 3.0% and 1.7% respectively.

The diagnosis of respiratory diseases and the evaluation of their functional effect sometimes may be made by appropriate history taking and physical examination. However, in most instances applicable laboratory, radiological and bedside procedures are necessary for a definitive diagnosis, accurate functional assessment and close monitoring⁴.

There are various methods⁵ to evaluate the lung function in health and disease which range from simple bedside spirometry⁶ to most modern computerized equipment. These tests include body plethysmography, diffusing lung capacity and arterial blood gases⁷. These tests help in diagnosis and management.

Pulmonary function tests (PFTs) provide objective means for determination of the presence or absence of functional impairment of the respiratory system and allow assessment of its severity, progression, and response to therapeutic measures. These tests are essential in the diagnosis and management of asthma; however the results of the studies should always be interpreted in light of clinical information, and by considering their accuracy, sensitivity and specificity⁶.

Spirometry is simple and easy to perform. It has both diagnostic and prognostic significance. It depends upon the age, sex and body size, FEV1 declines with age after 25 years⁷. Variation in ventilatory capacity of normal people may be due to ethnic origin, physical activity, posture of patient and co-operation.

Pulmonary function tests⁷ include Tidal Volume(TV), Inspiratory Reserve Volume(IRV), Expiratory Reserve Volume(ERV), Inspiratory Capacity, Vital Capacity(VC), Function Residual Capacity(FRC), and Total Lung Capacity(TLC).

This study was designed to assess the effect of smoking on respiratory function tests in healthy asymptomatic smokers.

MATERIALS AND METHODS

This cross sectional analytic study was carried out from June 2009 to November 2009 in Department of Medicine and Pulmonology, Jinnah Hospital, Lahore. A total of 200 subjects were included in the study. All individuals were selected from healthy general public visiting Jinnah hospital Lahore as attendants of the patients.

RESULTS

Results are shown in the form of tables.

Table No.1: Measurement of PEFr in Smokers and Non-Smokers n=200

Age group Years	Smokers n=100	Non smoker n=100
18-34	n=56 5.03+1.40	n=53 6.87+1.62
35-44	n=24 5.29+1.78	n=26 6.95+1.40
45-65	n=20 3.27+1.06	n=21 6.54+0.62
Total	100	100

Table No.2: Forced Expiratory Volume in first second in smokers and non-smokers n=200

Age group Years	Smokers Mean FEV1+SD (Litres) n=100	Non smoker Mean FEV1+SD (Litres) n=100
18-34	n=56 2.73+0.74	n=53 3.54+0.47
35-44	n=24 2.56+0.55	n=26 3.54+0.58
45-65	n=20 1.92+0.44	n=21 3.02+0.052
Total	100	100

Table No. 3: Forced vital capacity in smokers and non smokers

Age group (Years)	Smokers n=100	Non smoker n=100
18-34	n=56 4.13+0.46	n=53 4.31+0.67
35-44	n=24 3.98+0.69	n=26 4.52+0.59
45-65	n=20 2.92+0.62	n=21 3.83+0.32
Total	100	100

Table No.4: Comparison of peak expiratory flow rate in smokers and non smokers

T –TEST

Age group (Years)	Smokers n=100	Non smoker n=100
18-34	n=56 mean PEFR=5.03 SD=1.40 SE Mean=0.18	n=53 mean PEFR=6.87 SD=1.62 SE Mean=0.19 P-VALUE= 0.000 Highly significant
35-44	n=24 mean PEFR=5.29 SD=1.78 SE Mean=0.33	n=26 mean PEFR=6.95 SD=1.40 SE Mean=1.40 P-VALUE= 0.000 Highly significant
45-65	n=20 mean PEFR=3.27 SD=1.06 SE Mean=0.31	n=21 mean PEFR=6.54 SD=0.618 SE Mean=0.36 P-VALUE= 0.000 Highly significant
Total	100	100

DISCUSSION

In our study majority of the smokers (56%) were in the age group 18-34 years. Among the smokers, number of males was greater than female. Majority of smokers smoke more than 20 cigarettes per day. Asymptomatic smokers have significantly reduced pulmonary function tests including peak expiratory flow rate (PEFR), forced expiratory volume in one second (FEV1), forced vital capacity (FVC), and forced expiratory volume in first second /forced vital capacity(FEV1/FVC) showing obstructive pattern⁸.

Table No.5: Comparison of forced expiratory volume in first second in smokers and non smokers**T –TEST**

Age group (Years)	Smokers n=100	Non smoker n=100
18-34	n=56 mean FEV1=2.734 SD=0.748 SE Mean=0.097	n=53 mean FEV1=3.540 SD=0.585 SE Mean=0.069 P-VALUE= 0.000 Highly significant
35-44	n= 24 mean FEV1=2.568 SD=0.555 SE Mean=0.10	n=26 mean FEV1 =3.540 SD=0.472 SE Mean=0.094 P-VALUE= 0.000 Highly significant
45-65	n=20 mean FEV1=1.623 SD=0.446 SE Mean=0.13	n=21 mean FEV1 =3.02 SD=0.052 SE Mean=0.03 P-VALUE= 0.000 Highly significant
Total	100	100

Table No.6: Comparison of forced vital capacity in smokers and non smokers**T –TEST**

Age group (Years)	Smokers n=100	Non smoker n=100
18-34	n=56 mean FVC=4.13 SD=0.461 SE Mean=0.06	n=53 mean FVC=4.319 SD=0.68 SE Mean=0.08 P-VALUE= 0.061 Non-significant
35-44	n=24 mean FVC=3.977 SD=0.693 SE Mean=0.13	n=26 mean FVC =4.516 SD=0.588 SE Mean=0.12 P-VALUE= 0.0033 Highly significant
45-65	n=20 mean FVC=2.927 SD=0.622 SE Mean=0.18	n=21 mean FVC =3.83 SD=0.0318 SE Mean=0.18 P-VALUE= 0.012 Significant
Total	100	100

Lubinski et al⁹ performed study on 3004 subjects 18-23 years old. The analysis of influence of smoking on

pulmonary function tests showed statistically significant decrease of total lung capacity (TLC), forced expiratory volume in first second (FEV1), FEV1%/VC, PEF and FEF50% in the smokers' group. Percentage of people with airflow limitation (FEV1%/VC < 85% N, FEV1 < 80% N, FEF50 < 70% N) was two times higher than in the non-smokers' group. Smoking significantly increases the number of subjects with airflow limitation among healthy young male. Similar results were obtained in our study.

Aparici M_i et al¹⁰ determined the characteristics of spirometric performance in a group of smokers and to carry out a prospective study of the changes in ventilatory lung function after smoking withdrawal. The ventilatory lung function was studied in 90 smokers and 30 non-smokers. Afterwards the smokers were included in smoking withdrawal program. One year later, the ventilatory function tests were repeated in those individuals who were able to stop smoking. Respiratory function tests were likewise repeated in 10 subjects chosen randomly among those who were not able to stop smoking. The initial study of the ventilatory lung function showed that smokers had significantly lower values of FVC (p < 0.001), FEV1 (p < 0.001), FEV1/FVC (p < 0.001), FEF25-75 (p < 0.01 and PEF (p < 0.01) compared to non-smokers. Likewise smokers also had a statistically significant higher prevalence rate of obstructive pulmonary disease (p < 0.001). Ventilatory function studies performed one year after smoking withdrawal on those who were able to stop smoking showed a significant improvement of respiratory function parameters compared to studies done one year before. There was also a significant decrease in the prevalence and severity of obstructive pulmonary disease. No differences were observed in the ventilatory function tests performed on the ten subjects who did not stop smoking. From these data i suggest that tobacco consumption produces obstruction of the airways that can be reverted, at least in part, after smoking withdrawal.

Kanner RE et al¹¹ evaluated the effects of smoking-cessation intervention in early chronic obstructive pulmonary disease (COPD) on the symptoms of chronic cough, chronic phlegm production, wheezing and shortness of breath, and determined the effects of quitting smoking on forced expiratory volume in one second (FEV1) and forced expiratory volume in the first second as a percentage of forced vital capacity (FEV1/FVC).

A total of 5,887 male and female smokers 35 to 60 years of age with early chronic obstructive air way disease (COPD) [defined as a forced expiratory volume in the first second (FEV1) of 55% to 90% of predicted and FEV1/forced vital capacity (FVC) <0.70] were enrolled in a 5-year clinical trial. Two-thirds of participants were randomly assigned to smoking-

intervention groups and one-third to a usual-care group. The intervention groups attended 12 intensive smoking-cessation sessions that included behavior modification techniques and the use of nicotine chewing gum. Smoking status was biochemically validated by salivary cotinine measurements or exhaled carbon monoxide values. At the end of the study, sustained quitters had the lowest prevalence of all four symptoms, whereas continuous smokers had the greatest prevalence of these symptoms. Changes in symptoms occurred primarily in the first year after smoking cessation.

Respiratory symptoms were associated with greater declines in forced expiratory volume in one second (FEV1) during the study ($P < 0.001$). In this prospective randomized trial using an intention-to-treat analysis, smokers with early chronic obstructive pulmonary disease (COPD) who were assigned to a smoking-cessation intervention had fewer respiratory symptoms after 5 years of follow-up¹².

Reduction in pulmonary function tests including peak expiratory flow rate (PEFR), forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), and forced expiratory volume in the first second as a percentage of forced vital capacity (FEV1/FVC) was more in smokers with high (>7.5) pack years than in those with low (<7.5) pack-years.

CONCLUSION

Smoking causes significant reduction in lung functions in asymptomatic healthy smokers as compared to asymptomatic healthy non-smokers which can be prevented by quitting smoking.

REFERENCES

1. Adil MM, Zubair M, Khan UA. Prevalence of smoking in various cities of Pakistan. *Rawal Med J* 2005; 30:74-5.
2. Smoking Statistics. British Heart Foundation, January 2004 www.heartstats.org.
3. Zurdari KM, Sahto MM, Ahmed TS, Rahu AA, Badar A. Pulmonary function tests in chronic obstructive pulmonary disease with and without cardiac failure. *J Ayub Med Coll Abbottabad* 1999;11:17-9.
4. Ayoob Z, Ansari AK, Akhtar R. Pulmonary function tests in heroin addicts at Karachi. *Med Channel* 2001; 7:11-4.
5. Holten KB. Revisiting spirometry for the diagnosis of COPD. *J Fam Pract.* 2006 ; 55:51.
6. Manzar S. Appropriateness of blood gas analysis in newborns with respiratory distress. *Pak J Med Sci* 2004; 20:33-5.
7. Spergel JM, Fogg MI, Bokszczanin-Knosala A. Correlation of exhaled nitric oxide, spirometry and asthma symptoms. *Asthma* 2005; 42:879-83.

8. Lokke, A, Lange, P, Scharling, H, et al. Developing COPD: a 25 year follow up study of the general population. *Thorax* 2006; 61:935
9. Lubiński W, Targowski T, Frank-Piskorska A. Evaluation of the influence of tobacco smoking on pulmonary function in young men. *Pneumonol Alergol Pol* 2000; 68(5-6):226-31.
10. Aparici M, Fernández González AL, Alegría E. Respiratory function tests. Differences between smokers and non-smokers. Effects of withdrawal. *Rev Clin Esp* 1993; 192:169-72.
11. Kanner RE, Connett JE, Williams DE, Buist AS. Effects of randomized assignment to a smoking cessation intervention and changes in smoking habits on respiratory symptoms in smokers with early chronic obstructive pulmonary disease: the Lung Health Study. *Am J Med.* 1999; 106:410-6.
12. Van Durme YM, Verhamme KM, Stijnen T, et al. Prevalence, Incidence, and Lifetime Risk for the Development of COPD in the Elderly: The Rotterdam Study. *Chest* 2009; 135:368.

Address for Corresponding Author:

Dr. Waseem Shafqat,
Associate Professor,
Department of Medicine,
Jinnah Hospital, Lahore.