Original research article

"A comparative study of pulmonary function tests in healthy male smokers & non-smokers."

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Abstract

Background: Tobacco smoking is widely prevalent in developing countries and it has extensive effects on respiratory function and is a risk factor for a number of respiratory diseases. Early detection of lung function decline in smokers will be beneficial for promoting smoking cessation and reducing lung tissue damage.

Method: This cross-sectional study was conducted in the rural and urban areas of Ghaziabad. We assessed the lung function in 150 healthy male smokers and 150 healthy non-smokers through spirometry.

Results: The prevalence of smoking was higher in middle age group (38-49 years age group) as compared to older and younger ones. The spirometry parameters were significantly greater in non-smokers than smokers ($p<0.001$). Both smokers and non-smokers showed negative correlation between spirometry parameters and age ($p<0.001$). It was also observed that all spirometry parameters increased with increase in height in both the groups.

Conclusion: Smoking leads to accelerated decline in lung function.

Key words: spirometry, smokers, non-smokers

Introduction

Cigarette smoking, relative to other factors plays a dominant role in accelerated decline of pulmonary function. Because clinical symptoms of respiratory impairment become apparent only after many years of smoking, the potential for prevention of accelerated decline through smoking cessation efforts is considerable. [1,2] Various forms of tobacco smoking are practiced in India including cigarettes, beedies, chilums (Claypipe), Chutta (Reverse smoking), hukka (hubble-bubble) the first two beings the predominent types in urban areas. [3]

Tobacco smoking is widely prevalent in both developed and developing countries. It is one of the important preventable causes of premature deaths. More than 8 million people each year die because of tobacco use and the commonest cause among them is smoking. Over 80% of the world's 1.3 billion tobacco users live in low- and middle-income countries. [4]The death toll is steadily increasing and total tobacco-attributable deaths are projected to rise from 5.4 million in 2005 to 8.3 million in 2030.[5]

In most of the countries the prevalence of smoking is more among men than women and it is associated with the socioeconomic conditions.[6] The factor involved in the initiation and maintenance of the habit of smoking are social and psychological with physical dependence supervening.[7]

Tobacco has remained as one of the most important predisposing factors responsible for so many respiratory and cardiovascular diseases.[8] Cigarette smoking has extensive effects on respiratory function and is clearly implicated in the aetiology of a number of respiratory diseases, particularly chronic bronchitis, emphysema and bronchial carcinoma.[8,9]
In this study we focused on studying the pulmonary function among smokers and non-smokers through spirometry.

Materials and Methods:
The present study was conducted in the department of physiology in association with department of T.B. & Chest in Santosh Medical College and Santosh Hospital Ghaziabad. Following approval of the ethical board of institution volunteers were selected randomly from rural as well as from urban area of Ghaziabad. The subjects for the study were selected from the relatives and attendants of the patients attending the outpatient department and indoor ward, staff members of the hospital and residents of nearby locality. We included 300 subjects in this study (150 healthy male smokers and 150 non-smokers) of the age group 25-55 years.

Inclusion criteria:
1. Control group (Non-smokers) one who has never smoked a cigarette.
2. Active smokers: one who has been smoking at least one cigarette per day for last five years.

Exclusion criteria:
1. Those whose status of smoking is not clear.
2. Those who were suffering from respiratory or cardiovascular diseases like Asthma, Pulmonary T.B., Pleurisy, Chronic obstructive lung disease.
3. Conditions where spirometry is contraindicated like recent surgery, infection, Pneumothorax.
4. Females were excluded from this study.
5. Persons who worked in textile mills or other places where lungs are affected by dust or fumes.
6. Those with history of hospitalization with chronic ailments.

Detailed history with special emphasis on respiratory symptoms like dyspnoea, cough, haemoptysis etc was recorded. Smoking history which included type of smoking, duration of smoking and pattern of inhalation and exhalation. Pack year was calculated from the number of cigarettes smoked per day and the number of years the person had been smoking.
(one pack year being smoking of 20 cigarettes per day for one year or 80 beedies per day for 1 year)
SPIROMETRY [10]: Spirometry was performed with Medspiror which displays spirometry parameters as actual, predicted and percentages predicted values.
The subjects were asked to follow these precautions before the procedure.
- The subjects were told not to smoke at least 1 hour before the test.
- Not to drink alcohol for at least 30 minutes before the test.
- No heavy exercise for at least 30 minutes before the test.
- Not to wear tight clothing which makes it difficult for them to take a deep breath.
- Large meals to be avoided within 2 hours before the test.

The recording was done in the sitting posture and in morning between 10 AM - 2 PM. The subjects were given adequate rest and time before the test so that they get acclimatized to environmental conditions. The nature of the study was explained to the subjects beforehand to avoid any apprehension which could alter the values of the tests. They were demonstrated

the procedure with the emphasis on the importance of taking a full breath and blowing out as fast and hard as possible. Three reading were taken. Highest amongst the three readings was taken as subjects lung function values.

Statistical Analysis

The p-value < 0.05 was considered statistically significant. Intergroup comparison for parametric data was done using unpaired 't' test and for non-parametric data was done using Mann-Whitney U test. Correlations were assessed with Pearson correlation co-efficient and Spearman correlation co-efficient as and when applicable. Results are expressed as mean ± standard deviation (Mean ± SD).

Results:

Table 1: Shows the age and height of the smoker and non-smoker group.

PARAMETERS	SMOKER (n=150)	NON-SMOKER (n=150)	p VALUE
AGE (years)	40.83 ± 8.505	39.49 ± 8.196	0.1678
HEIGHT (cm.)	164.7±4.475	164.9 ± 4.565	0.721

*p<0.05-significant, **p<0.01- highly significant, ***p<0.001-very highly significant

Table 2: Shows Spirometry parameters among smoker and non-smoker group.

PARAMETER	SMOKER (n=150)	NON-SMOKER (n=150)	p VALUE
FVC (liters)	2.674±0.234	2.903±0.389	<0.0001****
FEV1(liters)	2.323±0.247	2.504±0.278	<0.0001****
PEFR (liters/sec.)	7.295±0.639	7.990±0.908	<0.0001****

*p<0.05-significant, **p<0.01- highly significant, ***p<0.001-very highly significant

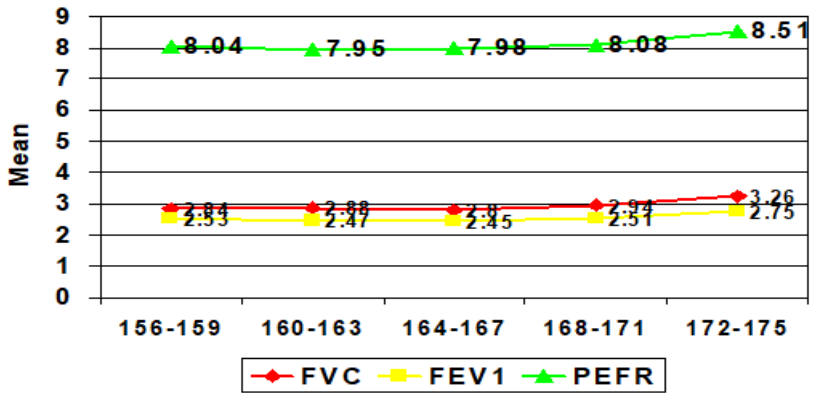


Figure 1: Graph showing the age wise distribution of spirometry parameters among non-smokers.

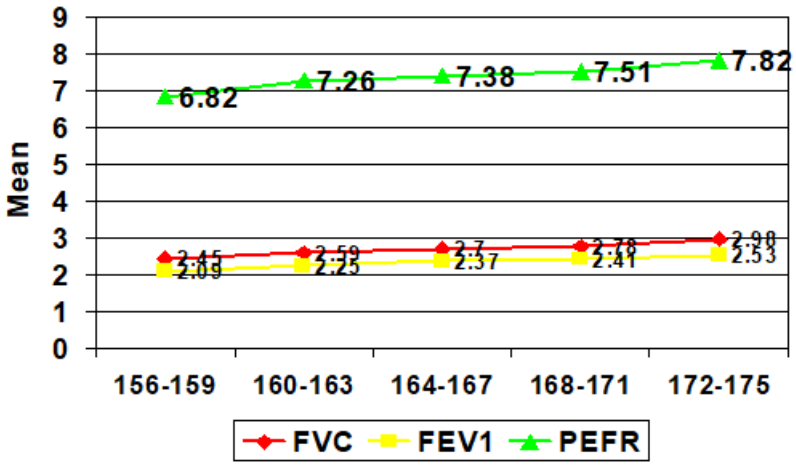
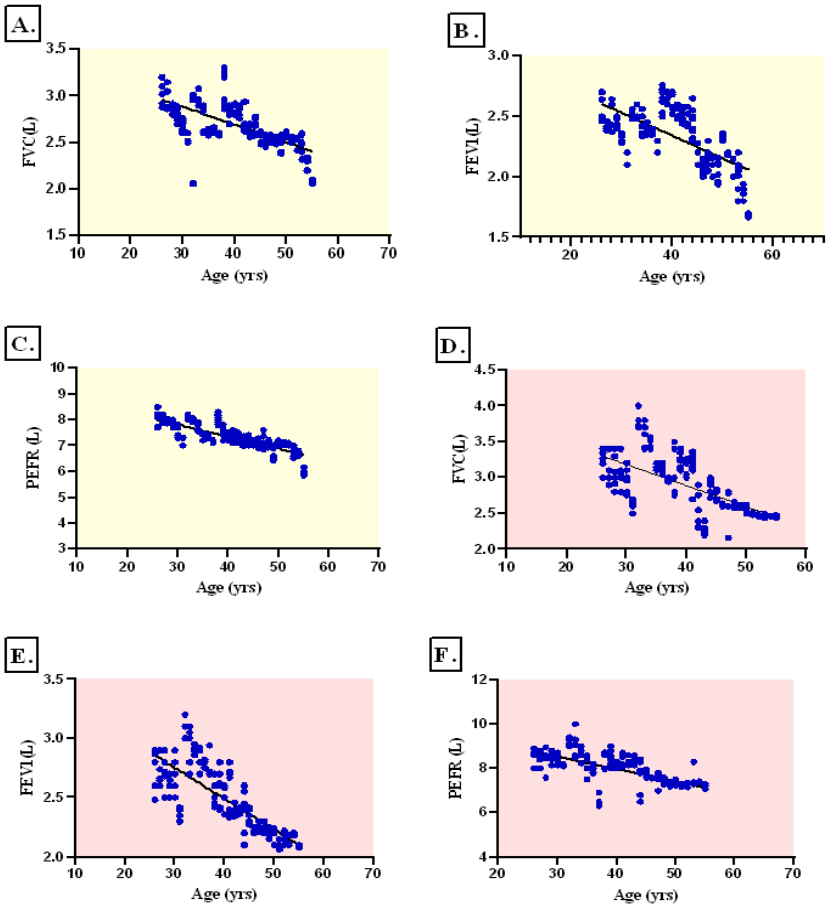


Figure 2: Graph showing the height wise distribution of spirometry parameters among smokers.



A. Age and FVC correlation among smokers (r = -0.696, p = <0.0001)
B. Age and FEV1 correlation among smokers (r = -0.650, p = <0.0001)
C. Age and PEFR correlation among smokers (r = -0.610, p = <0.0001)
D. Age and FVC correlation among non-smokers (r = -0.617, p = <0.0001)
E. Age and FEV1 correlation among non-smokers (r = -0.771, p = <0.0001)
F. Age and PEFR correlation among non-smokers (r = -0.666, p = <0.0001)

Figure 3: Graphs showing the correlation between age and spirometry parametes (FVC,FEV1,PEFR) among smokers and non-smokers.

Discussion:

Present study was conducted to study the lung function among healthy smokers and non-smokers. Females were excluded from the study because there were only few female smokers available who were asymptomatic and therefore statistical analysis was not possible with such a small number. Also, the number of smoker females were very less due to low prevalence of smoking in Indian females as well as psychosocial impact on smokers leading to concealment of history of smoking.

In the present study it was observed that the middle-aged persons were more prone to indulge in smoking. The highest rate of smoking was observed in age group of 38-49 years followed by 26-31 years. The most perceived cause for this trend (38-49 years age group) appears to be the economic and social establishment of a person in society and since most of the subjects in our study were from rural area and in these areas Hukka, Bidi, Cigerette smoking are socially acceptable and are used to maintain social status and social relationship. The most perceived cause for the trend (26 to 31 years age group) may be related to psychosocial factors which includes stress, social support, social networks, attitude and belief toward smoking behaviour and social norms. [11]

As we know that pulmonary function status varies with physical dimension i.e. size and development of the subject, tall person who has more BSA due to large chest size more muscle power have higher spirometry values.[12] In our study we found increase in spirometry parameters with increase in height among the participants of both the groups.

Values of all parameters of pulmonary function tests were found highest in age group 26-37 years. All the parameters showed a declining trend with advancing age. Previous studies also have shown similar results with lung function deterioration along with advancing age.[12,13]

Cotes et al. described that advancing age produces degenerative changes in the musculoskeletal system of the thoracoabdominal compartment. This imposes a limitation on the maximal effort for inspiration as well as for expiration and hence the reduced value of ventilator capacity. Loss of elastic tissue with advancing age may also be a factor, other possible explanation may be an associated change in the lung volume at which airway closure occurs with and increased pulmonary flow resistance in the elderly. This is in accordance with our present study.

In the present study we have observed that spirometry parameters have a negative correlation with age. Chhabra SK et al. also observed same type of pulmonary function status with respect to age and height which is in agreement with the present study.[15]

The pulmonary function showed a declining trend in smokers with increasing age and the decline in FEV1 and PEFR was significantly more in smokers as compared to non-smokers. These finding correlated with the finding of Peat J K et.al who reported that in smokers the rate of decline of FEV1 is greater than non-smokers, and was related to the amount smoked.[17] Similar results have been found in many other previous studies also. [17,18]

Spirometry can help in identifying early changes in lung function, even before clinical symptoms appear for lung disease. Since in our study we found decline in lung function in smokers with no history of any respiratory symptoms, we can say spirometry is a sensitive tool for assessing biomedical risks of lung disease in them. Spirometry by providing information about the lung function may help in increasing awareness of the effect of smoking among smokers who are asymptomatic.

We can conclude from our study that smoking has a deleterious effect on the pulmonary function and spirometry can be used for early detection of lung tissue damage and planning strategy for smoking cessation.

References:

1. United States Public Health Service Office of the Surgeon General; National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. Smoking Cessation: A Report of the Surgeon General [Internet]. Washington (DC): US Department of Health and Human Services; 2020. Chapter 4, The Health Benefits of SmokingCessation. Availabl from: https://www.ncbi.nlm.nih.gov/books/NBK555590/
2. Geijer RM, Sachs AP, Hoes AW. Salume PL. Lammers JW et al. Prevalence of undected persistent airflow obstruction in male smokers 40-65 years old. Fam Pract, 2005; 22 (5): 485-9.
3. Chhabra SK, Rajpal S, Gupta R. Pattern of smoking - in Delhi and comparison of Chronic respiratory morbility among beedi and cigerette smokers Indian J. Chest. Diseases and Allied sciences, 2001; 43 (1); 19-26.
4. World Health Organization. WHO Report on the Global Tobacco Epidemic, 2017: Monitoring Tobacco Use and Prevention Policies. Geneva, Switzerland: World Health Organization; 2017
5. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 2006 Nov;3(11):e442. doi: 10.1371/journal.pmed.0030442. PMID: 17132052; PMCID: PMC1664601.
6. Sreeramareddy CT, Pradhan PM. Prevalence and social determinants of smoking in 15 countries from North Africa, Central and Western Asia, Latin America and Caribbean: secondary data analyses of demographic and health surveys. PLoS One. 2015 Jul 1;10(7):e0130104.
7. Esen BK, Gündoğdu M. The relationship between internet addiction, peer pressure and perceived social support among adolescents. The International Journal of Educational Researchers. 2010 Jul 1;2(1):29-36.
8. Bartal M. Health effects of tobacco use and exposure. Monaldi archives for chest disease. 2001 Dec 1;56(6):545-54.
9. Sasco AJ, Secretan MB, Straif K. Tobacco smoking and cancer: a brief review of recent epidemiological evidence. Lung cancer. 2004 Aug 1;45:S3-9.
10. Miller MR, Hankinson JA, Brusasco V, Burgos F, Casaburi R, Coates A et al. Standardisation of spirometry. European respiratory journal. 2005 Aug 1;26(2):319-38.
11. Yun EH, Kang YH, Lim MK, Oh JK, Son JM. The role of social support and social networks in smoking behavior among middle and older aged people in rural areas of South Korea: a cross-sectional study. BMC Public Health. 2010 Feb 18;10:78.
12. Hankinson JL, Odencrantz JR, Fedan KB. Spirometric reference values from a sample of the general US population. American journal of respiratory and critical care medicine. 1999 Jan 1;159(1):179-87.
13. Tantisuwat A, Thaveeratitham P. Effects of smoking on chest expansion, lung function, and respiratory muscle strength of youths. J Phys Ther Sci. 2014 Feb;26(2):167-70
14. Ray D, Rajaratnam A, Richard J. Peak expiratory flow in rural residents of Tamil Nadu, India. Thorax. 1993 Feb;48(2):163-6.
15. COTES JE: lung function asserrment and application in medicine VI edition 1993; 487 – 419.
16. Chhabra SK, Kumar R, Gupta U, Rahman M, Dash DJ. Prediction equations for spirometry in adults from northern India. Indian J Chest Dis Allied Sci. 2014 Oct 1;56(4):221-9.
17. Peat JK, Woolcock AJ, Cullen K. Decline of lung function and development of chronic airflow limitation: a longitudinal study of non-smokers and smokers in Busselton, Western Australia. Thorax. 1990 Jan;45(1):32-7.

18. De AK Tripathi MM, Matah SC and Roy DC: Importance of smoking for assessing lung damage by lung function tests; Ind. Jour. Chest Dis. And Allied Science 1989, 31 (3) : 165-169.
19. Jensen EJ, Dahl R, Steffensen F. Bronchial reactivity to cigarette smoke in smokers: repeatability, relationship to methacholine reactivity, smoking and atopy. Eur Respir J. 1998 Mar;11(3):670-6. PMID: 9596120.