# STUDY OF PULMONARY FUNCTION TESTS AMONG SMOKERS AND NON-SMOKERS IN A RURAL AREA

Rubeena Bano, Mahagaonkar AM, Kulkarni NB, Nadeem Ahmad, Nighute S

## Abstract

*In India smoking is a common habit prevalent in both urban and rural areas. Cigarette smoking has extensive effects on respiratory function and is clearly implicated in the etiology of a number of respiratory diseases, particularly chronic bronchitis, emphysema, and bronchial carcinoma. An attempt has been made to study the pulmonary function tests among smoker and non-smoker population in a rural area. The pulmonary functions were done on a computerized spirometer in 100 male subjects comprising of 50 smokers and 50 non smokers. Almost all the pulmonary function parameters were significantly reduced in smokers and obstructive pulmonary impairment was commonest.*

**Key words**: *Smoker, Spirometry, Pulmonary functions, Rural area*

## INTRODUCTION

Cigarettes kill an estimated 5 million people annually world wide[1]. The World Health Organization reported that tobacco smoking killed 100 million people worldwide in the 20th century and warned that it could kill one billion people around the world in the 21st century[2]. By the early 2030, tobacco related death would increase to about 10 millions a year[3]. Tobacco smoking rates have decreased in industrialized countries since 1975, but there has been a corresponding 50% increase in smoking rates in low- income countries[4].

In India smoking is a common habit prevalent in both urban and rural areas irrespective of mode of smoking i.e. cigarettes, bidis, pipes, cigar, hookah etc. The cigarette / bidi smoke is a heterogeneous aerosol produced by the incomplete combustion of the tobacco leaf. In India, tobacco is consumed mainly in the form of bidis (54%), followed by smokeless tobacco (27%) and cigarettes (9%)[5].

Bidi smoke may be more injurious because bidi contains unrefined form of tobacco as compared to cigarettes[6]. A bidi is also required to be puffed more frequently per minute to keep it burning. In the experimental study[7], it has been shown that bidi smoke at 2 puffs / minute produces similar amounts of steam-volatile phenols, hydrogen cyanide and benzopyrene as unfiltered cigarette at 1 puff/ minute.

Cigarette smoking has extensive effects on respiratory function and is clearly implicated in the etiology of a number of respiratory diseases, particularly chronic bronchitis, emphysema, and bronchial carcinoma[8].

**Materials and Methods:**

The present cross sectional study was conducted in Pravara Rural Hospital, PIMS, Loni from January 2007 to August 2008. The study population included 100 male subjects comprising of 50 smokers and 50 non smoker controls aged between 30-60 years. Considering the low prevalence of tobacco smoking among females in the local population, and also its non-reporting by female smokers, females were not included in this study. Individuals with history of smoking cigarettes / bidis daily for at least one year were considered as smokers. The smokers were selected voluntarily from amongst Pravara Medical Trust employees, patients coming to OPD of Pravara Rural Hospital for non-respiratory ailments, and from residents living in and around the Pravara Rural Hospital premises. Ex-smokers or past smokers were excluded from the study. The materials used in the study were a computerized RMS Med-spirometer, weighing machine, measuring tape, Blood Pressure set and

* *Dept. of Physiology, RMC, Loni.*

Stethoscope. Purposive sampling was done and results were analyzed by statistical methods like percentages, chi square test and t-test of significance.

**Classification Criteria As Suggested By WHO (1998)[9].**

- **Smoker**: Someone who, at the time of the study, smokes any tobacco product either daily or occasionally.
- **Non-smoker**: Someone who, at the time of the study, does not smoke at all.
- **Ex-smoker**: Someone who was formerly a daily or occasional smoker but currently does not smoke at all.

In this study a detailed record of smoking with reference to duration of smoking (in years) and number of cigarettes / bidis smoked per day was taken. None of individuals smoked tobacco in any form other than bidis or cigarettes. To evaluate dose and duration response relationship, quantification of tobacco smoking was performed by calculating smoking index for smokers.

**Smoking Index:**

The Smoking index for an individual was equal to multiplication of the average number of cigarettes/bidis smoked per day and duration (in years) of tobacco smoking. Further, smokers were classified as per exposure level, on the basis of smoking index criteria[10,11].

| **Habit** | **\Smoking Index** (Frequency x duration) |
|---|---|
| Non-smokers | 0 |
| Light smokers | 1-100 |
| Moderate smokers | 101-200 |
| Heavy smokers | more than 200 |

Selection criteria for non smoker controls For the control group, 50 healthy non smoker males belonging to almost same age and matching other characteristics with no history of smoking of any type. It was ensured that none of them had any significant present or past history of sickness particularly of the respiratory system.

**Procedure of spirometry:**

The subject was asked to sit comfortably in a chair. The complete procedure was explained, all doubts if any are cleared. Subject was instructed to breathe in fully by deep inspiration with nostrils closed. Seal the lips around the sterile mouthpiece of spirometer and forcefully expire the air out, as fast and as far as possible. Best of three readings was recorded and interpreted.

## Observations:

The physical characteristics of smokers and non-smokers are shown in Table1. In the present study the age range of subjects was 30-60 years with mean age 48.26 years in smokers and 48.10 years in non smokers. Similarly there was no significant difference in the means of other physical parameters like height, weight, body mass index and body surface area in smokers and non-smokers.

| **Variables** | **Smokers Mean ± 2 S.D.*** | **Non-smokers Mean ± 2 S.D.*** |
|---|---|---|
| Age (years) | 48.26 ± 10.09 | 48.10 ± 10.54 |
| Height (m) | 1.66 ±0.11 | 1.67 ± 0.12 |
| Weight (Kg) | 65.4 ± 8.8 | 64.4 ± 11.5 |
| Body Mass Index (BMI) | 23.52 ± 3.20 | 23.80 ± 3.37 |
| Body surface area($m^2$) | 1.71 ± 0.06 | 1.74 ± 0.14 |

* S.D. = Standard Deviation

Table 1: Physical Characteristics of Smokers and Non-Smokers.

The pattern of tobacco smoking is shown in Table 2. In the present study bidi smoking was most common (62.0%), followed by both cigarette and bidi smoking (24.0%) and only cigarette smoking (14.0%) in smokers.

| Type of smoking | No. | % |
|---|---|---|
| Only Bidi | 31 | 62.0 |
| Both cigarette/ bidi | 12 | 24.0 |
| Only Cigarette | 7 | 14.0 |
| Total | 50 | 100.0 |

Table 2: Type of Tobacco Smoking in Smokers.

| Grade of smoker | Number of smokers | Percentage (%) |
|---|---|---|
| Light smoker | 27 | 42.0 |
| Moderate smoker | 15 | 32.0 |
| Heavy smoker | 8 | 26.0 |
| Total | 50 | 100.0 |

Table 3: Distribution of Grade of Smoking in Smokers.

The distribution of grade of smoking is shown in Table 3. Light smokers were commonest (42.0%), followed by moderate (32.0%) and heavy smokers (26.0%).

Most of the smokers were in the age group of 41-50 years (44.0%). Majority of light smokers (51.85%) were in the age group 41-50 years, moderate smokers (46.66%) in 51-60 years and heavy smokers (75.0%) in 51-60 years(Table 4).

The mean values of all the pulmonary function tests are significantly reduced in smokers compared to non smokers. The association of impaired PFTs in smokers was found to be statistically highly significant by applying unpaired t test of significance (Table 5).

In the present study obstructive pulmonary changes were most common in smokers (36.0%), followed by mixed (4.0%) and restrictive (2.0%) changes. Most of the non smokers (96.0%) had normal PFT results.

| Age group (years) | Light Smoker No. (%) | Moderate smoker No. (%) | Heavy smoker No. (%) | Total No. (%) |
|---|---|---|---|---|
| 31-40 | 7 (25.92) | 2 (13.33) | 0 (0.0) | 9 (18.0) |
| 41-50 | 14 (51.85) | 6 (40.0) | 2 (25.0) | 22 (44.0) |
| 51-60 | 6 (22.22) | 7 (46.66) | 6 (75.0) | 19 (38.0) |
| Total | 27 (54.0) | 15 (30.0) | 8 (16.0) | 50 (100.0) |

Table 4: Age Wise Distribution of Grade of Smoking.

| Pulmonary Function Tests (PFTs) | Smokers Mean ± 2 S.D | Non-smokers Mean ± 2 S.D** | Significance* p value |
|---|---|---|---|
| FVC | 2.98 ± 1.06 | 3.13 ± 0.98 | 0.03242 (S) |
| $FEV_1$ | 2.48 ± 1.02 | 2.81 ± 0.86 | 0.000692 ( HS) |
| $FEV_1$/FVC | 83.93 ± 23.98 | 89.49 ± 10.54 | 0.003808 (HS) |
| PEFR | 5.30 ± 3.46 | 6.80 ± 3.44 | 0.000034 (HS) |
| $FEF_{25-75\%}$ | 2.99 ± 2.02 | 3.59 ± 1.74 | 0.00196 (HS) |
| MVV | 86.1 ± 44.22 | 103.6 ± 33.66 | 0.00002 (HS) |

*Significance has been calculated by unpaired t test

Table 5: Pulmonary Function Tests among Smokers and Non-Smokers.

| PFT **Results** | **Smokers No. (%)** | **Non-smokers No. (%)** | **Total No. (%)** |
|---|---|---|---|
| Obstructive | 18 (36.0) | 2 (4.0) | 20 (20.0) |
| Restrictive | 1 (2.0) | 0 (0.0) | 1 (1.0) |
| Mixed | 2 (4.0) | 0 (0.0) | 2 (2.0) |
| Normal | 29 (58.0) | 48 (96.0) | 77 (77.0) |
| Total | 50 | 50 | 100 |

Table 6: Interpretation of PFT results in smokers and non-smokers.

Chi square value = 20.84, so $p < 0.001$, highly significant. (Odds' ratio = 17.3)

The relation of type of smoking with pulmonary function tests is shown in table 7. In the present study, bidi smoking was most common (62.0%) and it accounted for most of the obstructive lung changes (72.22%) in smokers after spirometry.

## Discussion:

There was no significant difference in the mean physical parameters like age, height, weight, body mass index and body surface area by calculating mean and standard deviation in smokers and non-smokers thereby showing proper matching of smokers and non-smokers (Table 1). Most of the smokers smoked only bidi (62.0%) followed by both cigarette and bidi mixed (24.0%) and only cigarettes (14.0%). None of individuals smoked tobacco in any form other than bidis or cigarettes.

Most cigarette smokers usually smoked non-filter cigarettes since they are cheap and easily available in rural areas.

Also, most smokers belonged to rural background and were of low socio-economic status.

A smoker was considered as "deep inhaler" if he drew in the cigarette/bidi with prolonged inspiration, and exhaled through mouth or nose, otherwise he was considered as "puffers". In the present study all the smokers were deep inhalers .

To evaluate dose and duration response relationship, quantification of tobacco smoking was performed by calculating smoking index for smokers.

The smokers were classified into light, moderate and heavy smokers as per the criteria of smoking index.

As per the criteria of smoking index, it was observed that most smokers were light smokers (42.0%) followed by moderate smokers (32.0%) and heavy smokers (26.0%).

Majority of the light smokers were in the age group of 41-50 years (51.85%), moderate smokers in 51-60 years (46.66%) and heavy smokers, 51-60 years (75.0%). Similarly, Burrows et al[12] reported that there is quantitative significant relationship between impaired ventilatory function and duration and frequency of smoking.

All Pulmonary function parameters like FVC, FEV1, $FEV_1/FVC$, PEFR, $FEF_{25-75\%}$ and MVV showed

| **Type of smoking** | **Pulmonary Function test interpretation** | | | | **Total** |
|---|---|---|---|---|---|
| | **Obstructive** | **Restrictive** | **Mixed** | **Normal** | |
| Only Bidi | 13(72.22) | 0(0.0) | 2(100.0) | 16(55.17) | 31(62.0) |
| Both cigarette/ bidi | 4 (22.22) | 1(100.0) | 0 (0.0) | 7 (24.13) | 12 (24.0) |
| Only Cigarette | 1 (5.55) | 0 (0.0) | 0 (0.0) | 6 (20.68) | 7(14.0) |
| Total | 18 | 1 | 2 | 29 | 50 |

Table 7: Relation of Type of smoking with Pulmonary Function tests

statistically highly significant association between smokers and non-smokers by applying unpaired t-test of significance ($p < 0.001$). Similar, observations showing lung function impairment in smokers were reported by Burrows et al[12], Pandya et al[13], Dhand et al[14], Gosavi et al[15] and Gupta et al[16]. However, several researchers like Angelo[17], Malo[18] and Indian workers Gupta et al[19] and Mahajan et al[20] observed that there was no change in FVC in smokers and non-smokers.

In the present study out of total 100 study subjects 77 (77.0%) had normal lung functions, whereas 23 (23.0%) had impaired lung functions, out of which 21 (91.3 %) were smokers and only 2 (8.7%) were non-smokers. The association between smoking and impaired PFT was statistically highly significant. The smokers had 17.3 times more risk of having impaired pulmonary functions as compared to non-smokers.

The fall in $FEV_1$, PEFR and other flow rates indicate obstructive lung changes and fall in FVC indicates restrictive lung changes. In the present study, obstructive lung dysfunction was commonest among those with impaired pulmonary functions in both smokers (18 out of 21 i.e. in 85.71%) and non-smokers group (2 out of 2 subjects i.e. in 100.0%). The obstructive lung changes were most common and were observed predominantly in only bidi smokers (72.22%), followed by in both cigarette and bidi smokers (22.22%) and only cigarette smokers (5.55%). Padmavathy[21] in a study concluded that pulmonary functions are more affected in bidi smokers than in cigarette smokers .

## Conclusions:

Tobacco smoking in any form, bidi or cigarette or both, has significantly deleterious effects on the pulmonary functions. In this rural study area, bidi smoking was most common. Almost all the pulmonary function parameters were significantly reduced in smokers and obstructive pulmonary impairment was commonest.

## Acknowledgement:

This study could not have been possible without the support and guidance from the Department of Physiology, RMC and College of Physiotherapy, PIMS. I would also like to acknowledge the constant support and encouragement from Dr. Y.V. Sharma, Principal RMC and Dr. K.S. Soodan, Ex-Principal RMC.

## References:

1. Bulletin of the WHO, International Journal of Public Health, June 2006, Vol. 2006 ; 84(6) : 495.
2. WHO Report: Tobacco Could Kill One Billion by 2100, Science Daily; Aug 2008; 24: 71.
3. Yach D. Partnering for better lung health: Improving tobacco and tuberculosis control. Int J Tuberc Lung Dis 2000; 4: 693-7.
4. Yu JJ, Shopland DR. Cigarette smoking behavior and consumption characteristics for the Asia-Pacific region. World Smoking Health 1989; 14: 7-9.
5. Anonymous. IUALTD: The world tobacco situation. IUALTD News Bull Tobacco Health 1998; 11: 19-21.
6. World Health Organisation. Health Situation in the South East Asia region 1999; 12: 83.
7. Pakhale SS, Jayant K, Bhide SV. Chemical analysis of smoke of Indian cigarettes, bidis and other indigenous forms of smoking, levels of phenol, hydrogen cyanide and benzopyrene. Indian J Chest Dis Allied Sci 1990; 32: 75-81.
8. WHO; World tobacco epidemic; 1993; 2nd Edition; p-47.
9. World Health Organization. Guidelines for controlling and monitoring the tobacco epidemic. WHO, Geneva, 1998; 76-101.
10. S.K. Gupta; Respiratory disorders among workers in a railway workshop; Ind. J Tub., 1995, 42, 161.

11. Sanjay P. Zodpey and Suresh N. Ughade. Tobacco Smoking and Risk of Age-related Cataract in Men..Regional Health Forum; WHO South-East Asia Region; September 2006; Vol. 3 ; 336-46
12. Burrows B, Khudson R.J, Martha Jeline, Lebowitz M.D. Quantitative relationship between cigarette smoking and ventilatory function. Amer. Review. Resp. Dis. 1977; Vol. 115, 195-205.
13. Pandya KD, Dadhani AC, Chandwani S. Effect of physical trainings, age, sex, posture and smoking on peak flow rates; Indian. J. Physiol & Pharmacol 1984; 28: 3, 38.
14. Dhand R, Malik SK Sharma PK: Long term effects of tobacco smoking: Results of spirometric study in 300 old men. Ind. J. Chest Dis. And Allied Sci. 1985; Vol. 27: 44-49.
15. Gosavi G.R., Pisolkar R.M., Deshkar BV. Forced vital capacity in smokers and non-smokers. Journal of Indian medical association. 1981; Vol. 77; 12; 189-191.
16. Gupta P, Dhir VS, Sharma K. Cardiorespiratory function in healthy smokers and non-smokers. Ind. Jr. Physio. And Pharm. 1984; Vol. 28:5-30.
17. Angelo MT, Silva D, Paul Hamosh. Effect of smoking cigarettes on small airways. Jour. Appl. Physio. 1973; Vol. 34; 3: 361-365.
18. Malo JL and Leblanc P. Functional abnormalities in young asymptomatic smokers with special references to flow volume curves. Amer. Rev. Resp. Dis. 1975; Vol. 3; 623-629.
19. Gupta S and Tandon VR.: Acute effects of cigarette smoking; Jour. Asso. Physio. Of India. 1977; 25: 119-121.
20. Mahajan BK, Raghunandan V, Maini BK, Mahajan SK. Effect of cigarette smoking smoking on airways. 1983; 27:1-37.
21. Padmavathy KM. Comparative study of pulmonary function variables in relation to type of smoking. Indian J Physiol Pharmacol; 2008; 52 (2): 193-196.

## MEDICAL HUMOR

1. What is a double blind study?

   A Dermatologist & an Orthopaedic Surgeon reading an Electrocardiogram.

   And what's a single blind study?

   A Cardiologist reading an Electroencephalogram (EEG).

2. A patient was rushed to a Psychiatrist by relatives as he was telling everyone that he is God.

   After patient quietly settled on the bed, Psychiatrist asked the patient, I am not well versed with your problem, so please start from the very beginning.

   Of course said the patient standing & beaming, "I first created Earth & Heavens".