A comparative Study of Lung Function Tests in Smokers and Non-smokers in Rural Maharashtra

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ABSTRACT

Background: 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.

Objective: To study the pulmonary function tests among smoker and non-smoker population in a rural area.

Methods & Results: 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.

Conclusion: Pulmonary function parameters are reduced in smokers as compared to non-smokers in rural Uttar Pradesh. *J Med Sci* 2009;12(2):37-40

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

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chronic bronchitis, emphysema, and bronchial carcinoma.⁸

Material 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 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 were used as below:

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 the 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}

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 is asked to sit comfortably in a chair. The complete procedure is explained. Subject is 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 is recorded and interpreted.

Results

In the present study, it was observed that there was no significant difference in the mean physical parameters like age, height, weight, body mass index and body surface area in smokers and non-smokers.

In the present study, most of the smokers smoked only bidi (62.0%) followed by both cigarette and bidi mixed (24.0%) and only cigarettes (14.0%).

Most (42%) smokers were light smokers (42.0%) followed by moderate smokers (32.0%) and heavy smokers (26.0%) based on the criteria of smoking index. Table 4

Table 1: Physical characteristics of smokers and non-smokers

Variables	Smokers Mean $\pm$ 2 SD	Nonsmokers mean $\pm$ 2 SD
Age (years)	48.26 $\pm$ 10.09	48.10 $\pm$ 10.54
Height (m)	1.66 $\pm$ 0.11	1.67 $\pm$ 0.12
Weight (Kg)	65.4 $\pm$ 8.8	64.4 $\pm$ 11.5
Body Mass Index (BMI)	23.52 $\pm$ 3.20	23.80 $\pm$ 3.37
Body surface area(m ²)	1.71 $\pm$ 0.06	1.74 $\pm$ 0.14

S.D. = Standard deviation

Table 2: Type of tobacco smoking 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

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

Table 3: Distribution of grade of smoking in smokers

Grade of smoker	No. of smokers	Percentage (%)
Light smoker	27	42.0
Moderate smoker	15	32.0
Heavy smoker	8	26.0
Total	50	100.0

depicts the age wise distribution of the grade of smoking.

All pulmonary function parameters like FVC, FEV₁, FEV₁/FVC, PEFR, A FEF_{25-75%} and MVV (Table 5) showed highly significant difference between smokers and non-smokers with values observed amongst 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

Table 4: Age-wise distribution of grade of smoking

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-5: Pulmonary function tests among smokers and non-smokers

Pulmonary function tests(PFT's)	Smokers Mean $\pm$ 2 SD	Non-smokers Mean $\pm$ 2 SD	Significance* p-value
FVC	2.98 $\pm$ 1.06	3.13 $\pm$ 0.98	0.03242 (S)
FEV ₁	2.48 $\pm$ 1.02	2.81 $\pm$ 0.86	0.000692 (HS)
FEV ₁ /FVC	83.93 $\pm$ 23.98	89.49 $\pm$ 10.54	0.003808 (HS)
PEFR	5.30 $\pm$ 3.46	6.80 $\pm$ 3.44	0.000034 (HS)
FEF _{25-75%}	2.99 $\pm$ 2.02	3.59 $\pm$ 1.74	0.00196 (HS)
MVV	86.1 $\pm$ 44.22	103.6 $\pm$ 33.66	0.00002 (HS)

*Significance has been calculated by unpaired t-test

smokers and only 2 (8.7%) were non-smokers. The association between smoking and impaired PFT was statistically highly significant. Chi square value = 20.84, so $p < 0.001$, highly significant. (Odds' ratio = 17.3). Thus smokers had 17.3 times more risk of having impaired pulmonary functions as compared to non-smokers.

Obstructive lung changes were the commonest 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%), (Table 7).

Table-6: Interpretation of PFT results in 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-7: Relation of type of smoking with pulmonary function tests

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

Discussion

In the present study Pulmonary function parameters showed 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 Angelo¹⁷, Malo¹⁸ 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 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. Similarly, Burrows *et al*¹² reported that there is quantitative significant relationship between impaired ventilatory function and duration and frequency of smoking.

The fall in FEV₁, PEFR and other flow rates indicate obstructive lung changes and fall in FVC indicates restrictive lung changes. Padmavathy²¹ in a study concluded that the pulmonary function tests 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.

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