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Research Article

COMPARISON OF THE EFFECTS OF VARIOUS MODES OF SMOKING ON THE PULMONARY FUNCTIONS IN HEALTHY VOLUNTEERS

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ABSTRACT

Objectives: Smoking is common in our society and day by day number of smokers are increasing. Smoking causes serious health hazards such as respiratory diseases, lung, and oral cancers.

Methods: This cross-sectional study involved 60 smokers of age 18-45 years and 60 age-matched non-smokers who were otherwise healthy as controls. The smokers were subgrouped into cigarettes smokers (n=30) and beedi smokers (n=30). Pulmonary function parameters such as forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV percentage (FEV1/FVC), peak expiratory flow rate (PEFR), forced expiratory flow (25-75%) and maximum voluntary ventilation were measured for all the participants using computerized spirometer.

Results: All the above pulmonary function parameters were significantly reduced ($p<0.05$) in smokers when compared to non-smokers. When compared with cigarette smokers, beedi smokers have a more significant reduction in pulmonary function.

Conclusion: Smokers have reduced lung functions when compared to non-smokers. Beedi smokers were more affected when compared to cigarette smokers and obstructive pulmonary impairment was the most common.

Keywords: Smokers, Pulmonary function tests, Cigarette, Beedi

INTRODUCTION

Smoking is a common habit, particularly younger people get addicted to smoking. Smoking has numerous health hazards on the respiratory, cardiovascular, gastrointestinal and immune systems. Various forms of tobacco smoking are practised in India, including chillum (clay pipe), chutta (reverse smoking) and hukku (hubble-bubble) with cigarette and Beedi smoking being the commonest [1]. They contain tobacco and harmful chemicals which are deleterious to our wellness.

Smokers usually take up the habit of smoking in adolescence for psychosocial reasons, and they are regularly addicted to smoking because of nicotine. It acts as a major part in persistence, conferring some advantage to the smoker's mood.

Tobacco smoke contains more than 4000 chemicals and around 40 carcinogens including nicotine, tar, carbon monoxide (CO), methoprene, propylene glycol, benzopyrene, butane, cadmium, acetone, ammonia, lead, benzene, formaldehyde, etc. [2]. This type of smoke contains smaller particles which get deposited deep in the lungs. Smoking is well known as the most important causative factor for chronic obstructive pulmonary diseases and bronchogenic carcinoma, emphysema, and other respiratory diseases.

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 globe in the 21st century. By the early 2030, tobacco-related death would increase to about 10 million a year [3].

Cigarette smoking is more common among the higher income groups while beedi smoking is the main form of smoking among the lower and middle-income group of people and there is a common belief that beedi smoking is less harmful than cigarette smoking. Beedis are made from sun-cured tobacco rolled in tendu leaf wrapper and do not have filters. So in this study, we aimed to compare the pulmonary functions of smokers with various modes of smoking with non-smokers.

METHODS

The present cross-sectional study was conducted in Department of Physiology, SRM medical College Hospital and Research centre Kattankulathur, Kancheepuram district Tamil Nadu. In this study we included 120 male subjects comprising of 60 smokers (Group 1) and 60 non-smoker controls (Group 2) of age 18-45 years. Group 1 - Smokers were further subgrouped into cigarette smokers (n=30) and beedi smokers (n=30). Considering the low prevalence of tobacco smoking and its non-reporting by female smokers, females were excluded in this study.

Individuals with a history of smoking cigarettes/beedis daily for at least 1-year were considered as smokers. The smokers were selected voluntarily from amongst our hospital employees, patients coming to outpatient department of SRM Hospital for non-respiratory ailments, and from residents living in and around the hospital premises. Ex-smokers or past smokers and those with respiratory diseases were excluded from the study. None of the individuals in Group 1 consumed tobacco in any form other than beedis or cigarettes. In this study, a detailed record of smoking with reference to the duration of smoking (in years) and number of cigarettes/beedi's smoked per day was taken.

Informed written consent of the subjects was obtained and Institutional Ethical Committee clearance was obtained. The pulmonary function of all the subjects was analyzed using the computerized spirometer "EASYONE PRO" in the research lab in the Department of Physiology. The subject was asked to sit comfortably

in a chair. The complete procedure was explained. The subject was instructed to breathe in fully by deep inspiration with nostrils closed and seal the lips around the sterile mouthpiece of the spirometer and forcefully expire the air out, as fast and as far as possible. Best of three readings was recorded and interpreted. Parameters recorded were forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), peak expiratory flow rate (PEFR), FEV1/FVC, FER 25-75% and maximum voluntary ventilation (MVV). The data were analyzed using SPSS software by applying unpaired t-test. $p<0.05$ was considered as significant.

RESULTS

In this study, there was no significant difference in the mean physical parameters like age, height, weight, and body mass index thereby showing proper matching of smokers and non-smokers (Table 1).

Pulmonary function parameters such as FVC, FEV1, PEFR, FEV1/FVC, FER 25-75%, MVV show a highly substantial decrease in smokers compared to the non-smokers (Table 2).

All parameters like FEV1, FVC, PEFR, FEV1/FVC, forced expiratory flow (FEF) 25-75%, MVV parameters show a significant reduction in beedi smokers when compared with cigarette smoker (Table 3).

The interpretation of the pulmonary function tests (PFT) (Table 4) shows that out of 30 cigarette smokers, 13.2% had obstructive diseases and 3.3% had restrictive diseases and 3.3% had mixed pulmonary impairment. Among the beedi smokers 39.6% were affected by obstructive diseases, 6.6% had a restrictive impairment and 3.3% had mixed pulmonary impairment.

DISSCUSION

In this study, there was no significant difference in the mean physical parameters like age, height, weight, and body mass index between the different groups thereby showing proper matching of smokers and non-smokers (Table 1). PFT analysis shows that smoking causes pulmonary functional impairments among smokers. The values of FVC, FEV1, PEFR, FEV1/FVC, FEF 25-75% and MVV show a significant reduction in smokers compared with the non-smokers (Table 2). Also in the previous studies by Padmavathy [4] and Bano *et al*. [5] and other similar studies [6-8] the above parameters were significantly reduced in smokers than the non-smokers.

We also compared the pulmonary function parameters among smokers with various modes of smoking like cigarette smokers and beedi smokers. In our study cigarette smokers used both filter and non-filter cigarettes and depending upon their economic condition. The parameters like FVC, FEV1, PEFR, FEV1/FVC, FER 25-75%, MVV show significant reduction in beedi smokers compared with cigarette smokers (Table 3) which is in congruence with the findings of Chhabra *et al*. [1]. This may be due to the fact that beedis are relatively low in combustibility and the non-porous nature of the tendu leaves requires more frequent and deeper puffs by the smoker to keep beedis lit and is, therefore,, more harmful to the smoker's lungs [9]. There is an excess of CO, tar and other toxic constituents present in the smoke of the beedi than that of cigarette [10]. One study found that beedis produced approximately three times the amount of CO, more of steam volatile phenol, hydrogen cyanide, and benzopyrene along with higher level of particulate matter and nicotine approximately five times the amount of tar as cigarettes [11].

In our study, we found that smoking causes both obstructive and restrictive pulmonary impairment as shown in Table 4 and obstructive diseases are more common in beedi smokers.

In the smokers inflammation leads to permanent changes in the lung. The walls of the airways thicken and more mucus is produced. Damage to the walls of the air sacs in the lungs causes emphysema, and the lungs lose their normal elasticity. The smaller airways also become narrowed. Usually, airways are surrounded by smooth muscle, which contains adrenergic and cholinergic receptors. Stimulation of β_2-adrenergic receptors by circulating catecholamines dilates airways, whereas stimulation of airway irritant receptors constricts airways through a cholinergic mechanism via the vagus nerve. These changes cause the symptoms of breathlessness, cough and phlegm associated with chronic obstructive pulmonary diseases.

Table 1: Comparison of physical characteristics of smokers and non-smokers

Characteristics	Age	Height	Weight	BMI
Smokers (n=60)	34.7±10.9	164.8±6.8	65.3±12.7	24.1±3.9
Non-smokers (n=60)	33.7±6.8	164.1±6.4	65.3±13.9	24.2±4.2
p value	0.599	0.641	0.992	0.931

p>0.05; not significant. BMI: Body mass index

Table 2: Comparison of pulmonary function parameters between smokers and non-smokers

PFT parameters	Mean±SD		p value
	Smokers	Non-smokers	
FVC (L)	2.92±0.70	3.28±0.58	0.014*
FEV1 (L)	2.33±0.59	2.91±0.52	0.0001**
PEF (L/S)	5.33±1.77	6.64±1.44	0.001**
FEV1/FVC %	77.19±11.95	89.17±5.22	0.0001**
FEF 25-75% (L/S)	2.48±1.14	3.57±0.74	0.0001**
MVV (L/minutes)	79.55±14.66	110.6±15.25	0.0001**

PFT: Pulmonary function test, FVC: Forced vital capacity, FEV1: Forced expiratory volume in 1 second, PEFR: Peak expiratory flow rate, FEF: Forced expiratory flow 25-75, MVV: Maximal voluntary ventilation, *p<0.05; significant, **p<0.001; highly significant. SD: Standard deviation

Table 3: Comparison of pulmonary function parameters between cigarette smokers and beedi smokers

PFT parameters	Mean±SD		p value
	Cigarette smokers	Beedi smokers	
FVC (L)	3.24±0.53	2.60±0.73	0.003*
FEV1 (L)	2.66±0.45	2.01±0.55	0.000**
PEF (L/second)	6.19±1.69	4.76±1.73	0.011*
FEV1/FVC %	80.55±9.55	72.02±11.97	0.017*
FEF 25-75% (L/second)	2.98±1.11	1.98±0.95	0.004*
MVV (L/minutes)	85.6±17.65	73.45±7.21	0.007*

*p<0.05; significant, **p<0.001; highly significant. PFT: Pulmonary function test, FVC: Forced vital capacity, FEV1: Forced expiratory volume in 1 second, PEFR: Peak expiratory flow rate, FEF: Forced expiratory flow 25-75, MVV: Maximal voluntary ventilation, SD: Standard deviation

Table 4: Type of pulmonary impairment in smokers

Smokers	Obstructive	Restrictive	Mixed
Cigarette smokers	4 (13.2)	1 (3.3)	1 (3.3)
Beedi smokers	12 (39.6)	2 (6.6)	1 (3.3)

CONCLUSION

Our study concludes that smoking in any form, beedi or cigarette affects the pulmonary functions. Nearly all the pulmonary function parameters were significantly reduced in smokers than the non-smokers and obstructive pulmonary impairment was the most common. The pulmonary functions were more affected in beedi smokers than in cigarette smokers.

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