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Original Article

Correlation of Smoking Index with Mid-expiratory Flow Rate in Tobacco Smokers

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ABSTRACT

Background and Aim: Tobacco smoking was injurious to health, lung function and cause for many diseases has been known to mankind since decades. Access, peer pleasure, and various causes lead to addiction to tobacco smoking, and leads to a morbid lifestyle in later life. The aim of the study was to find out the harmful impact of the tobacco smoke on lung health by comparing the effect of the exposure of tobacco smoke on the mid-expiratory lung function indices (MEF75, MEF50, and MEF25). **Materials and Methods:** The study was carried out on 80 subjects between the age group of 18 - 45 years, and were divided into two groups with 40 subjects in tobacco smokers' and 40 subjects as controls, and PFT indices were obtained before and after giving bronchodilator. Smoking index was calculated. **Results:** Predicted MEF25 and MEF75 were significantly decreased in tobacco smokers compared to control group. Predicted MEFR was significantly correlated with smoking index. **Conclusion:** Mid-Expiratory flow rate 25-75% was reduced in chronic smokers. The rate of reduction in MEFR 25-75% is proportional to the number of years the person been smoking.

Key words: Pulmonary function test, Mid-expiratory flow rate, Smoking index, Tobacco smokers, Adult males.

INTRODUCTION

Tobacco, obtained from fresh leaves of plant *Nicotiana tabacum*[1] with high concentrations of nicotine, harvested and processed for slow oxidation and degradation of carotenoids.[2] Then, tobacco smoke becomes palatable and enhances the addictive potency. Cigarettes are made from finely cut and reconstituted tobacco, with additives rolled to a paper-wrapped cylinder and are ignited, inhaled through an acetate filter.[3] Smoking is a major addiction in this current generation, also with widespread criticism; its use is on the rise.[4] The tobacco smoke is an aerosol produced by the incomplete combustion of tobacco leaves. With evolution, the form of smoking attains different shape.

In our country, tobacco is consumed in the form of bidis (54%), smokeless tobacco (27%), and cigarettes (9%). Recent major form of smoking is cigarette smoking with tobacco as its content.[5] The number of packs smoked per day has a significant effect on pulmonary functions. The ill effects explained by different governments all over the world prevented a rise in tobacco smoking but it's apt to say its use is on a plateau with youngsters at rise.[6] Among the younger generation cigarette smoking is the initial step to lure them into different type of addictions because, cigarettes are easily available than any other abuse products. Around 1980s, death due to tobacco was 6.3 lakhs per year.[7] Current estimates have increased to 8 to 9 lakhs per year with no signs of decline. An alarming attribute being an increasing incidence of oral cancers[8] among men and women, due to its easy availability of different smoking and non-smoking forms of tobacco. Cardiovascular ailments in people younger than 40 years are contributed by smoking. Each passing year 4.5 million smokers suffer from heart ailments and 3.9 million people from respiratory diseases in our country. Almost all these morbidities are preventable.[9]

The exposure to harmful toxins is directly proportional to the damage of lung parenchyma.[10] An obstructive pattern can be identified with an early pulmonary function tests. One important parameter is mid-expiratory flow rate (MEFR - MEF75, MEF50, and MEF25) which identifies the obstruction of the smaller airways like bronchioles at earliest.[11] Mid-expiratory flow rate (25-75%) is the average forced flow rate over the middle 50% of the forced vital capacity (FVC). A reduction in MEF 25-75% of less than 60% and FEV1/FVC reduced may confirm airway obstruction. MEF 25-75 represents the forced expiratory flow between 25% and 75% of vital capacity and indicates the small airway patency. The obstruction in the airflow is primarily due to the abnormalities in the airways less than 2mm in internal diameter. The importance of this parameter lies in its ability to detect the obstruction of airways which can be reversed with complete abstinence from smoking. We took asymptomatic smokers and compared their smoking index with non-smokers and analyzed the MEFR.

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MATERIALS AND METHODS

The study was conducted in department of Physiology in collaboration with department of Respiratory Medicine, Bhagat Phool Singh Government Medical College for Women and associated hospital, Khanpur Kalan, Sonepat. The study was carried out on 80 subjects between the age group of 18 - 45 years, and were divided into two groups with 40 subjects in tobacco smokers' and 40 subjects as controls, and PFT indices were obtained before and after giving bronchodilator and others who were not willing and having end stage disease were excluded. After getting approval from the institutional ethics committee, patients were recruited after obtaining written informed consent. Parameters such as age, sex, height, weight, body mass index, blood pressure, pulse rate, temperature, and pulmonary function test (PFT) indices were obtained.

Smoking index was calculated by the average number of cigarettes/bidis smoked per day multiplied by the number of years the person has been smoking.[12]

Statistical Analysis of Data

Percentage analysis was used for categorical variables and the mean and standard deviation was used for continuous variables. To find the significant difference between the two independent groups, unpaired sample *t* test was used. For the multivariate analysis, the Krusal Wallis was used. P value < 0.05 was considered as statistically significant. Statistical analysis was carried out by using Microsoft excel and standard statistical software (IBM Statistical Package for the Social Sciences (SPSS), Statistics for Windows, Version 20.0. Armonk, NY: USA)

RESULTS

Anthropometric indices such as age, height, weight and body mass index were not statistically significant between tobacco smokers and control group (Table 1).

The predicted MEF75 in tobacco smokers' and in controls were 7.77 ± 0.46 and 7.81 ± 0.92 respectively. On comparison, no significant difference was found. The predicted percentage of post bronchodilator MEF75 in tobacco smokers and control group were 109.92 ± 27.62 and 102.27 ± 13.81 respectively. On comparison between them, no significant difference was found (Table 2).

Table 1: Comparison of age, height, weight, body mass index among tobacco smokers and controls.

Sl. No.	Parameters	Cases	Controls	P value
1	Age (years)	37.95 ± 7.58	35.81 ± 7.84	0.2183
2	Height (cm)	165.43 ± 6.01	168.91 ± 5.78	0.171
3	Weight (kg)	58.06 ± 11.79	60.70 ± 10.22	0.287
4	BMI (kg/m^2)	20.90 ± 3.68	22.01 ± 3.39	0.165

Data was expressed as mean±SD. P<0.05 was considered as statistically significant. BMI: Body mass index.

Table 2: Comparison of predicted MEF75 and predicted MEF75% (post bronchodilator) among tobacco smokers and controls.

Sl.No.	Parameters	Cases	Controls	P value
1	Predicted MEF75 (l/s)	7.77 ± 0.46	7.81 ± 0.92	0.806
2	Predicted MEF75% (post-bronchodilator)	109.92 ± 27.62	102.27 ± 13.81	0.121

Data was expressed as mean±SD. P<0.05 was considered as statistically significant. MEF: Mid-expiratory flow

The predicted MEF50 in tobacco smokers and in control group were 4.84 ± 0.40 and 4.33 ± 0.44 respectively. On comparison between them, statistically significant difference was found. The predicted percentage of post bronchodilator MEF50 in tobacco smokers and control group were 112.92 ± 27.92 and 107.18 ± 13.29 respectively. On comparison between them, no significant difference was found (Table 3). The predicted MEF25 in tobacco smokers and in control group were 2.08 ± 0.27 and 1.96 ± 0.43 respectively. On comparison between them, no significant difference was found (Table 3).

The predicted percentage of post bronchodilator MEF25 in tobacco smokers and control group were 114.09 ± 35.53 and 111.69 ± 23.20 respectively. On comparison between them, no significant difference was found (Table 4). Predicted MEF75, MEF50 and MEF25 showed significant correlation with smoking index (Table 5 and Figure 1).

Table 3: Comparison of predicted MEF50 and predicted MEF50% (post bronchodilator) among tobacco smokers and controls.

Sl.No.	Parameters	Cases	Controls	P value
1	Predicted MEF50 (l/s)	4.84 ± 0.40	4.33 ± 0.44	0.001
2	Predicted MEF50% (post-bronchodilator)	112.92 ± 27.92	107.18 ± 13.29	0.249

Data was expressed as mean±SD. P<0.05 was considered as statistically significant. MEF: Mid-expiratory flow

Table 4: Comparison of predicted MEF25 and predicted MEF25% (post bronchodilator) among tobacco smokers' and controls.

Sl. No.	Parameters	Cases	Controls	P value
1	Predicted MEF25 (l/s)	2.08 ± 0.27	1.96 ± 0.43	0.139
2	Predicted MEF25% (post-bronchodilator)	114.09 ± 35.53	111.69 ± 23.20	0.721

Data was expressed as mean±SD. P<0.05 was considered as statistically significant. MEF: Mid-expiratory flow

Table 5: Correlation of smoking index with the lung function parameters.

		Pred. MEF 75	Pred. MEF 50	Pred. MEF 25
Smoking Index	*r*	-0.458**	-0.567**	-0.597**
	P	0.001	0.001	0.001

P<0.05 was considered as statistically significant. MEF: Mid-expiratory flow.

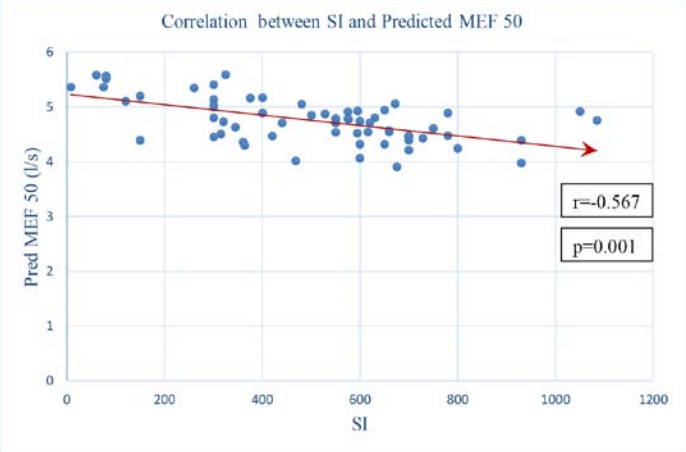

Figure 1: Correlation of smoking index with the predicted MEF50.

DISCUSSION

Tobacco smoking is one of the most preventable forms of causative agent for respiratory and cardiac related morbidity and mortality. Annual deaths due to tobacco smoking is around 7 million.[13-14] Smoking index was used to compare the effect of tobacco smoke on the lung function.[12]

In our study, we have assessed the effect of tobacco smoke on lung function indices by comparing the pre and post bronchodilator values between the cases and controls. The Mid-expiratory flow rate (MEFR) causes obstruction of airways more commonly the smaller airways. Likewise in our study, the obstruction of smaller airways is observed by a decrease in MEFR among smokers. The more alarming trend is the increase in the smoking among the teenagers.[15] Another striking point is that the smoking among rural and urban areas is narrowed with the rising awareness and availability of tobacco products to farther corner of the country.

Tobacco use was around 2.5% in urban compared to 2.6% in rural areas. According to the Government data,[16] COPD is ranking 7th in Northeastern states and 4th in rest of the states, telling the penetrance of tobacco on a widespread level. The important parameter into consideration in the evaluation of smokers is the development of the obstructive pattern noted in the smaller airways, which we found in our study.

Most of the studies conducted have a similar trend of the smoking pattern and the trend is due to the addiction pattern seen among the individuals in society. The significant parameter into consideration in the evaluation of smokers is the development of the obstructive pattern noted in the smaller airways. MEFR 25-75% was lesser in tobacco smokers implying the nature[17] of burden in the smaller airways. This frightening reduction in the MEFR among smokers that too in asymptomatic participants urges the physician to screen all patients with smoking history to undergo rigorous psychological procedures to curtail its use. The proportion of reduction is more with early smokers than with chronic smokers over the years. Different studies support our results i.e., in the reduction of flow rates in particularly MEFR is more in early stages than in the late stages.

CONCLUSION

Mid-Expiratory flow rate 25-75% was reduced in chronic smokers. The rate of reduction in MEFR 25-75% is proportional to the number of years the person been smoking. Among the parameters considered MEF 50 seems to be significantly reduced with the smoking years. Considering the major population is of youth age, smoking affects mental health as well as physical health, also the reason for major cardiovascular and respiratory related problems.

As shown in our study, the number of cigarettes and duration are being directly proportional to the reduction in the lung function parameters. The obstruction of small airways causing decrease in lung function requires more research into the mid-expiratory values to understand the pathological mechanism better. So, government as well as public has to be aware of the harmful effects of tobacco smoking and have to be vigil and alert about the conditions.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

MEFR: Mid-Expiratory Flow Rate; **FVC:** Forced Vital Capacity; **PFT:** Pulmonary Function Test.

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