Effect of Smoking on Lung Volume and Capacity

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ABSTRACT: Tobacco smoking is highly prevalent all over the world. Tobacco smoke affects almost all the systems of the body. This study aimed to see the effects of smoking on the respiratory system. For this study we selected 30 control and 30 cases and divided cases into mild, moderate and heavy smokers according to no. cigarettes they were smoking daily. Pulmonary functions tests were performed by medspior instrument in a standing posture. We found that difference between predicted value and observed actual value is increased from mild smoker to heavy smokers in all the parameters like FVC, FEV1, PEFR, FEV1/FVC ratio. It suggests that tobacco smoking starts obstructive changes in the respiratory system before the onset of respiratory symptoms. Prolonged tobacco smoking may lead to respiratory diseases like emphysema, asthma and even lung cancer.

Key words: Lung Volume and Capacity, Respiratory diseases, Smoking

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INTRODUCTION: 'SMOKING IS INJURIOUS TO HEALTH.'Is written in all the tobacco containing products[1]. Despite this tobacco smoking is widely prevalent in developed as well as developing countries, it is estimated that nearly 50% of men are dependent on some form of tobacco use[1,2]. In spite of laws, regulations and various policies to reduce the smoking, tobacco consumption in India have significantly increased during recent decades.

Social and psychological factors have been primarily suggested to be involved in initiation of smoking and physical dependence supervens[1]. Smoking has significant detrimental effects on various systems of the body amongst which it affects respiratory system first. It has been identified as the most important risk factor for Chronic Obstruction Pulmonary Disease (COPD). It has been associated with lower levels of Forced Expiratory Volume in 1 second (FEV_1) and increased respiratory symptoms and

infections, as it causes various changes in structure and functions of the lung[3].

Tobacco smoke is a mixture of more than 4000 compounds. Many constituents are known to be toxic, mutagenic or even carcinogenic. It can cause various pathophysiological effects including changes in the central and peripheral airways, alveoli and capillaries as well as in the immune system. Thus it affects the various respiratory parameters like FEV_1 and FVC. The present study was conducted to find out various respiratory parameters between smokers and non-smokers. The aim of the study is to inform about the hazards of tobacco use and to discourage its use.

MATERIAL AND METHODS: The present study was carried out in 30 healthy smokers and 30 healthy non-smokers. The control groups (non-smokers) were comparable in age, sex, economic status, socio-physical activity to study group (smokers). The inclusion and exclusion criteria were as follows:

Inclusion criteria:

- Age range: 20-40 years
- Non-smokers- Never smoked for more than 6 months in lifetime and not smoked at all in the preceding 1 year.

Exclusion criteria:

- Evidence of any chronic respiratory or cardiovascular disease (on history and physical examination).
- History of recent acute respiratory illness within the preceding 6 week.
- Any thoracic or spinal deformity or muscular deformity.
- History of any drug intake at the time of the study.
- Family history of any cardio-respiratory disease.

Procedure for taking readings: Age, height, weight, sex of each subject at room temperature was filled in. Spirometry was done in standing posture. Subject were explained and demonstrated about the procedure to be performed. They were allowed to do enough practice, as lung volumes depend on the subject's making a maximal voluntary effort.

For FVC maneuver, subjects were instructed to take maximum inspiration, nose was clipped, mouth piece was kept firmly in the mouth between lips so as to avoid escape of any air, then breath out as forcefully as, as fast as and as long as possible, and values of FVC and its component were obtained.

Observation and Results: The study was carried out in 30 healthy non smokers and 30 healthy smokers showed following

results: General examination and systemic examination of all the subjects were normal. Table 1 shows the distribution of number of control subjects and mild, moderate and heavy smokers. Table 2 shows the mean age, height, weight, pulse rate, respiratory rate, mean blood pressure in smokers and non smokers.

Table 1: Distribution of control and cases subjects

	Control	**Cases**		
N	30	30		
		Group-I (mild smokers)	Group-II (moderate smokers)	Group-III (heavy smokers)
N		10	10	10

Table 1 shows the distribution of number of subjects, the smokers group was again divided in to mild smokers (group I), moderate smokers (group II) and heavy smokers (group III).

Table -2 Distributions of age, height, weight, pulse rate, respiratory rate, mean blood pressure in control and cases.

	Mean Age (in yrs)	***Mean Height (in cms)***	***Mean Weight (in kgs)***	***Mean PR (per min)***	***Mean RR (per min)***	***MBP (mm of Hg)***
Control (n=30)	26.13±2.93	168.7±7.66	64.77±10.60	80.66±5.52	15.73±1.55	91.90±3.79
Cases (n=30)	30.93±6.83	166.37±8.89	56.2±11.98	90.3±4.24	18±2.17	97±5.11

The average duration of smoking was 7.5 years of smokers group.

- The mean age (in years) of non smokers was 26.13±2.92 and that of smokers was 30.93±6.83. The mean height (in cms) of non smokers was 168.7±7.66 and that of smokers was 166.37±8.89. The mean weight (in kg) of non smokers was 64.7±10.60 and that of smokers was 56.2±11.98.
- General examination and systemic examination of all the subjects were normal.
- Cardio-respiratory parameters of both groups were within normal range. The mean respiratory rate of non smokers was 15.7±1.55 and that of smokers was 18±2.17. The mean pulse rate of non smokers was 80.6±5.51 and that of smokers was 90.3±4.24. The mean value of MBP of non smokers was 91.90±3.79 and that of non smokers was 97±5.11. But smoker group

shows significantly higher pulse rate and mean blood pressure than control group.

Table-3 FVC in control, mild smokers, moderate smokers and heavy smokers

	Actual mean value ± SD (in L/sec)	***Predicted mean value ± SD (in L/sec)***	***% predicted ± SD***	***Difference of mean value***	***P value***
Control	3.42±0.33	3.57±0.38	96.1±6.78	0.15	0.1
Mild smokers	2.77±0.57	3.46±0.55	81.13±17.48	0.69	0.013
Moderate smokers	2.61±0.46	3.38±0.51	77.43±8.46	0.77	0.023
Heavy smokers	2.32±0.44	3.33±0.35	69.71±11.57	1.01	0.000

Table-3 shows the mean FVC recorded in control, mild smokers, moderate smokes, and heavy smokers were 3.42±0.33, 2.77±0.57, 2.61±0.46, 2.32±0.44 respectively. Non smokers group shows non significantly change in FVC value than their predicted value. Smokers group shows significantly lower value of FVC than their predicted value. But the difference of mean value of FVC is much more in heavy smokers than mild and moderate smokers.

Table-4 FEV1 in control, mild smokers, moderate smokers and heavy smokers

	Actual mean value ± SD (in L/sec)	***Predicted mean value ± SD (in L/sec)***	***% predicted ± SD***	***Difference of mean value***	***P value***
Control	2.89±0.46	3.06±0.31	94.53±12.83	0.17	0.053
Mild smokers	2.02±0.30	2.94±0.47	68.89±3.47	0.92	0.000
Moderate smokers	1.7±0.36	2.87±0.45	59.28±7.33	1.17	0.000
Heavy smokers	1.4±0.31	2.79±0.29	50.9±12.65	1.39	0.000

Table-4 shows the mean FEV1 recorded in control, mild smokers, moderate smokers and heavy smokers were 2.89±0.46, 2.02±0.30, 1.7±0.36, 1.4±0.31 respectively. Non smokers group shows non significantly change in FEV1 value than their predicted value. Smokers group shows significantly lower value of FEV1

than their predicted value. But the difference of mean value of FEV1 is much higher in heavy smokers than mild and moderate smokers.

Table-5 PEFR in control, mild smokers, moderate smokers and heavy smokers.

	Actual mean value ± SD (in L/sec)	***Predicted mean value ± SD (in L/sec)***	***% predicted ± SD***	***Difference of mean value***	***P value***
Control	9.01±1.07	9.18±0.54	98.3±11.32	0.17	0.47
Mild smokers	5.33±1.85	8.97±0.83	58.5±16.57	3.64	0.000
Moderate smokers	4.34±2.15	8.85±0.79	47.7 ±20.89	4.51	0.000
Heavy smokers	2.44±0.90	8.67±0.62	28.24±10.5	6.23	0.000

Table- 5 shows the mean PEFR recorded in control, mild smokers, moderate smokers and heavy smokers were 9.01±1.07, 5.33±1.85, 4.34±2.15, 2.44±0.90 respectively. Non smokers group shows no significantly change in PEFR value than their predicted value. Smokers group shows significantly lower value of PEFR than their predicted value. But the difference of mean value of PEFR is much higher in heavy smokers than mild and moderate smokers.

Table-6 shows mean FEV1/FVC in control; mild, moderate, heavy smokers were 84.37±9.15, 74.78±14.15, 65.08±6.86, 61.56±13.08 respectively. Non smoker group shows no significant change in FEV1/FVC than their predicted value. Smokers group shows significant lower value than their predicted value. But the difference of mean value of FEV1/FVC is much more high in heavy smokers than mild and moderate smokers.

Table-6 FEV1/FVC in control, mild smokers, moderate smokers and heavy smokers**.**

	Actual mean value ± SD (in L/sec)	***Predicted mean value ± SD (in L/sec)***	***% predicted ± SD***	***Difference of mean value***	***P value***
Control	84.37±9.15	85.8±1.08	98.37±10.91	1.43	0.395
Mild smokers	74.78±14.15	85.09±2.50	87.96±17.2	10.31	0.035
Moderate smokers	65.08±6.86	84.83±1.25	76.74±8.19	19.75	0.000
Heavy smokers	61.56±13.08	83.94±1.90	73.39±15.99	22.38	0.000

DISCUSSION: Smoking is a unique form of systemic drug administration in that entry in the circulation is through pulmonary rather than portal or systemic venous circulation[4].

Exposure to whole smoke or selected constituents like carbon monoxide and nicotine are greatest risk factors. It acts predominantly presynaptically to enhance release of specific neurotransmitters brings various effects like pleasure, arousal, relief of anxiety, reduced hunger, improved task performance. As nicotine is psychoactive, smoking started to get the pleasure and other subjective and cognitive benefits. Withdrawal symptoms of smoking like restlessness, irritability, anxiety, impatience, confusion, impaired concentration, make a desire to smoke again and thus the smoking continues. But with prolonged or repetitive exposure to nicotine, neuro adaptation occurs.

It has been suggested that certain carcinogenic nitrosamines may be formed endogenously from one or more metabolites of nicotine[5]. Cigarette smoke also contains various cilliotoxic agents, irritants, tumour accelerator substances like tar, cresol, phenol, benzo(a)pyrene etc. which are present in particulate phase of smoke. While hydrocyanic acid, acetaldehyde, acrolein, hydrazine etc. present in gas phase of smoke.

It causes alteration in central pathway like loss of cilia, mucus gland hyperplasia, pseudostratified cilliated epithelium to squamous metaplasia, carcinoma in situ and eventually invasive bronchogenic permeability, and alteration in peripheral airways like inflammation and atrophy, smooth muscle hypertrophy, peribronchiolar fibrosis. It also causes alteration in alveoli and affects immune functions too[3]. Numerous studies using various techniques have found that smoker have between 6% and 20% lower diffusing capacity that age matched non smoker[6]. Cigarette smoking has been shown to lead to accelerated decline of FEV1 in adults. In general, annual decline in FEV1 for non smokers has been estimated to be 20-30 ml/yr as shown in Table 7[3] .

Table – 7: Comparison of rates of decline in FEV^1 based on smoking status.

SMOKING STATUS	RATE OF DECLINE IN FEV1
·Never smokers	20-30 ml/yr
·Former smokers	25-50ml/yr
·Current smokers	25-80ml/yr

CONCLUSION: Smokers group shows significantly lower value of FVC, FEV1, PEFR than their predicted value. Smokers group also shows significant lower value of FEV1/FVC than their predicted value. Values of different parameters are much lower in heavy smokers than mild smokers. These data supports that the smoking induced changes are associated with the observed pulmonary dysfunction. It suggests that impairment of lung function has occurred before the disease is diagnosed.

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