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Comparison of FEF between Smokers and Non-Smokers

L.K. Sudeer Kumar

Abstract

Introduction: The value of FEF 25%-75% has been both praised and condemned. The test has been recommended by Leuallen E. et al as an early index of airway obstruction. According to Gilbert R. et al. a normal value has poor specificity. It has been suggested by Voter K.Z that obstruction in peripheral airways can be discriminated from that in larger airways by a disproportionate decrease in FEF 25%-75% compared to FEV1. *Methodology:* First, case history is taken with special emphasis on personal habits. Then secondly the physical examination including the measurement of height and weight. All the tests are done at the same time of the day to avoid possible diurnal variation. Subject is allowed to sit comfortably on the stool. Instructions are given about the tests. *Results:* Non-smokers with normal weight is having mean FEF of 71.13 with a standard deviation of 20.15 and non-smokers with over weight the mean is 74.86 and standard deviation is 18.83. *Conclusion:* The effect of smoking on FEF is more affected in overweight group of subjects than the normal weight group of subjects.

Keywords: FEF; Smoking; Overweight.

Introduction

Wide spread smoking was a major stumbling block to a successful achievement of WHO's goal of 'health for all by the year 2000'. As a cause of death, smoking out numbers alcohol, cocaine, heroin, suicide, homicide, HIV/AIDS and road traffic accidents combined on an annual basis. Each year tobacco is responsible for the death of some 3.5million people or one death every nine seconds. Unless current trends are reversed this numbers will go on increasing [1]. In 1996 it was estimated that about 8.15 million males above 30 years and 4.21 millions females above 30 years are chronic smokers. In developed countries, about 30-40% of men and 20-40% women smoke. In developing countries like India between 2-10% of women smoke. In smoking the male to female ratio is 1.5:1. Smoking is also one of the main causes of premature death. It is estimated that in future smoking related deaths will increase from 3.5 million to 10 million per year at the end of 2025. Smoking adversely affects every single organ system in the body in one way or other. It greatly increases the risk of lung cancer, other respiratory diseases, coronary heart diseases, peripheral vascular disease and ulcers. Smoking is also responsible for the low birth weight babies and premature deaths. In women lung cancer increases dramatically following adaptation to smoking. It is also demonstrated that passive smoking causes several diseases including lung cancer. The epidemiological evidence suggests that cigarette smoking is the single major factor associated with respiratory diseases. The major respiratory diseases caused by cigarette smoking are lung cancer, chronic bronchitis, emphysema, chronic obstructive pulmonary diseases and lung failure. Inhalation of tobacco smoke first cause immediate rise in airway resistance. This change is a reflex response due to the deposition of dust particles upon the epithelium of respiratory tree and in not due to tobacco smoke. But ultimately tobacco smoke causes airway obstruction by damaging mucus secreting cells, cilia, bronchial muscles, small airways and alveoli. Mucosal glands undergo hypertrophic changes with excess mucus secretion. The above changes are slow. Only a minor

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proportion of cigarette smokers show progressive deterioration, but the knowledge of natural history is insufficient to identify those individuals who are at risk. These persons can be identified only by doing Pulmonary Function Tests (PFT) [Spirometry]. This test is the simplest, easiest and most reliable test. In chronic smokers all measures of pulmonary function tests decline especially Forced Expiratory Volume in one second. (FEV1) Obesity/Over weight is another major risk factors and which adversely affect health. It affects pulmonary system by reducing the pulmonary complaints and small airway caliber (Biring M.S et al, 1997, Ray et. al, 1983 & Berger et al, 2001) and is associated with a number of pulmonary abnormalities [2,3,4].

Forced Mid Expiratory Flow Rate (FEF 25%-75%) FEF 25%-75% is the mean forced expiratory flow during the middle half of the FVC. It was formerly called the maximal mid expiratory flow rate (MMEF). It was expressed in liters/sec. Locating the points on the volume time curve corresponding to 25% and 75% of the FVC and then passing a straight line through them determine the FEF 25%-75%. The slope of this line represents the average rate of airflow over the mid portion of the FVC. Normal values Males > 2.0L/sec, Females > 1.6L/sec. The value of FEF 25%-75% has been both praised and condemned. The test has been recommended by Leuallen E. et al (1955) as an early index of airway obstruction. According to Gilbert R. et al. a normal value has poor specificity. It has been suggested by Voter K. Z that obstruction in peripheral airways can be discriminated from that in larger airways by a disproportionate decrease in FEF 25%-75% compared to FEV1. But reliability of this interpretation has been questioned, primarily because of the large variability of this measurement. Others like Birath et al (1963) and Sobol et al (1965) have found PEF 15%-75% less useful than other measurements because of poor correlation with other ventilatory measurements and wide range of normal values.

Peak Expiratory Flow Rate (PEFR) It is the maximum flow, which can be sustained for a period of 10 milliseconds during expiration from a position of full inspiration. PEFR can be measured either from an MEFV (Maximum Expiratory Flow Volume) curve or by using portable peak flow meters. PEFR is a reflection of the status of the large airways and body and chest development (Mead j et al (1967). There is a definite correlation between FEV1 and PEFR in patients with asthma and COPD who are undergoing bronchodilator therapy (Shim C 1978,Kelly C.A et al 1988) [5,6].

Methodology

At first a thorough physical examination was carried out and also make sure that patient had not taken cigarette or heavy meals at least an hour prior to the test.

Selection of Tests: When choosing tests for lung function a number of criteria should he taken into account.

1. The tests should be safe, simple and should not be inconvenient to the subjects.
2. The information, which it is intended to be obtained from a tests, should ideally be independent of both the motivation and extent of emotional participation of the subjects and personality of the operator.
3. The tests should be repeatable.
4. The tests of lung function should be appropriate to circumstances for which they are required. So the tests were selected with a view for pointing information on different aspects of function.

Procedure: First, case history is taken with special emphasis on personal habits. Then secondly the physical examination including the measurement of height and weight. All the tests are done at the same time of the day to avoid possible diurnal variation. Subject is allowed to sit comfortably on the stool. Instructions are given about the tests. A very enthusiastic demonstration by the operator is required. So that a maximum effort is made by the subject when carrying out the forced expiratory test. Subjects who has not previously examined on spirometry should have two or more practice attempts until it appears that maximum effort is being obtained. A disposable mouthpiece should be used in each subject. The mouthpiece was positioned so that the subject's chin was slightly elevated and neck extended. After the insertion of mouth piece a careful check was made to ensure that there was no air leak present. The subject was asked to make maxima! effort for each test and was closely watched to ensure that he maintained an airtight seal between the lips and the mouthpiece of the instrument. First the subject data was entered as name, age, sex, height, weight, address, occupation, addiction etc. Then the required measurement was called up from menu. Forced Vital Capacity (FVC) The subject is made comfortable and the nose clip kept in place to close the nostril to prevent air entry through the nose. Then the mouthpiece is placed in the mouth and which is connected to pneumotach. Then the

subject is asked to breach via, the mouthpiece. After a brief period of quiet normal breathing subject is asked to breathe in and completely as possible then suddenly breathe out forcefully, rapidly and completely as much as possible. The performance of the maneuver was evaluated by inspecting the graphic output of flow volume curve and the subject was reinstructed if necessary. Repeat it for 2 to 3 times. Measurement was taken from the best of the three tests.

Results

The statistical analysis in smokers in relation to body mass index showed that there is reduction of FEF in obese smokers, which denotes that there is statistically significant difference of FEF in over weight smokers.

As per the Table 1 non-smokers with normal weight is having mean FEF of 71.13 with a standard deviation of 20.15 and non-smokers with over weight the mean is 74.86 and standard deviation is 18.83. This values are tested using chi-square test and it is found that the difference actually observed does not have significance since the p value is more than 0.05. In smokers, the smokers with normal weight the mean is 54.34 and the standard deviation is 27.52. In smokers with overweight the mean is 51.75 and the standard deviation is 24.07. When this values are tested using chi-square test, it is found that there is significant difference, according to the chi-square test the P value is less than 0.05 and it shows that the effect of smoking on FEF is more affected in overweight group of subjects than the normal weight group of subjects.

Table 1: Statistical analysis of FEF

Category	Mean	Std Deviation
Non Smokers Normal Wt.	71.13	20.15
Non Smokers Over Wt.	74.86	18.83
Smokers Normal Wt.	54.34	27.52
Smokers Over Wt.	51.75	24.7

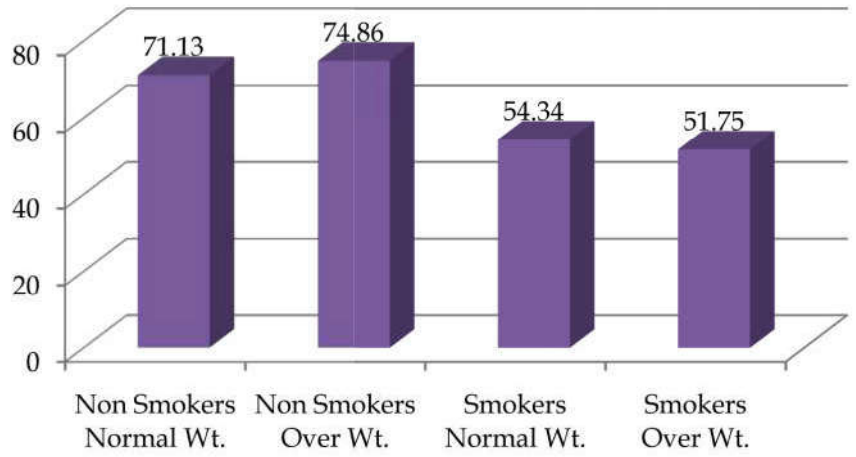

Fig. 1: Comparison of FEF

Discussion

The adverse effect of cigarette smoking on Spirometric indices have been well documented. Tobacco smoke contains a number of substances which may exert their effects upon the body; they include particles of dust which disturb the function of the airways, tar which exerts an irritant effect; pon the bronchial epithelium and nicotine which increase heart rate and elevates systemic Blood Pressure [Cotes, 1968]. Cigarette smoking affects pulmonary function soon after it is started (Seely 3.E, 1971). The inhalation of tobacco smoke causes an immediate rise in airway resistance, which persists for at least an hour. Early changes are mild and reversible following cessation of smoking or modification of smoking habits (Buist As 1976, McCarthy Ds, 1976). PFT in Smokers Cigarette smoking has been identified as a single most significant cause of preventable morbidity (McGinnis 3M 1993). One of the two continuing smokers wily die of a smoking related diseases [7]. (Thun M 3, 1995

and Boll R & Peter 1994). Half of all cigarette smokers will eventually be killed by their habit (Boll R & Peter 1994). The death may be due to Lung cancer, chronic bronchitis & emphysema, corpulmonale, ischemic heart disease and cerebero vascular accident (Royal College of Physicians, 1997). The annual excess mortality is nearly 440, 000, out of these majorities will die prematurely (Centers for control and prevention of disease, U.S, 1984). Coronary heart disease, cancer and various respiratory diseases account for the majority of excess mortality related to cigarette smoking (Center of Control and Prevention of Diseases, U.S, 1993). From cancer death 29% where from lung cancer and 83% of these death were attributed to smoking (Center for Control and Prevention, U.S., 1993 and Rock ville 1990). COPD such as chronic bronchitis and emphysema account for another percentage of death annually by smoking (Centre for Control and Preventing, 1'13) [8].

It has been estimated that an average of 7 minutes of life is lost for each cigarette smoked. This estimated in based on an average reduction in life expectancy for cigarette smokers of 6.6 years (LEW E.A 1987). Smoking one pack per day (20 cigarettes), the reduction of life in average 4.6 years (Public Health Service, Washington, 1979). Smoking was also associated with irreversible obstructive changes in the airways in some subjects (Fleature C., 1997). Cigarette smoking is usually regarded as the dominant risk factor for developing COPD (U.S. Dept of Health, 1979). Smoking related lung damage occurs as a result of inflammation and eventual scarring of the small or peripheral airways. It was suggested that smokers those who are susceptible to COPD can identified by PFT in early middle age (Burrows .B., 1991). It is by FEV1 and in smokers FEV1 declines by twice compared with non smokers (Sandrik L. et al, 1995 and Marcus E.B. et al., 1995). Cigarette smoking affects pulmonary function soon after it is started (Seely 3E. 1971). Tobacco smoke causes an immediate rise in airway resistance (Buist AS. 1976 and McCarthy D.S.,1976). Walter and Richard in 1991 proved that smoking in adolescents and early aoulthood diminishes the airway growth. Previously by Lebowitz et al. 1987 [9].

In smokers, PFT shows reduced FEVI and it is the early sign to stop smoking (Tager IB., et. al., 1988). On average, cigarette smokers have a high annual rate of decline in FEV1 of about 50 ml which 30 ml annually in nonsmokers. In some smokers, there is rapid decline in FEV1 and this may be early sign of COPD (Tager. IB. et. al., 1988). Stopping cigarette smoking does not produce a substantial improvement in FEV1, but the subsequent rate of decline in decreased (Authonisen NR et. al. 1994 and Fletcher et.al 1976) The rate of decline of FEVI can be used to assess susceptibility in cigarette smokers, progression of the disease and reversibility of the airway obstruction (ATS 1995, Siafakas NM et al 1995 and British Thoracic Society, 1997).

In some smokers PFT shows low or normal FVC. If PVC is low it is the early sign of restrictive respiratory diseases but it can be lower in other respiratory diseases also (ATS 1995 and BTS 1997). The FEV1/ FVC also decline in smokers, which is the early sign of COPD, but less sensitive than FEVI. (Brain N Legere et al., 1993) FEF 25-75% is a useful measure meant to detect airflow limitation. In smokers it fall less than 50% of predicted value. This is considered to be an indicator of small airway function, but probably provide no more clinical useful information than measurement of FEVI (ATS, 1991) Smokers show low FEF than predicted. This can be measured directly from the flow volume loop or measured with a hand-held peak flow meter. This is an inferior measurement of airway obstruction compared to FEVI (Detels R., et al., 1982) The pulmonary function values of the smokers found lower than those of the non smokers such as VC, IRV, IC, FVC, FEVI, MMEF, PEF, FEF, FEV 25- 75% and MW. FEVI, PEF are sensitive indicator of large way resistance and WIEF, FEF and FEF 25-75% are sensitive indicator of small airway resistance [10]. The ventilatory function tests carried out in smokers showed there is significant lowering of the following parameters VC, IRV, IC, FVC, FEV, FEF, PEF, MMEF, FEF 25-75% and MW. This showed there is definite tendency to narrowing of both the large and small airways.

Conclusion

The statistical analysis in smokers in relation to body mass index showed that there is reduction of FEF in obese smokers, which denotes that there is statistically significant difference of FEF in over weight smokers.

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Original Research Paper

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FVC in Smokers in Relation to BMI: A Comparative Study with Non Smokers

L.K. Sudeer Kumar

Abstract

Introduction: Forced vital capacity (FVC) is the maximum volume of air that can be expired, when a subject tries as forcefully and rapidly as possible, after a maximal inspiration to total lung capacity. A maneuver performed similarly beginning at residual volume and inspiring as forcefully as possible is called forced inspiratory vital capacity. *Methodology:* The tests are done by selecting chronic smokers of different age group from 30-70 years from out patient, and impatient from the department of TB & chest diseases, medical college. Control groups are selected from patient who does not smoke. The instrument used was a portable small-computerized spirometer called "Compact Vitalograph". *Results:* In smokers with overweight the mean is 61.14 and the standard deviation is 22.93. When this values are tested using chi-square test, it is found that there is significant difference, according to the chi-square test the P value is less than 0.05. *Conclusion:* The effect of smoking on FVC is more affected in overweight group of subjects than the normal weight group of subjects.

Keywords: Forced Vital Capacity; Compact Vitalograph; Overweight.

Introduction

Evaluation of pulmonary function dates back to the 17th century. John Hutchinson wrote in 1846 that, Borelli is the earliest physiologist (1679) who established an experimental enquiry into the quantity of air received by a single inspiration. In 1800 Humphrey Davy used his Mercurial Air Holding Machine; and a Hydrogen dilution technique to measure his own residual volume. Then Hutchinson in 1846 devised the spirometer and described and measured vital capacity [1]. In his treatise entitled 'On the capacity of the lungs and on Respiratory Functions' he defined the functional subdivisions of lung volume. He defined the vital capacity as the greatest voluntary expiration following the deepest inspiration. He also reported the result of vital capacity measurements in more than 1700 "healthy cases". He related these values to the age, height and weight of his subjects and thus established a basis of predicting normal values. The simplicity and rapidity with which vital capacity could be measured led to an abundance of subsequent reports with tables of normal standards and formula for prediction. Reports were published by Peabody and Wentworth (1917), LundsGaard and Van Slyke (1918) Dreyer (1919), West (1920), Hewlett and Jackson (1922), Myers (1923) etc. They related vital capacity to various physical parameters like body surface area, height, body weight, chest circumferences, sitting height etc [2,3].

Forced vital capacity (FVC) is the maximum volume of air that can be expired, when a subject tries as forcefully and rapidly as possible, after a maximal inspiration to total lung capacity. A maneuver performed similarly beginning at residual volume and inspiring as forcefully as possible is called forced inspiratory vital capacity [4]. Both maneuvers are often performed in sequence to provide a continuous flow-volume loop. Both are recorded in liters, BTPS. FVC normally equals the slow vital capacity (SVC), within 5% of each other. They can differ substantially in subjects with severe airway obstruction. The FVC can be lower than the SVC in subjects who have obstructive disease if forced expiration causes bronchiolar

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collapse. The FVC can ne reduced in emphysema, because of mucus plugging and bronchiolar constriction (chronic bronchitis, chronic or acute asthma, bronchiectiasis, and cystic fibrosis), and in subjects with large airway obstruction (tumours). Decreased FVC is a common feature of restrictive diseases, resulting from increase in fibrotic tissue (pulmonary fibrosis), vascular congestion (pneumonia or pulmonary edema), space occupying lesions, neuromuscular disorders and chest deformities. Normal values — Males > -4.0L, Females > -3.0L. These values provide an indirect measure of the flow resistive properties of the lung [5,6].

Methodology

The study was conducted at department of TB &chest diseases, medical college. Tests were carried out in the laboratory and these tests were done in chronic smokers who attend in the smoker's clinic at morning hours. Here pulmonary function test are done using spirometry. The tests done are FVC, FEV1, FEF, FEV1/FVC and FEF 25-75%. These studies were done to find out the effects of smoking on lung function tests by comparing smokers with non-smokers in relation to body mass index. The tests are done by selecting chronic smokers of different age group from 30-70 years from out patient, and impatient from the department of TB & chest diseases, medical college. Control groups are selected from patient who does not smoke. The instrument used was a portable small-computerized spirometer called "Compact Vitalograph". Here mouthpiece is attached to resistant pneumatochograph, which contains parallel rows of resistant wire. Airflow through these procedures a pressure gradient across the resistant element, which is converted to electrical, signal and measured by the computer system. Results were displayed on the screen. This can be printed on an electro sensitive paper for a permanent record. The test was done in 100 subjects and another 100 as control. The subjects were chronic smokers and then they are divided into two groups as

A. Chronic smokers with normal body weight (50 numbers).
B. Chronic smokers with overweight/Obesity (50 numbers).

The control arenon smokers and also they were divided into two groups:-

A. Nonsmokers with normal weight (50 numbers).
B. Nonsmokers with overweight/Obesity (50 Numbers). The control was selected from the college campus.

Results

As per the Table 1 non-smokers with normal weight is having mean FVC of 77.11 with a standard deviation of 16.63 and non-smokers with over weight the mean is 79.12 and standard deviation is 15.26. This values are tested using chi-square test and it is found that the difference actually observed does not have significance since the p value is more than 0.05.

In smokers, the smokers with normal weight the mean is 64.12 and the standard deviation is 20.47. In smokers with overweight the mean is 61.14 and the standard deviation is 22.93. When this values are tested using chi-square test, it is found that there is significant difference, according to the chi-square test the P value is less than 0.05 and it shows that the effect of smoking on FVC is more affected in overweight group of subjects than the normal weight group of subjects.

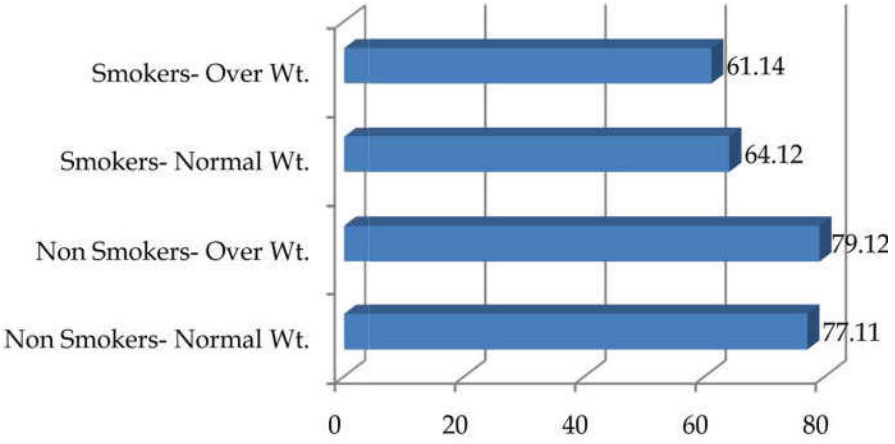

Fig. 1: Comparison of FVC

Table 1: Comparison of FVC in relation to BMI

Category	Mean	Std Deviation 1
Non Smokers- Normal Wt.	77.11	16.63
Non Smokers- Over Wt.	79.12	15.26
Smokers- Normal Wt.	64.12	20.476
Smokers- Over Wt.	61.14	22.93

Discussion

Cigarette smoking is addictive; smoking nearly always begins in adolescence for psychosocial reasons and then it becomes a regular habit. Some says that nicotine present in the cigarette conferring some advantage to the smoker's mood; but later it adversely affects every organ system of the body. Most often it will affect respiratory system first with a variety of respiratory diseases. Cigarette smoking causes increased sputum production followed by airflow limitation. If this person continues smoking it leads to decreased effort tolerance and ultimately causes chronic bronchitis and emphysema. The toxic effect is because cigarette smoke contains polycyclic aromatic hydrocarbons and nitrosamines, which are potent carcinogens and mutagens. It causes release of enzyme from macrophages, which are capable of destroying elastin, leading to lung damage. Like nicotine, obesity/over weight is another major factor, which adversely affects health by affecting each organ system of the body. The cause of obesity is nutritional abundance or sedentary life style. Obesity affects pulmonary system by reducing pulmonary compliance, rise airway resistance and reduces small airway caliber which in turn leads to increased work of breathing, increased minute volume, decreased total lung capacity, decreased functional residual capacity, and is associated with sleep apnea syndrome. Obesity is the adiposity, which can be measured by the method called body mass index (BMI) [7,8].

The normal BMI is 18.5 to 24.9. Obesity is not directly related to respiratory diseases, but it reduces pulmonary compliance and decreases the caliber of the small airways, which in turn increases the risk of respiratory diseases in smokers. The pathological changes in the respiratory system are slow and only a minor proportion of smokers show progressive deterioration, and the knowledge of natural history is insufficient to identify those individuals who are at risk. Smokers at risk can be identified only by doing pulmonary function tests (PET) [9]. Investigations and laboratory assessments are important adjuncts to confirm variable airflow obstruction. Although there is a wide range of different methods to assess the level of airflow obstruction, pulmonary function tests (spirometry) is the only test widely used, because it is the simplest, easiest and most reliable test. Pulmonary function tests are used to differentiate obstructive pulmonary diseases from restrictive pulmonary diseases, to make an objective assessment of severity of disease, and also to monitor response to treatment. Spirometry shows different types of readings; but only 5 values are taken. They are FVC, FEV1, FEF, FEV1/FVC and FEF25- 75%. PFT changes in obesity and smoking In this spirometric study, only 5 measurements were taken and analysed, i.e.:- FVC, FEV1, FEF, FEV1/FVC and FEF 25-75%. The spirometric evaluation was done in chronic smokers with normal weight and over weight and was compared with non-smokers.

The statistical analysis of the present study showed that there was significant reduction of FVC in over weight smokers when compared to normal weight smokers. The reduction of FVC observed in over weight smokers is statistically significant.

Conclusion

Effect of smoking on FVC is more affected in overweight group of subjects than the normal weight group of subjects.

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Original Research Article

FEV1/FVC among smokers and non smokers: A comparative study

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Abstract

Background: Respiratory Physiological changes in obesity are decreased overall compliance, increased airway resistance and shallow breathing pattern. These changes are due to increased intra abdominal pressure, decreased chest wall expansion, reduced small airway caliber and adaptation to the increased load. **Methodology:** The study was conducted at department of TB and chest diseases, medical college. Tests were carried out in the laboratory and these tests were done in chronic smokers who attend in the smoker's clinic at morning hours. Here pulmonary function test are done using spirometry. **Results:** In smokers, the smokers with normal weight the mean is 81.89 and the standard deviation is 23.10. In smokers with overweight the mean is 78.29 and the standard deviation is 21.61. When these values are chi-square test, it is found that there is significant difference, according to the chi-square test the P value is less than 0.05 **Conclusion:** The effect of smoking on FEV1/FVC is more affected in overweight group of subjects than the normal weight group of subjects.

Key Words: FEV1/FVC, Overweight, Spirometry.

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INTRODUCTION

Obesity is measured using "BODY MASS INDEX" (BMI). There was a study of pulmonary functions tests in relation to body mass index (2001) from the Arizona Respiratory Center, University of Arizona, Tucson. They found that except emphysema all other respiratory diseases are more in obese/overweight people. Ray *et al* also found that obesity affects pulmonary function by lowering many spirometric measures. The risk of pulmonary diseases are two times more in obese person who smoke than in smokers with normal weight. The effects of smoking in obesity on respiratory system are reduced pulmonary compliance, increased work of breathing, increased minute volume, decreased total lung capacity and decreased functional residual volume. Based on these observations, an attempt has been made to study the pulmonary function tests in smokers in relation to body mass index and comparing these results with non-smokers in relation to body mass index.[1] Obesity may be defined as an abnormal growth of the adipose tissue or increase in the fat cell number or combination of the both. Overweight mean weight in excess of the average for a given sex, height and age. Obesity is the one of the most significant contributors to ill health. It is the key risk factor for chronic and non-communicable diseases. It has been estimated to affect 30-40 percent of adults and 10-20% of children in developed countries.[2] The etiology of obesity are: - Age, Sex, Genetic factor, physical inactivity, Socio economic status, eating habit, familial tendency and endocrine factors. Assessment of Obesity Obesity can be assessed by Body Mass Index (BMI). It is the measurement of body fat. It is a simple index of weight for height; it is commonly used to classify overweight and obesity in adult. BMI is calculated as the weight in kilograms divided by the square of the height in meters. For example, an adult who is 80 kg in weight and 1.7 meters in height BMI=80Kg/i.7m2 =NW- c21. 7 Normal range is 18.5-2IP Below 18.5 is underweight and

above 25 is overweight This BMI is widely accepted. Other methods used are skin fold thickness and waist circumference and waist: hip ratio Hazards of Obesity is a positive risk factor of diabetes, hypertension and coronary artery disease, moderate risk factor for osteoarthritis, gallstones and other several diseases. Numerous studies also suggested that, it directly affects respiratory system and by lowering some of the spirometric measures. Respiratory Physiological changes in obesity are decreased overall compliance, increased airway resistance and shallow breathing pattern. These changes are due to increased intra abdominal pressure, decreased chest wall expansion, reduced small airway caliber and adaptation to the increased load. Respiratory Effects of obesity are dysponea and exercise intolerance, bronchial asthma, rapid shallow breathing. Sin D.D. *et al*., suggested that obesity also associated with obstructive sleep apnea, obesity hypoventilation syndrome, hypoxaemia and pulmonary hypertension. PFT in Obesity Recently studies suggested, many measures of PFT declines in obesity. Especially measures such as FEV1, FVC, FEV1/FVC, MW, ERV and FRC are reduced. VC and TLC are preserved. The pulmonary function values in obesity found lower values such as FEV1, FVC, FEV1/FVC and FEF. Obesity showed low PFT values such as FVC, FEV1, FEV1/FVC, MW, FRC and FVC. It suggested that even in the absence of obstructive or restrictive lung diseases, obesity affects the respiratory system.[3,4] Effect of Smoking and Obesity in Respiratory System Ewing M.S. *et al*., 1997 done PFT in obese smokers and he found that the PFT measures such as FVC, FEV1, ERV, FRC and FEF 25-75% were significantly reduced. In 2002, A.M.Li *et al*. found reduced ERV, FVC, FEV1, FEF25-75% and MW of PFT values in obese smokers. In 1997, A.M.J. Respir 1997 found that there was significant reduction in the PFT values such as FVC, FEV1, FEF 25-75%, FEF, FEV1/FVC and MW in obese smokers.

MATERIAL AND METHODS

The study was conducted at department of TB and chest diseases, medical college. Tests were carried out in the laboratory and these tests were done in chronic smokers who attend in the smoker's clinic at morning hours. Here pulmonary function test are done using spirometry. The tests done are FVC, FEV1, FEF, FEV1/FVC and FEF25-75%. These studies were done to find out the effects of smoking on lung function tests by comparing smokers with non-smokers in relation to body mass index. The tests are done by selecting chronic smokers of different age group from 30-70 years from outpatient, and impatient from the department of TB and chest diseases, medical college. Control groups are selected from patient who does not smoke. The instrument used was a portable small-computerized. Here mouthpiece is attached to resistant pneumatochograph, which contains parallel rows of resistant wire. Airflow through these procedures a pressure gradient across the resistant element, which is converted to electrical, signal and measured by the computer system. Results were displayed on the screen. This can be printed on an electro sensitive paper for a permanent record. The test was done in 100 subjects and another100 as control. The subjects were chronic smokers and then they are divided into two groups as

a. Chronic smokers with normal body weight (50 numbers)
b. Chronic smokers with overweight/Obesity (50 numbers).

The control arenon smokers and also they were divided into two groups:-

a. Nonsmokers with normal weight (50 numbers)
b. Nonsmokers with overweight/Obesity (50 Numbers). The control was selected from the college campus.

RESULTS

Table 1: Statistical analysis of FEV1/FVC

Category	Mean	Std Deviation
Non Smokers- Normal Wt.	86.78	17.89
Non Smokers- Over Wt.	86.45	16.37
Smokers- Normal Wt.	81.89	23.1
Smokers- Over Wt.	78.29	21.61

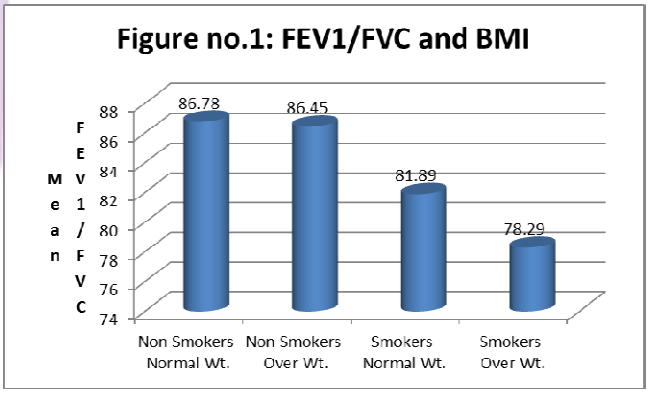

Figure 1:

As per the table non-smokers with normal weight is havingmean FEV1/FVC of 86.78 with a standard deviation of 17.89 and non-smokers with overweight the mean is 86.45 and standard deviation is 16.37. This values are tested using chi-square test and it is found that the difference actually observed does not have significance since the p value is more than 0.05. In smokers, the smokers with normal weight the mean is 81.89 and the standard deviation is 23.10. In smokers

with overweight the mean is 78.29 and the standard deviation is 21.61. When this values are chi-square test, it is found that there is significant difference, according to the chi-square test the P value is less than 0.05 and it shows that the effect of smoking on FEV1/FVC is more affected in overweight group of subjects than the normal weight group of subjects.

DISCUSSION

Comparison of PFT between smokers and nonsmokers, in relation to BMI Statistical analysis of the observations of the present study showed that there is significant reduction of spirometric parameters such as FVC, FEV1, FEF, FEV1/FVC and FEF25-75% in overweight subjects (smokers and nonsmokers). The reduction observed in all parameters were more significant in overweight smokers compared to normal weight smokers than the reduction observed in overweight nonsmokers as compared to normal weight nonsmokers. This is because of the addictive effects of smoking as well as overweight on the respiratory system in this group of subjects. Obesity is not directly related to respiratory diseases but increases the risk of respiratory diseases in smokers. The sedentary habit of overweight individuals may contribute to the impairment of pulmonary function.[5] The obese subjects are categorized under people who are doing sedentary works. The sedentary life style and obesity causes many physiological changes on respiratory system by reducing respiratory compliance, increase airway resistance and reduces small airway caliber. This in turn leads to various types of respiratory diseases. This study reveals that moderate type of respiratory exercise needed for proper maintenance of respiratory compliance, This can be achieved by decreasing the body weight and by doing regular physical exercise or by decreasing the body weight and by doing simple respiratory exercise (example Yoga). In the present study it was observed that the reduction in FVC, FEV1, FEF, FEV1/FVC and FEF25-75% in obese smokers as compared with non-obese smokers were statistically significant than the reduction in these parameters in obese nonsmokers as compared with normal weight nonsmokers. This indicates there is a synergistic harmful effect of obesity in the presence of smoking. There are many previous studies on PFT in smokers in relation to obesity. They also proved that smoking with obesity reduces pulmonary function two times more than that of non-smokers with obesity. Biring M.S et.al, 1997 proved that PFT measures such as FVC, FEV1, FEE 25-75%, ERV and FRC were significantly reduced in obese smokers. In another study it was found that there was significant reduction in the PFT values such as FVC, FEV1, FEF 25-75%, FEF, FEV1/FVC and MW in obese smokers. A.M.Li et.al, in 2002 found reduced ERV, FVC, FEV1, FEF 25-75% and MW of PFT values in obese smokers. Sterfano Gueriaet. al, on 2002 found that obesity and smoking increases the risk of asthma.[6] The present study also substantiates the views of the above workers. All the pulmonary function parameters analyzed in the present study were found to be significantly reduced in obese smokers compared to nonobese smokers.

CONCLUSION

The statistical analysis of the present study showed that there was significant reduction of FEV1/FVC in over weight smokers when compared to normal weight smokers. The reduction of FEV1/FVC observed in over weight smokers is statistically significant. FEF 25-75%: The results of present study showed that there was a significant reduction of FEF 25-75% in over weight smokers when compared to normal weight smokers. The reduction of FEF 25-75% in over weight smoker is statistically significant.

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Original Research Article

A study of FEV1 in relation to body mass index among smokers

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Abstract

Background: FEV1 is the most specific and dependable measure of airway obstruction. Because of the reliability and simplicity of equipment needed to measure FEVI this parameter is used most frequently to measure bronchial hyper-responsiveness. Reduction in FEVI reflect the total effects of reduction in TLC, obstruction of airway, loss of lung recoil and relatively uncommon gross weakness of respiratory muscles. **Methodology:** First, case history is taken with special emphasis on personal habits. Then secondly the physical examination including the measurement of height and weight. All the tests are done at the same time of the day to avoid possible diurnal variation. Subject is allowed to sit comfortably on the stool. Instructions are given about the tests. A very enthusiastic demonstration by the operator is required. So that a maximum effort is made by the subject when carrying out the forced expiratory test. Subjects who has not previously examined on spirometry should have two or more practice attempts until it appears that maximum effort is being obtained. **Results:** In smokers, the smokers with normal weight the mean are 54.85 and the standard deviation is 26.42. In smokers with overweight the mean is 51.94 and the standard deviation is 22.47. When this values are tested using chi-square test, it is found that there is significant difference, according to the chi-square test the P value is less than 0.05 **Conclusion:** The effect of smoking on FEV1 is more affected in overweight group of subjects than the normal weight group of subjects.
Key Words: FEV1, Smoking, BMI.

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INTRODUCTION

(FEV1) Is the volume of air exhaled in the specified time during the performance of FVC maneuver, for example FEV1 is the volume of air exhaled during the 1st second of FVC. It can be expressed either as an absolute volume i.e. as FEVI or as a percentage of the FVC i.e. as FEV1/FVC%. FEV1 is the most specific and dependable measure of airway obstruction. Because of the reliability and simplicity of equipment needed to measure FEVI this parameter is used most frequently to measure bronchial hyper-responsiveness. Reduction in FEVI reflect the total effects of reduction in TLC, obstruction of airway, loss of lung recoil and relatively uncommon gross weakness of respiratory muscles. FEVI is mainly used to asses intrathoracic airway obstruction, either in clinical practice or in epidemiological surveys in COPD (Chronic Obstructive Pulmonary Diseases), the level of FEV1 is linked better to prognosis than any other single test of lung function. The normal value of FEVI /FVC % is more than 80, although this value does fall somewhat with advancing age. A study by Gilbert R *et al* revealed that FEV1/FVC% has a sensitivity of 0.82 and a specificity of 0.98 for diagnosis of airway obstruction. As the specificity is so high less precise clinical information is required.[1,2] Assessment of pulmonary function while air was flowing into, or out of the lung began only in 1933 when Hermannsen first proposed the test now known as the maximum voluntary ventilation (MW). But this did not gain wide spread use until Cournand and Richards developed regression equations to predict normal values.

In 1955 Leuallen arid Fowler introduced measurement of the average rate of air flow during the middle half of a Forced expiratory vital capacity. The earliest systematic attempt to use the peak flow rate as a physiological index was that of Hadorn who measured the flow rate on expiration by means of an anaeroid manometer connected across a simple orifice. Wyss. Fused the same type of orifice as Hardorn, but recorded the pressures photographically. This gave a permanent record and a higher frequency response. Determination of these indices of dynamic lung function is now generally part of the battery of tests-static and dynamic included under the designation Spirometry. In the first half of this century, progress in developing, methods for pulmonary function testing was slow. In the 1950's pulmonary physiologists quickly turned to take advantage of the opportunities afforded by the rapidly increasing field of electronics and the widespread application of transducers and computers, and the methods have become more complex and sophisticated. The respiratory system includes the lungs, the regulatory center in brain, the chest wall and the pulmonary circulation.[3] The 4 major components that support the function of respiration are ventilation, diffusion, perfusion and control of breathing. Any disorder may affect one or more of these functional components. Although, a carefully elicited history, proper physical examination and chest radiography can often establish a diagnosis in an individual patient, testing of lung function has become a standard practice in the evaluation and care of patients with various cardio respiratory disorders. Pulmonary function tests (PFT) are done to, entity and quantify the disturbances in respiratory functions. Analytical And Non Analytical Factors Influencing PFT Certain, analytical factors as well as the non-analytical factors must be taken into account to accomplish the true goal. Non-analytical factors include anxiety on the part of the patients. The performance of these test require co-operation and understanding. Worry and uncertainty can exert impact on the performance of the subject. Use of explanatory sheaths or descriptive brochures can reduce this apprehension. A patient who is fatigued or in pain should be alleviated of these symptoms, if possible, before the beginning of the test. Medication taken by the patient before PFT can significantly affect the outcome e.g; bronchodilators should be discontinued before testing. A major non-analytical cause for misinterpreting results is the in appropriate use of data obtained else where from a different patient population, as "control" values. Analytical factors include chances of error with the equipment, techniques and calculations. To help in achieving accuracy, reproducibility and comparability, attempts at standardization have been initiated on a global scale. Guidelines have been developed for valid determination of the Forced Vital Capacity (FVC), the number of attempts required, acceptable, variability efforts and criteria for judging reliable data. The major objective of a Pulmonary Function Lab should be provide accurate and timely results of lung function tests.[4,5] For the sake of quantification and comparison, the total volume of gas in the lungs is conventionally subdivided into compartments (volumes) and combinations of two or more volumes (capacities). Tidal volume (TV), Inspiratory reserve volume (IRV), Expiratory Reserve volume (ERV) and Residual volume (RV) are the 4 static volumes. Inspiratory Capacity (IC), Vital Capacity (VC), Functional Residual Capacity (FRC) and Total Lung Capacity (TLC) are the capacities. VITAL CAPACITY VC is the largest amount of air that can be expired after a maximal inspiratory effort. Expressed in liters (BTPS). VC can be measured as: 1. The volume expired from TLC to Residual Volume (RV) during a forced expiration (FVC) or a slow maneuver (relaxed maneuver) 2. As the volume inspired from RV to TLC. 3. As the sum of inspiratory capacity (Volume inspired from FRC to TLC) and the expiratory reserve volume. In healthy subjects, all these methods give similar results; but the value of VC is much more dependent on the technique used when there is airway obstruction. In general, inspiratory vital capacity gives the largest values. Usually 'Vital Capacity' refers to the expiratory VC unless otherwise specified. It is usually measured slowly from a position of maximum inspiration to full expiration (Slow Vital Capacity — SVC). VC gives useful information about the strength of the respiratory muscles and other aspects of pulmonary functions. Decrease in VC can be caused by loss of lung tissue, example; - lobotomy, space-occupying lesions (tumors), fibrosis. VC is often reduced in obstructive lung diseases. Other causes of a decreased VC are, depression of the respiratory centers or neuromuscular diseases, reduction of available thoracic space (pneumothorax, cardiac enlargement) and limitations of thoracic (kyphoscoliosis) or diaphragmatic (pregnancy, ascites) movements. Normal values: -4-5 L in Males, 3-4 L in Females VC was one of the earliest lung volumes to be measured Since then, various studies on VC have been conducted relating the volume to various physical parameters like body, surface area, calculated thoracic volume, sitting height standing height body weight.[6]

MATERIAL AND METHODS

At first a thorough physical examination was carried out and also make sure that patient had not taken cigarette or heavy meals at least an hour prior to the test. Selection of Tests: When choosing tests for lung function a number of criteria should he taken into account.

1. The tests should be safe, simple and should not be inconvenient to the subjects.
2. The information, which it is intended to be obtained from a tests, should ideally be independent of both the motivation and extent of emotional participation of the subjects and personality of the operator.
3. The tests should be repeatable.
4. The tests of lung function should be appropriate to circumstances for which they are required.

So the tests were selected with a view for pointing information on different aspects of function. Procedure: First, case history is taken with special emphasis on personal habits. Then secondly the physical examination including the measurement of height and weight. All the tests are done at the same time of the day to avoid possible diurnal variation. Subject is allowed to sit comfortably on the stool. Instructions are given about the tests. A very enthusiastic demonstration by the operator is required. So that a maximum effort is made by the subject when carrying out the forced expiratory test. Subjects who has not previously examined on spirometry should have two or more practice attempts until it appears that maximum effort is being obtained. A disposable mouthpiece should be used in each subject. The mouthpiece was positioned so that the subject's chin was slightly elevated and neck extended. After the insertion of mouth piece a careful check was made to ensure that there was no air leak present. The subject was asked to make maxima! effort for each test and was closely watched to ensure that he maintained an airtight seal between the lips and the mouthpiece of the instrument. First the subject data was entered as name, age, sex, height, weight, address, occupation, addiction etc. Then the required measurement was called up from menu. Forced Vital Capacity (FVC) The subject is made comfortable and the nose clip kept in place to close the nostril to prevent air entry through the nose. Then the mouthpiece is placed in the mouth and which is connected to pneumotach. Then the subject is asked to breach via, the mouthpiece. After a brief period of quiet normal breathing subject is asked to breathe in and completely as possible then suddenly breathe out forcefully, rapidly and completely as much as possible. The performance of the maneuver was evaluated by inspecting the graphic output of flow volume curve and the subject was reinstructed if necessary. Repeat it for 2 to 3 times. Measurement was taken from the best of the three tests.

RESULTS

Table 1: Relation between FEV1 and BMI

Category	Mean	Std Deviation
Non Smokers- Normal Wt.	75.03	20.89
Non Smokers- Over Wt.	71.88	18.13
Smokers- Normal Wt.	54.85	26.42
Smokers- Over Wt.	51.94	22.47

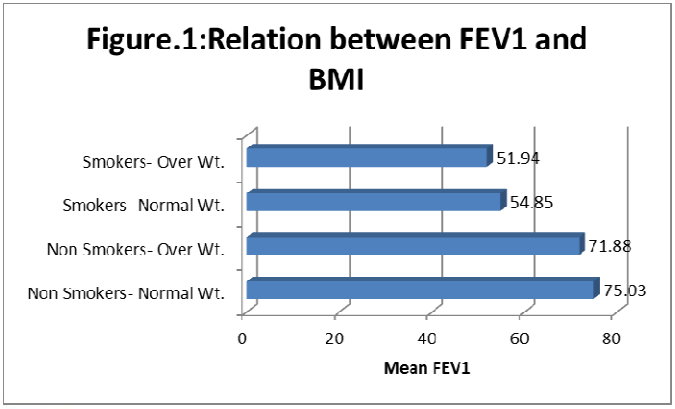

Figure 1:

As per the table non-smokers with normal weight is having meanFEV1 of 75.03 with a standard deviation of 20.89 and non-smokers with overweight the mean is 71.88 and standard deviation is 18.13. These values are tested using chi-square test and it is found that the difference actually observed does not have significance since the p value is more than 0.05. In smokers, the smokers with normal weight the mean are 54.85 and the standard deviation is 26.42. In smokers with overweight the mean is 51.94 and the standard deviation is 22.47. When this values are tested using chi-square test, it is found that there is significant difference, according to the chi-square test the P value is less than 0.05 and it shows that the effect of smoking on FEV1 is more affected in overweight group of subjects than the normal weight group of subjects.

DISCUSSION

The pulmonary function tests were conducted in 200 people in the Respiratory Medicine Laboratory, and the values were analyzed statistically using software package. The PFT values analyzed are FVC, FEV1, FEF, FEV1/FVC and FEF 25- 75%. The present study has confirmed the result of earlier researchers who observed impairment of lung function in obese individuals when compared to normal v:eight subjects. The present study has also undoubtedly revealed a significant reduction in pulmonary functions among over weight individuals when compared to normal weight individuals in the smoking group and in the nonsmoking group. Obesity has an adverse effect on pulmonary function and it is

associated with a number of pulmonary abnormalities. It has been proved that obesity is not directly related to respiratory disease. Obesity reduces pulmonary compliance, increases airway resistance, and reduces the small airway caliber, which in turn increases the risk of respiratory disease in smokers.[7] Thus this study has proved that the obesity is an independent parameter, which can impair lung function in smokers as well as nonsmokers. The study also show that smoking and obesity when present concurrently greatly reduces the lung function. The observations of the present study implicate the need to normalize body weight in patients with compromised respiratory function and to stop smoking if they are smokers. A global long-term prospective study of the effect of obesity on lung functions, involving various races, measurement of compliance, work of breathing and measurement of airway resistance is a need of this era, because obesity is a global health problem affecting developed as well as developing nations. We hope the present study will be a small step, which would inspire the giant leap in the near future. Statistical analysis of the observation between smokers with normal weight and smokers with overweight show that there is significant reduction of spirometric measures such as FVC, FEV1, FEF, FEV1/FVC and FEF 25-75% in overweight smokers compared to normal weight smokers. This reduction could be due to the physiological changes in the respiratory system due to the obesity and sedentary life style of the overweight subjects in addition to smoking. Statistical analysis of the observation of the present study showed that there is significant reduction of FVC, FEV1, FEF, FEV1/FVC and FEF25-75% in over weight nonsmokers when compared to normal weight nonsmokers. Thus, among smokers as well as nonsmokers over weight subjects showed a statistically significant association with impairment of respiratory function as evidenced by spirometric study. The obese subjects are categorized under people who are doing physiological changes in sedentary works. This may leads to various the respiratory system like reduced pulmonary compliance, rise airway resistance and reduces small subjects.[8]

CONCLUSION

The results of present study showed that there was a significant reduction of FEV1 in over weight smokers when compared to normal weight smokers. The reduction of FEV1 in over weight smoker is also statistically significant.

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