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STUDY OF EFFECT OF BODY MASS INDEX ON FVC, FEV1, FVC/FEV1

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ABSTRACT: Obesity is one of the chronic non-communicable diseases, posing as a global health hazard. Obesity is found to decrease the lung volumes & capacities is by decreasing both lung and chest wall compliance. There is also increased in resistance to outflow of air through the airways in obesity [(1)]. The pattern of pulmonary function is found to worsen with the degree of obesity moving from a restrictive pattern in mild and moderate obesity with both FEV_1 & FVC reduced and the ratio being normal to an obstructive pattern in severe and morbid obesity with significant decrease in FEV_1 against FVC & FEV_1/FVC ratio being decreased. A prospective observational study is done on 120 subjects of age ranging from 20 to 45 years for a duration of 1 year. Males & females aged between 20 to 45 years with apparently normal general health were included in this study. The results revealed that with increasing degree of obesity, the pulmonaryfunction pattern is moving from restrictive pattern towards obstructive pattern.

KEY WORDS: Obesity, FVC, FEV1, Obstructive lung disease, restrictive lung disease.

1. INTRODUCTION:

Obesity is one of the chronic non-communicable diseases, posing as a global health hazard. It is a problem of the newer world with rapidly changing life styles, involving consumption of highly processed and calorie rich foods [(1)]. Though it is increasing in epidemic proportions, it is one of the most neglected public health problems, according to WHO. It was not, until the 20th century that the WHO finally recognized obesity as a global epidemic [(1)] A new word describing the global nature of the epidemic has been coined –
"globesity".Once considered a problem of rich countries, obesity rates are increasing worldwide, with developing countries experiencing unprecedented increases [(2)].The prevalence of adult overweight and obesity is estimated to rapidly increase worldwide from 937 & 396 million in 2005 to 1.3 billion and 573 million in 2030[(1)].India, a country with multiple ethnicities, has a varied prevalence of overweight and obesity. Also, the increase of overweight and obesity has been found to increase with age, with the middle aged people being under higher risk compared to younger and older counterparts [(1)]. Obesity has reached

epidemic proportions in India in the 21st Century, with morbid obesity affecting 5% of the countries‟ population. This isonly the tip of iceberg and the incidence is growing. It is mainly because the unhealthy and processed foods have become much more accessible [(2)]. India has the third highest number of obese and overweight people (11% of adolescents 20% of all adults) after U.S. and China [(2)]. Overweight and obesity are associated with an increased burden of diabetes, hypertension, cardiovascular diseases, hyperlipidemia, stroke, metabolic syndrome, osteoporosis, arthritis, gall bladder diseases and gall stones, some type of cancers, gout, premature deaths and reduction in overall quality of life [(3)].Overweight and obesity are also known to affect the respiratory function in various forms depending on severity[(4)].Obesity forms a major cause of dyspnea, exercise intolerance, functional limitation and disability [(5)]Obesity is important risk factor for pathophysiological changes contribution to altered lung functions[(6)],even if they have no respiratory illness.Both static & dynamic lung volumes are compromised in obesity [(1)].

Obesity is found to decrease the lung volumes & capacities is by decreasing both lung and chest wall compliance. There is also increased in resistance to outflow of air through the airways in obesity [(1)].The pattern of pulmonary function is found to worsen with the degree of obesity moving from a restrictive pattern in mild and moderate obesity with both FEV_1 & FVC reduced and the ratio being normal to an obstructive pattern in severe and morbid obesity with significant decrease in FEV_1 against FVC & FEV_1/FVC ratio being decreased[(1)].Obese people are at increased risk of respiratory symptoms such as breathlessness, particularly during exertion and exercise, even if they have no obvious respiratory illness. Obesity has a clear potential to have a direct effect on respiratory wellbeing. In addition to exertional breathlessness and limited exercise capacity, the changes in pulmonary mechanics due to obesity can impact on patients with concomitant chronic respiratory illness, including asthma and COPD. More importantly, it can result in sleep disordered breathing, including obstructive sleep apnoea (OSA) and obesity related respiratory failure (ORRF). While the clinical implications of obesity such as diabetes, vascular disease and osteoarthritis are well established, less emphasis is traditionally placed on the effects of obesity on the respiratory system. The present study is done to observe the effect of obesity on the respiratory system by observing FVC, FEV1.

Aim:

To study the effect of body mass index on FVC, FEV1and FVC/FEV1 among healthy, non-smoking adults.

Objectives:

-To assess the body mass index of the subjects by recording height and weight.

-To assess the pulmonary FVC, FEV1, and FVC/FEV1 clinically by performing the pulmonary function tests innormal weight, overweight & obese people.

-To compare the results and to assess whether body mass index correlates with the values of spirometry innormal, over weight and obese individuals

2. MATERIALS& METHODS:

A prospective observational study is done on 120 subjects of age ranging from 20 to 45 years for a durationof 1 year.

The study population was grouped in to the following groups depending on BMI (normal weight, over weightand obese groups)

Group A- 40 subjects with BMI between18.5 to 24.9 Kg/m^2 Group B-40 subjects with BMI between25 to 29.9 Kg/m^2 Group C-40 subjects with BMI $\geq$30 Kg/m^2

Inclusion criteria: Males & females aged between 20 to 45 years with apparently normal general health wereselected.

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Exclusion criteria:

-Subjects with known respiratory diseases

-People with history of any respiratory complaints like cough, shortness of breath or history of upperrespiratory tract infection for past 4 weeks

-Subjects with cardiovascular diseases, skeletal deformities and endocrine disorders

-Subjects with history of tobacco chewing, smoking and alcohol consumption.

-Pregnant and lactating women.

Anxious, apprehensive & unco- operative subjects.

The test was carried out in a well ventilated and quiet room with ambient temperature ranging from 28^0 c to 35^0 c. The subjects were asked to avoid beverages like tea, coffee and other stimulants and to report with light breakfast in the forenoon. The subjects were allowed to rest for 5-10 minutes before recording the lung functions and the procedure to be carried out were demonstrated to them. They were briefed and familiarized with the procedure. Informed consent was obtained from all the subjects who participated in thestudy.

3. RESULTS:

Table No-1 Distribution of study population showing different groups

All the subjects in each group were equal in numbers.

S.No.	Group	Numbers
1	Group A	40
2	Group B	40
3	Group C	40
	Total	120

Table No-2: The demographic data for all the three groups is shown in Table No.2 and depicted in Chart No.1to3.

S.No.	Parameter	Group A	Group B	Group C
1	Age in years	32	33	35
2	Height in Cms	168	163	160
3	Weight in Kgs	67	71	83

BMI of group A is between 18.5 to 24.9 Kg/m^2. The mean value of age group A was 32 years, mean height of group A was 168cms, mean weight of group A was 67 kgs. BMI of group B is between 25 to 29.9 Kg/m^2. The mean value of age group B was 33 years, mean height of group B was 163cms, mean weight of group A was 71 kgs.BMI of group C is $\geq$30 Kg/m^2. The mean value of age group C was 35 years, mean height of group C was 160cms, mean weight of group C was 83 kgs**.**

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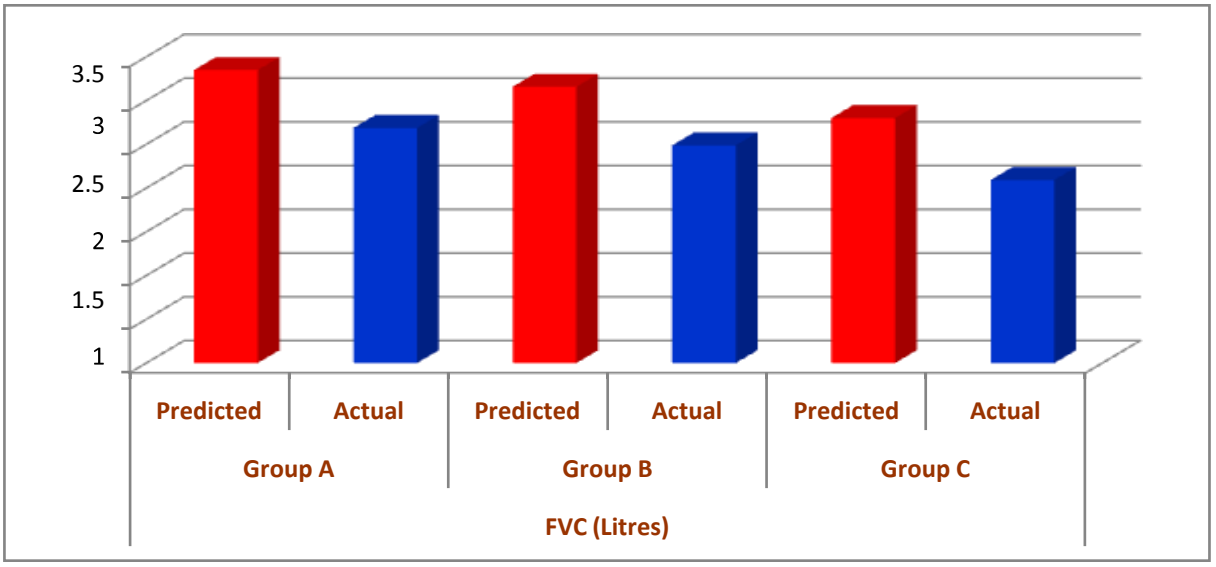
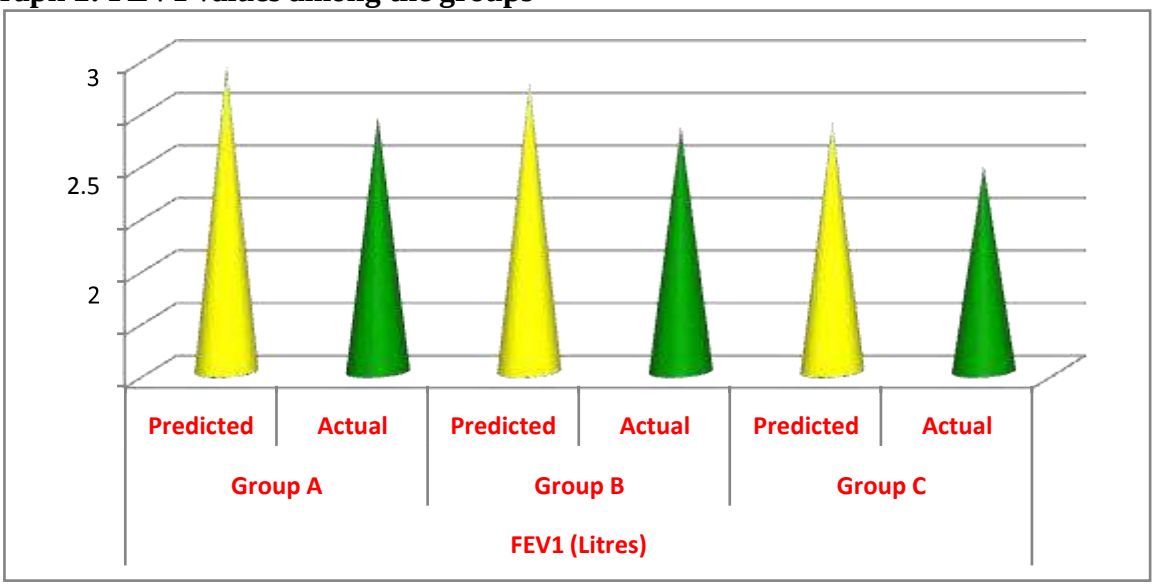
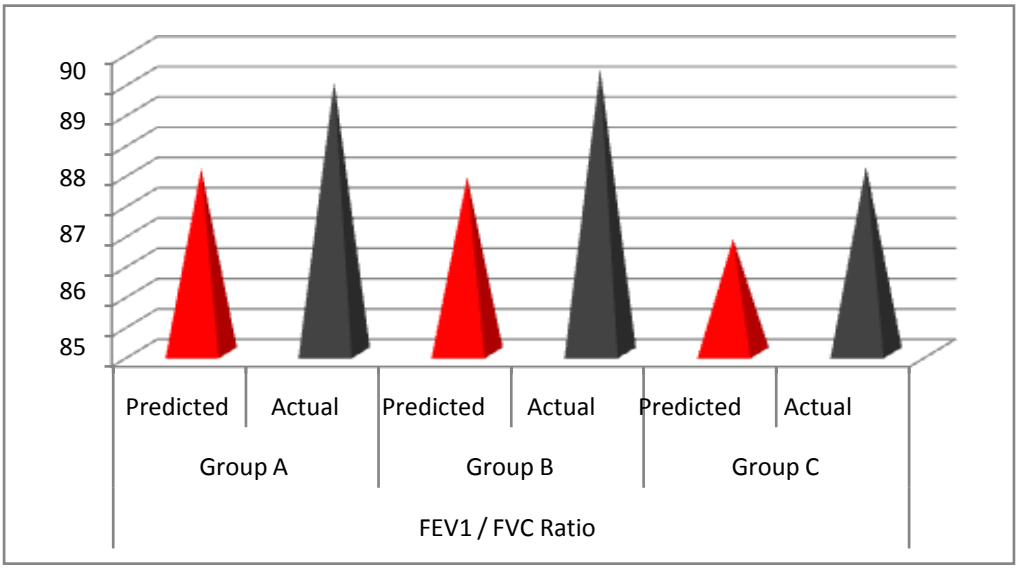
Graph 1: FVC values among the groups



Graph 2: FEV1 values among the groups



Graph 3: FEV1/FVC values among the groups



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4. DISCUSSION:

Throughout most of human history, weight gain and fat storage have been viewed as signs of health and prosperity in times of hard labour and frequent food shortages, securing an adequate energy intake to meet requirements has been the major nutritional concern. Today, however, as standards of living continue to rise, weight gain and obesity are posing a growing threat to the health in countries all over the world.

Clinical evidence of obesity can be dated as far back as GrecoRoman times, but little scientific progress was made towards understanding the condition until the 20th century. The discovery that fat is stored in the

"cells", the basic unit of biology, led to the idea that obesity could be caused by the presence of too many fat cells. Obesity comorbidities include coronary heart disease, hypertension and stroke, certain types of cancer, non-insulin dependent diabetes mellitus, gall bladder disease, dyslipidemia, osteoarthritis and gout but over recent years, the clinical effect of obesity upon the respiratory system has been highlighted.

Obesity has a clear potential to have a direct effect on respiratory well – being, since it increases oxygen consumption and carbon dioxide production, while at the same time it stiffness the respiratory system and increases the mechanical work needed for breathing. In addition to exertion breathlessness and limited exercise capacity, the adverse changes in pulmonary mechanics due to obesity can impact on patients with concomitant chronic respiratory illnesses, including asthma and chronic obstructive pulmonary disease.

Body Mass Index, provides the most useful, population level measures of obesity. It can be used to estimate the prevalence of obesity within a population and the risks associated with it. Mild hypoxemia and increased alveolar arterial oxygen difference are frequently reported even in eucapnic obese individuals and have been associated with abdomen Obesity and respiratory dysfunction could both reflect some underlying common etiology. Studies of diet induced obesity in rats have reported changes in lipid deposition in the lungs, which may affect surfactant production. Obesity induced disturbances of the respiratory function related to weight gain is worse among subjects with higher baseline BMI.In simple obesity, subjects tend to breathe more rapidly at lower tidal volumes as a strategy to reduce the respiratory muscle load and avoid hypoventilation
(23).

When group A FVC was compared with group B FVC, p value was 0.204056(not significant) When group B FVC was compared with group C p value was 0.010057(significant) When group A was compared with group C p value was 0.00001 (significant). The Mean Values in group A, B & C were showing gradual decrease and p value is highly significant. A significant inverse relationship between Body Mass Index and to FVC was found in the present study, with increasing significance as BMI increases. Shinde PU, Irani FB, Heena Kousar GH, in their study of also observed significant inverse relationship with increasing Body Mass Index and FVC, which is compatible with the present study. Y. chen, S.L. Home, J.A. Dosman, in their study also observed similar findings [31]. Swapnil.J. Paralikar et.al. in their study observed similar findings in their study. The present study findings are compatible with Pradeep Prajapathi et.al"s study, who observed similar findings.

The mean value of FEV_1 in group A was 2.42975 The mean value of FEV_1 in group B was 2.32675 The mean value of FEV_1in group C was 1.9535.When group A was compared with group B p value was 0.506345(not significant) When group B was compared with group C p value was 0.01425(significant) When group A was compared with group C p value was 0.000338(significant)The Mean Values in group A, B & C were showing gradual decrease and p value is highly significant in the overweight and obese group compared with normal

weight group. A significant inverse relationship between Body Mass Index and to FEV_1 was found in the present study, with increasing significance as BMI increases. The present study findings are compatible with the study of Anugya Aparajitha Behra, Basantha Kumar Beghra,et.al. who observed that FEV_1 decreases with increasing Body Mass Index.They also found that with 1Kilogram increase in weight correlated with a decrease in FEV_1 of approximately 13ml. in males and 5ml. in female. Anuradha R. Joshi, Rathan Singh and A.R. Joshi in their study also stated that increase in adult body mass is a predictor of FEV_1 decline. Christopher Zammit and Helen Liddicoat in their study also observed similar findings. Bharath Thyagarajan, David Jacobs, George G. Apostal, et, a. observed that FEV_1 decreased in accordance with duration of obesity. Umesh Prahlad Rao, Vilas G. Jaltade, Shital ShisLad, P. Satya Narayana also observed similar findings in their study. The present study findings are compatible with the study of Sahebjami H.and Garside PS., who observed similar findings. The present study findings are not compatible with the findings of Mohammed Al. Gobain who found no significant differences in FEV_1 with obesity [3] The present study findings are not in accordance with the findings of Joyarani Devershetty, Sandhya Metta, Satya Narayana Uppala and Ganesh Kamble who observed no difference in FEV_1 between obese and non-obese women.

The mean value of FEV_1/FVC in group A was 88.95925 The mean value of FEV_1/FVC in group B was 89.376. The mean value of FEV_1/FVC in group C was 86. 167.When group A was compared with group B p value was 0.847071 (not significant) When group B was compared with group C p value was 0.130751(not significant) When group A was compared with group C p value was 0.278587(not significant) The FEV_1/FVC ratio is preserved in the present study. (no statistical significance observed). The FEV_1/FVC ratio, also called in restrictive lung disease, the FEV_1 and FVC are equally reduced. Thus, the FEV_1/FVC ratio should be approximately normal, or even increased due to decrease of a greater magnitude in FVC as compared to FEV_1.No significant relationship between Body Mass Index and FEV_1/FVC ratio was observed in the present study. Saulo Maia D Avila Melo, Valdinalo Aragao de Melo,et.al.also found no significant differences in FEV_1/FVC ratio with increasing Body Mass Index. Cheryl M. Salome, Gregory G. King, Nobert Berend, in their study observed similar findings.

5. CONCLUSION:

These findings suggest that with increasing degree of obesity, the pulmonary function pattern is moving from restrictive pattern towards obstructive pattern. As weight reduction and physical activity are effective means of reversing the respiratory complications of obesity, health care policy makers need to develop major strategies to prevent and effectively manage obesity. Also, awareness of the effect of BMI on lung function testing will result in better interpreting the results and hopefully avert unnecessary pulmonary workup.

These results will also assist clinicians when interpreting pulmonary function test results in people withnormal airway function.

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