Original Research Paper Medicine

PULMONARY FUNCTION IN OBESE INDIVIDUALS- A CROSS SECTIONAL STUDY

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ABSTRACT

Aims: To assess the lung function in terms of forced vital capacity (FVC) and Forced Expiratory Volume in first second (FEV1), among obese people and correlation between lung function with BMI and Waist Hip Ratio.

Materials and Methods: This cross sectional study was conducted in subjects attending obesity clinic in the Dept. of Physical Medicine and Rehabilitation, Government, Medical College, Trivandrum, a tertiary care center, during the period 2014-2015. Thirty-five patients including males and females of age group 20-60 years with obesity according to WHO guidelines satisfying inclusion and exclusion criteria were included in the study.

Results: Univariate and multivariate linear regression statistical analysis were carried out to predict the correlation. The result analysis shows a lower value of forced vital capacity (FVC) and Forced Expiratory Volume in first second (FEV), for obese females. FVC and FEV are correlated negatively for Body Mass Index and Waist Hip Ratio of females. In multivariate analysis no significant correlation of FVC and FEV1 are noticed with BM I and Waist Hip Ratio of females. No significant correlation was observed in males for both univariate and multivariate statistical analysis.Waist circumferenceof >94 cm in men and 80cm in women are thresholds for significantly increased cardiovascular risk.

Conclusion:

Forced vital capacity (FVC) and Forced Expiratory volume in first second (FEV1)were the most representative findings suggesting presence of restrictive respiratory pattern associated with obesity. Both FEV1 &FVC of obese females are less. Severe restriction of FVC and FEV1 were seen in 14.3% and 20% of obese individuals. Females are more affected with obesity than male individuals. Increase in waist hip ratio is obese group is correlated to abdominal fat mass which can be used as a marker for abdominal obesity. Obesity leads to decrease in lung compliance.

KEYWORDS : Pulmonary function, Body Mass Index, Forced Initial capacity, Forced Expiratory Volume in 1st second, spirometer.

INTRODUCTION

Obesity is defined as abnormal or excessive fat accumulation causing a risk to health. Themost widely accepted WHO criteria based on BMI is BMI of 25-29.9 Kg/m^2 is obese ≥ 40 Kg/m^2 severe obesity and >50 Kg/m^2 is super obese. Obesity is described by WHO as an 'escalating epidemic' and one of the greatest neglected public health problems of our tissue with an impact on health[1]. Obesity significantly contributes to morbidity and mortality [2,3]. Epidemiological studies have shown that the period of early childhood is the age group that is gaining weight the fastest and hence greatest incidence of overweight and obesity[4,5,6]. One of the major reason for childhood obesity is that they prefer junk food over conventional meals. Alcohol and sedentary life style unhealthy processed food also play an important role. With advancement of science and technology there is a rapid change in life style of man which included increased mobility by mechanical means and thus a drastic reduction in physical activity by way of machines replacing men. Abdominal obesity is linked to an increased risk of co-morbidities and key feature of metabolic syndrome.

Respiratory complications form an important part of many clinical situations occurring in obese like chronic obstructive pulmonary disease, obstructive sleep apnoea and asthma. Poor respiratory function predicts overall mortality as well as death due to cancer, pulmonary diseases cardiovascular disease and stroke. Studies have reported inverse relationship between respiratory function and various indices of obesity or fat distribution. These indices include measure of overall adiposity such as weight or body mass index (weight in Kg/height in m^2) and measures of fat distribution such as waist circumference, hip circumference, waist-hip ratio, percentage of fat mass and skin fold thickness.

Obesity alters the relationship between lungs, chest wall and diaphragm, increasing the resistance within the system which increases the effort of breathing and affect gas exchange. Strongest prediction of lung function impairment is abdominal obesity rather than total body fat.In India, Kerala has 24.3% obese males and 37.4% obese females ranking second. So the proposed study is very relevant to the present situation.

MATERIALS AND METHODS

This was a cross sectional study conducted in subjects attending obesity clinic in the Department of Physical Medicine and Rehabilitation, Government Medical College, Trivandrum, a tertiary care center during the period 2014-2015. Thirty five patients including males and females of age group 20-60 years with obesity according to WHO guidelines satisfying Inclusion and Exclusion criteria are included in the study.

Inclusion criteria

Subjects with BMI>30kg/m^2, in the age group 20-60 years and willing for pulmonary function test and participate in the sudy.

Exclusion criteria

Respiratory disorders, acute upper or lower psychiatric illness, mental retardation or cognitive impairment and spine or chest deformity.

Study variables

- Body Mass Index (BMI) calculated by dividing weight in Kg/height in square meter
- Height is measured by wall mounted measuring scale
- Weight is measured by standard weighing machine
- Body fat percentage body fat monitor
- Waist circumference and hip circumference is measured and waist to hip ratio is calculated

The subjects were advised to report to the obesity clinic after a light breakfast. They were made to rest for a few minutes and anthropometric measurements will be taken. For pulmonary function test, spirometric measurementswere obtained by using a computerized spirometer. Subjects were familiarized with the equipment and they were made to breathe quickly for 10 minutes. A nose clip was applied and mouth pieces inserted, care was taken to prevent air leakage around it. The test was performed a maximum of three times with 1-2 minutes rest between each test. The most important parameters analyzed were FIC (Forced Initial Capacity) FEV1 (Forced Expiratory Volume in first second)

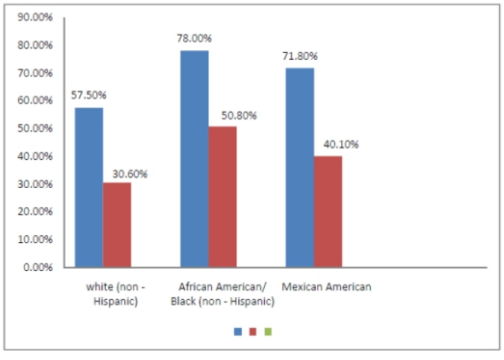
Severity of obesity and relative risk of various comorbid conditions

Relative risk	Associated with metabolic consequences	Associated with weight
Greatly increased	Type 2 diabetes, Gall bladder disease, Hypertension Dyslipidaemic, Insulin resistance, Atherosclerosis	Sleep apnoea, Breathlessness, Asthma, Social isolation/ depression, Daytime sleepiness /fatigue
Moderately increased	Coronary heart disease, Stroke, Gout/hyperuricaemia	Osteoarthritis, Respiratory disease, Hernia, Psychological problems
Slightly increased	Cancer (Breast, endometrial, colon), Reproductive abnormalities, Impaired infertility, Polycystic ovaries, Skin complications, Cataract	Varicose veins, Musculo-skeletal problems, back pain, stress incontinence Oedema, Cellulitis

RESULTS AND DISCUSSION

Baseline characteristics of obesity, lung function studies on gender, age, education, occupation, clinical history like diabetes, hypertension along with initial statistics of height, weight, waist hip circumference etc were considered. Using statistical tool of IMB SPSS software package data analysis was done. There are 35 number of cases considered for the present study.

With respect to gender analysis 71.4% of the case considered was females and 28.6% were males. Due to the nature of physiological characteristic obesity, lung function abnormalities are seen more in females than males. Based on the age group, 31-40 years group has maximum obesity related lung function abnormalities. This may be due to prevailing eating habits coupled with lack of exercise. Considering educational background, people with high school education has more obesity features.



Analysis based on occupation shows that 60% of total cases are housewives. Data analysis based on income has revealed 74.5% APL category has lung function abnormalities. Analysis on clinical features shows that diabetes and hypertension has no influence in lung function tests. Only 14.3% people of obese are diabetic and 8.6% are hypertensive.

Average BMI of the study population was 32.8± 2.8Kg/m^2 and Waist Hip Ratio was 0.96±0.003 cm.FVC analysis shows that 14.3% has severe reduction, 34.3% has moderate reduction, 31.4% has mild reduction and 20% has normal FVC.

Percentage prediction of FEV_1 was 69±23.9 (N range from 36 to 142). FEV_1 studies shows that 20% has severe obstruction, 14.3% has moderate obstruction 34.3% has mild obstruction and 31.4% has normal FEV_1.

FEV_1/FVC in the average study population was 0.75±0.11, normal range being 0.39 to 0.99. (Average percentage prediction of FEV_1/FVC was 97±13.8, range being 47 to 121) FEV_1/FVC prediction shows only 5.7% are with abnormal pattern whereas 94.3% are having normal pattern.

Detailed analysis of BMI was carried out.Average BMI of males were 31.0±0.85Kg/m^2 and females was 33.48± 2.98Kg/m^2. Average hip circumference of males was 110.10±11.35 cm and that of females 114.12±8.72cm. Average waist circumference of males was 105.80±9.14cm and females was 108.64± 7.36cm and average waist hip ratio of males was 0.96±0.03 and that of females was 0.95 ± 0.03.

Analysis of FVC with respect to gender yielded the following results. Average FVC of obese male was 3.33 ± 1.37 liters and that of female was 2.27 ± 0.45 liters. Average percentage prediction FVC among obese men was 68.9±9.57 and that of obese women was 73.12±26.78. There was no significant difference in average percentage prediction of FVC. 30% of males and 16% of females have normal FVC, 20% of males and 12% of females have severe reduction in FVC. There was no significant association between gender and FVC of the obese individual.

When FEV_1 was analyzed on gender basis, it was found that average FEV_1 of obese male was 2.54±1.17 litres and that of female was 1.81±0.44 litres. Obese women have significantly lower FEV_1 level than obese males. Average percentage prediction of FEV_1 among the obese men was 67.2±20.89 and that of obese women was 69.98±25.38. There was no significant difference in average percentage prediction of FEV_1. 24% females and 50% males have normal FEV_1 20% of females have severe restriction in FEV_1 but the difference is not statistically significant.

FEF 25-75% were analysed and conclusions are as follows:

Average FEF 25-75% of obese male was 2.4±1.45 litres and that of obese females was 1.98±0.87 litres. There was no significant association between gender and FEF. Severe obstruction was noted in 30% of males and 24% females but the observed difference is not statistically different.

There was no significant correlation between gender and FEV_1/FVC ratio and FEV1/FVC ratio prediction of obese individual.

Univariant linear regression analysis carried out keeping BMI as independent variable and FVC as dependent variable. It is observed that 2.5% variability in FVC can be influenced by BMI. Similarly keeping WHR as independent variable and FVC as dependent variable, analysis showed that 5-4% of variability in FVC is attributed to WHR.

Both the above univariate and multivariate linear regression model was used to predict FVC. In univariate regression it is found that BMI and WHR have no significant correlation with FVC. In multivariate regression analysis both BMI and WHR have no significant correlation with FVC, or regression coefficients.

Similarly univariate and multivariate analysis were carried out for the FEV_1 which shows that BMI and WHR have no significant correlation with FEV_1.

Obesity affects every organ system but consequences on the respiratory system are often under appreciated. The respiratory consequences of being overweight are predominantly mechanical and inflammatory element has been prepared. BMI is a widely accepted measure of obesity.

Studies have shown that dual energy X-ray absorptometry (DEXA) had significantly better correlation with the lung function impairment than anthropometric measurements. Adiposity on the thoracic cage and abdomen can have an effect on chest wall movement, airway size, respiratory muscle function and lung perform.

Respiratory muscle strength can be measured by maximum inspiratory and expiratory pressures. In obesity the reduction in chest wall compliance can lead to increased demands on the diaphragm. Respiratory muscle endurance can be measured by Pulmonary Function Tests (PFTs) by performing a maneouvre known as Maximal Voluntary Ventilation (MVV). Respiratory muscle endurance may be reduced as much as 45%in obese individuals[12]. Obesity leads to reduction in Expiratory Reserve Volume (ERV)[13].

The most frequent anomaly is the reduction in FRC and ERV caused by weight gain, which occurs exponentially and can be encountered with BMI values >30 Kg/m^2. As BMI increases there is reduction increases there is reduction in forced expiratory volume in 1st second (FEV_1) and Forced Vital Capacity. The FEV_1 to FVC ratio, a marker of airway obstruction is usually maintained unless there is coexistant airway disease.

Earlier studies conducted by YogeshSaxena, VarticaSaxena et al of Evaluation of Dynamic Function Tests in Normal obese individuals showed that obese females have significantly lower FVC and FEV_1 values than non obese females. Correlation bivariate analysis in males and females showed negative correlation between BMI and FVC and FEV, statistically significant only in females.

Obesity and lung function a systematic review by Luciana Costa Melo showed that the reduction of FVC occurs both in restrictive and obstructive diseases but the percentage of FEV_1 accompanies the reduction of FVC [53]. Such situation was found in the studies that evaluated these two variables suggesting a restrictive pattern [14,15,16]. This is explained by the alteration in ventilator mechanics experienced by the obese. The findings by Steela et al (55) demonstrate stronger relation of FVC and FEV_1 alteration in men than women. This is because make gender has a greater frequency of android fat deposit pattern while gynecoid fat is more common in female[17].

Obesity and pulmonary function in African Americans conducted by AlenMehrai and SameenaAfeen, decreasing with increase of BMI as shown in previous studies [18,19,20,21,22].

I the study conducted by Richard.L. Jones and Mary Magdaline- The effect of BMI on lung volumes, there were significant linear relationship between BMI and Vital capacity. Jones Rl et al studied pulmonary function results from 373 patients with wide range of BMI. He found significant inverse relationship between BMI and the values of vc and total lung capacity (TLC). Functional Residual Capacity and ERV decreased exponentially with increasing BMI. Morbid obesity resulted in the patients breathing near their Residual Volumes(RV).

In the present study, forced vital capacity (FVC) and forced expiratory volume in 1st second (FEV_1) will tend to decrease with increasing BMI. FEV_1/FVC ratio does not vary in obese due to fact that both spirometric variables FEV_1 and FVC are affected to the same extent. The most important change in pulmonary function in obesity is a disease in lung compliance due to increased weight of chest wall and highest position of diaphragm in the thoracic cavity resulting in a decrease in lung function which leads to increase in work of breathing.

CONCLUSION

1. Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1st second (FEV_1) were the most representative finding among the samples, both suggesting the presence of a restrictive respiratory pattern associated with obesity.
2. Pulmonary function test ie, both FVC and FEV_1 of obese female individual was less
3. Severe FVC restriction showed in 14.3% of obese individuals
4. FEV_1 reduction is seen in 20% of obese individuals
5. Female individuals are more affected with obesity than male individuals
6. Obesity leads to decrease in lung compliance due to increased weight of chest wall which leads to decrease in lung function
7. The present study showed highly significant increase in waist hip ratio is obese group which is highly correlated with abdominal fat mass. So it is used as a marker for abnamical obesity

REFERENCES:

1. World Health Organization; Obesity and overweight; http:/www.who.int/diet physical activity/publications/facts/pnesotu/en
2. Association of Body Mass Index with lung function Parameters in Non Asthmatics Identified by Spirometric protocols
3. WHO, http/www.who.int/gho.ncd/risk.factor/overweight-test/en/index htm
4. Allman-Farinelli Ma, Chet T, Banman AE, et al; age, period and birth Cohort effects on prevalence of overweight and obesity in Australian adults from 1900 to 2000. EurJclin Nutr.2007 (Eprint ahead of print)
5. Mc. TigueKM,Harris R, Hemphil B et al: Screening and interventions for obesity in adults: Summary of the evidence for the US preventive sciences Task force. Ann Intern Med 2003; 139(11): 933-949
6. Lewis CE, Jacobs Dr. Jr. McCreath H, et al; Weight gain continues in the 1990s; 10 year trends in weight and overweight from the CARDIA study. Coronary Artery Risk Development in Young adults. An I Epidemiol 2000; 151,1172-1181.
7. MC Gill HC, Jr MC Mahan CA, Herdericks FE et al obesity accelerates the prognosis of coronary athero in young men
8. WHO (1995) Tech. Rep. Ser. No. 854 and WHO (2000) Tech Rep. Ser. No. 894
9. Srinivas CH, MadhacilLatha M, SyryaKumari N, Surendranath; Comparative study of dynamic lung function tests in obese and nonobese individuals; Journal of Evaluation of Medical and Dental sciences 2013; Vol.2; Issue 35; September 2; Page 6736-6742
10. Koening SM, Pulmonary com. REso implication of obesity. American issual of the Medical Science 2001; 321: 249-279.
11. Ecsner MD, Bknic PD, Sidney S et al; Body composition and functional limitation in COPD, Respiratory Research 2007; 8:7
12. Engelen MP, Schols AM,Lamers RJ et al; Different patterns of chronic tissue wasting among patients with chronic obstition distance. Clinical Nutrition 1999, 18: 275-280
13. Landbe C, Prescott E, Lange P et al; Prognostic value of nutritional status in chronic obstructive pulmonary disease. American Journal of Respiratory and critical care medicine 1999; 160: 1856-1861.
14. Thygarajan B, Jacobs Dr. Jr, Apostol GG, Smith LJ, Jensen RL, Crapo Ro et al; Longitudinal association of body mass index with lung function: The CARDIA study Respir Res. 2008; 9:31.
15. Steele RM, Finucane FM, Griffin SJ, Waraham NJ, Ekelind U; Obesity is associated with altered lung function independently of physical activity and fitness obesity (silver spring); 2009; 7(3): 578-84
16. Saliman JA, Benditt JD, Fhim DR, Delschlager BK, Dellinger EP, Goss CH; pulmonary