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Respiratory Medicine

A COMPARITIVE STUDY OF PULMONARY FUNCTION TESTS AND BODY MASS INDEX IN YOUNG ADULT MALES

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ABSTRACT The present study was planned to study correlation between pulmonary function tests (PFT's) and BMI in young adult males.

DESIGN: 6 months cross-sectional study

Methods: The selected group of subjects were categorized into normal weight and overweight based on BMI. Before proceeding to the test a detailed clinical history was elicited followed by detailed clinical examination to rule out any illness/underlying disorders.

RESULTS: In the normal BMI group the mean of FEV1 was 3.19 ,it was 2.58 in the overweight group and was 2.41 in the obese group. FEV1/FVC% in normal BMI group was 95.92, it was 94.87 in the overweight group and was 94.69 in the obese group. In the normal BMI group, the mean for PEFR was 429.12, it was 367.86 in the overweight group and was 316.32 in the obese group.

CONCLUSION: Obesity influences the respiratory function enhancing dyspnoea and increasing both cardiac load and respiratory muscle fatigue of the thoracic wall and the diaphragm due to the higher pressure exerted by intra abdominal adipose accumulation. In the present study, clear association was found between indices of spirometry i.e. FVC, FEV1 and PEFR and increasing BMI in overweight and obese study group of young adult males as compared to young adult males of normal BMI.

KEYWORDS : : 1. FVC: FORCED VITAL CAPACITY, 2. FEV1: FORCED EXPIRATORY VOLUME IN 1st SECOND, 3. BMI: BODY MASS INDEX, 4. PEFR : PEAK EXPIRATORY FLOW RATE

INTRODUCTION:

The worldwide prevalence of obesity has nearly doubled between 1980 and 2008 [1] and is increasing at an alarming pace in India too. Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. [2] WHO recommends the use of body mass index (BMI) as the simplest form of defining obesity. [3, 4] Obesity is also linked with a wide range of respiratory conditions like chronic obstructive pulmonary disease (COPD), obstructive sleep apnoea (OSA), and asthma [5,6]

Obesity alters the relationship between the lungs, chest wall and diaphragm, increasing the resistance within the system which increases the work of breathing, and affects the gas exchange[7,8]This leads to limitations in pulmonary function tests and exercise capacity.[9] Previous studies have explored the association of age, sex, and anthropometric indices with pulmonary functions. [10,11] The present study was planned to be conducted in young adult males to assess the effect of BMI on their pulmonary function tests (PFT's) parameters and evaluate the association of BMI of study participants with various parameters of pulmonary function tests (PFT's).

AIMS AND OBJECTIVES

1. To compare various parameters FVC, FEV1 and PEFR of PFT's between overweight, obese and participants with normal BMI.
2. To evaluate the association of BMI with various parameters of pulmonary function tests (PFT's).

Inclusion Criteria:

1. Age 18 -24 years.
2. Sex-Males
3. Individuals who have given written consent.
4. Healthy individuals.

Exclusion Criteria:

1. Those who have physical deformities of the chest wall.
2. Individuals suffering from respiratory diseases such as pulmonary TB, chronic obstructive pulmonary disease, bronchiectasis, interstitial lung disease that might affect the pulmonary functions.
3. Individuals with present or past (in the last three months) history of upper respiratory tract or lower respiratory tract infections
4. Individuals with history of chronic exposure to substances which results in altered pulmonary functions.
5. Smokers
6. Alcoholics
7. Individuals suffering from Hypertension
8. Individuals suffering from diabetes mellitus

Methodology:

Study was conducted on out patients, total of 100 adult male participants, at Alluri Sitarama Raju Acadmey of Medical Sciences based on their BMI, classified according to Asian classification, were selected for the study. The study was conducted from July 2019 – January 2020 i.e 6 months.

RESULTS:

The present study was conducted on a total of 100 male participants to assess the effect of BMI on pulmonary function test parameters. The participants were grouped into three groups according to their BMI using the Asian classification [23] i.e. 30 (33%) participants had normal weight (BMI-19-22.9), 33(33%) were overweight (BMI 23-24.99) and 37 were obese (BMI 25-29.99)

FVC:

In the normal BMI group the Mean (+/- SD) of FVC was 3.33 (+/-0.46), it was 3.04 (+/-0.35) in the overweight group and was 2.83(+-0.27) in the obese group. The difference in the mean FVC values between the three study groups was found to be highly significant. (P<0.001)

FEV1:

In the normal BMI group the mean (+/-SD) of FEV1 was 3.19 (+/-0.48), it was 2.58 (+/-0.71) in the overweight group and was 2.41(+/-0.43) in the obese group. The difference in the mean FEV1 values between the three study groups was found to be highly significant. (P<0.001)

FEV1/FVC%:

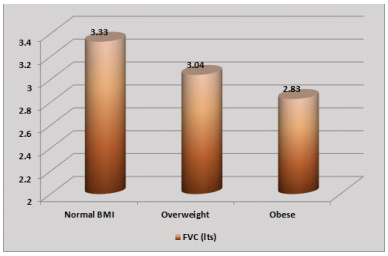
The Mean (+/- SD) of FEV1/FVC% in normal BMI group was 95.92 (+/-2.82), it was 94.87 (+/-4.14) in the overweight group and was 94.69(+-3.27) in the obese group. The difference in mean FEV1/FVC % between the three study groups was not found to be significant. (P=0.3)

PEFR:

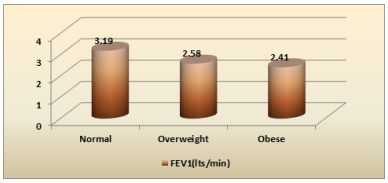
In the normal BMI group, the mean (+/-SD) for PEFR was 429.12 (+/-

44.69), it was 367.86 (+/-56.88) in the overweight group and was 316.32(+/-49.26) in the obese group. The difference in the mean PEFR values between the three study groups was found to be highly significant. (P<0.001)

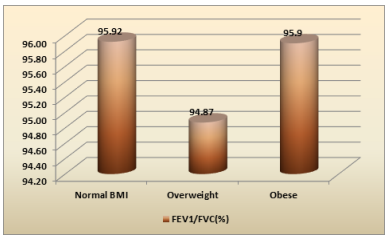
Graph 1: Mean FVC (Lts) In The Three Study Groups



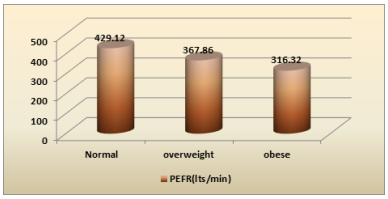
GRAPH 2: Mean FEV1 (Lts) in the three study groups



GRAPH 3.Mean FEV1/FVC (%) The Three Study Groups



Graph 4.Mean PEFR (Lts/Min) The Three Study Groups



DISCUSSION:

The present study was conducted to assess the effect of BMI on various parameters of pulmonary function tests (PFT's) i.e. FVC, FEV1, FEV1/FVC and PEFR in young adult males.

The present study selected subjects who were not having any previous history of serious medical illnesses (respiratory and non respiratory) which may have had an impact on the pulmonary function tests results.

FVC: In the present study, in the normal BMI group the Mean (+/- SD) of FVC was 3.33 (+/- 0.46), it was 3.04 (+/-0.35) in the overweight group and was 2.83(+-0.27) in the obese group. The difference in the mean FVC values between the three study groups was found to be highly significant. (P<0.001) and there was negative correlation of BMI with FVC in obese subjects (r = -0.16).

This finding of the present study was consistent with the study done by Chen Yue et al. who observed negative correlation of BMI with FVC in overweight and obese subjects when compared to normal subjects. [14] Intra abdominal pressure that has a mechanical effect on the diaphragm is suspected of being a major reason for the association of obesity with lung dysfunction. [14]

Similar findings were also seen in studies done by Sharlin B et al. [19] who observed a mean FVC of 3.14(+-0.7), 3.51(+-0.4) and 3.68(+-0.4) in normal, overweight and obese group respectively. Additionally, in the obese group BMI showed significant negative correlation with FVC (r = –0.3968)

Mahajan S et al. have observed a mean FVC of 3.45(+0.50) and 3.23(+0.40) in non obese and obese group respectively and Behera AA et al. [43] also showed mean FVC (3.36+-0.83) in their study. [20]

FEV1: In the present study, in the normal BMI group the mean (+/-SD) of FEV1 was 3.19 (+/-0.48), it was 2.58 (+/-0.71) in the overweight group and was 2.41(+/-0.43) in the obese group. The difference in the mean FEV1 values between the three study groups was found to be highly significant. (P<0.001).There was negative correlation of BMI with FVC in obese subjects (r = -0.22).

In the study by Banerjee J et al. [12] in obese subjects there was significant negative correlation observed in obese subjects between BMI and FEV1, (r=-0.531) which is comparable to that observed in the present study. Further suggestion of the predominance of a restrictive pulmonary function profile is offered by the lack of any significant effect of BMI on FEV1 in another study by Andrew J et al. [22]

Similarly, the study by Koraddi ST et al. showed Forced Vital Capacity (FVC) (2.83+-0.63) and mean Forced Expiratory Volume in first second (FEV1) significantly reduced in overweight (mean± SD 2.36±0.61) and obese subjects (mean±SD 2.82±0.30) when compared to normal weight subjects (mean± SD 2.90±0.33) .Also, both FVC,FEV1 were found to be negatively correlated {FVC (r = -0.253, p< 0.01), FEV (r = -0.236, p <0.05)} with adiposity markers. [16]

In the study by Attaur-Rasool S. obese subjects had significantly lower FVC% (p < 0.0001), as well as significantly lower FEV1% (p = 0.003) as compared to normal subjects which is similar to the present study. There were significant linear relationships between obesity and PFTs. BMI had significant negative linear association with FVC% in overweight (r = 0.197) and obese (r = 0.488) ; and with FEV1% in obese subjects (r = 0.510). [3]

FEV1/FVC: In the present study, the mean (+/- SD) of FEV1/FVC% in normal BMI group was 95.92 (+/- 2.82) it was 94.87 (+/-4.14) in the overweight group and was 2.41(+/-0.43) in the obese group. The difference in mean FEV1/FVC % between the three study groups was not found to be significant. (P=0.3).There was a weak correlation (r=0.1) of BMI with FEV1/FVC in obese subjects.

This is similar to the study by Koraddi ST et al. [55] who observed no significant change in FEV1/FVC ratio in overweight (mean±SD 76.12±15.08) and obese subjects (mean±SD 81.37±6.38) when compared to normal weight subjects (mean±SD 78.9±2.22).

Similar findings were also found with the study done by Mahajan S et al. [20] who observed a mean FEV1/FVC ratio of 81.35(+13.33) 81.42(+8.63)) in non obese and obese group respectively. Priyadarsini N et al. [63] have also reported similar findings in their study which are comparable to the present study.

In the present study, the FEV1/FVC ratio showed positive low correlation (r = 0.1). Other studies by Behera AA et al and by Banerjee J et al. [12] have found that there was a significant positive correlation of BMI with FEV1/FVC (r=0.603, p=0.002) in non-asthmatics thus also showed a similar pattern, suggesting the restrictive pulmonary effects of increased BMI [13]

Saxena Y et al. in their study observed mean FEV1/FVC (%) of 89.63(±2.68) in non obese and 89.50 (±2.47) in obese males. The difference in mean FEV1/FVC (%) between the two groups however, was not significant. [17]

The study by Banerjee J et al. also did not observe any significant association between BMI and lung function parameters (FVC, FEV1, FEV1/FVC, FEF25-75%) in obese male subjects. [12]

Paralikar SJ et al. in a similar study and observed that forced expiratory volume in the 1st second (FEV_1)/forced vital capacity (FVC) and maximum voluntary ventilation (MVV) were significantly decreased in the obese group (P < 0.001). [18]

PEFR: In the present study, in the normal BMI group, the mean (+/-SD) of PEFR was 429.12 (+/-44.69) in the normal BMI group; it was 367.86 (+/-56.88) in the overweight group and was 316.32(+/-49.26) in the obese group. The difference in the mean PEFR values between the three study groups was found to be highly significant. (P<0.001) A negative correlation between BMI and PEFR (r= -0.53) was also observed.

Sharlin B et al. observed a mean PEFR values of 287.68(+-167.46), 402.04+-(94.89) and 424.73(+-63.36) in overweight, obese and normal group respectively. [17]

Behera AA et al. observed a mean PEFR of 380.57(+-130.81) in their study which is lower than that of the present study. [13]

Joshi V, Shah S in their study observed a weak correlation between BMI and PEFR with Group A: BMI mean -18.74(±1.11) and PEFR mean – 395(±116.8), Group B: BMI mean - 28.7(±1.12) and PEFR mean – 309(±46). [15]

This is similar to the study by Koraddi ST et al who observed that PEFR significantly reduces in overweight (mean± SD 287.68±167.46) and obese subjects (mean± SD 402.04±94.89) when compared to normal weight subjects (mean± SD 424.73±63.36) and there was negative correlation of BMI with PEFR in obese subjects.[16]

This observation of the present study was also consistent with other similar studies done by Saxena Y et al. [17]

Ilango S et al. observed a mean PEFR OF 457.00 (± 63.92) in obese as compared to 523.50 (± 64.83) in non obese participants. These findings are higher than that observed in the present study. In males: There was a strong negative correlation between BMI and PEFR ($p < 0.002$, r value – 0.470) similar to the present study which also observed a negative correlation between BMI and PEFR (r=-0.53) [23].

CONCLUSION:

Obesity influences the respiratory function enhancing dyspnoea and increasing both cardiac load and respiratory muscle fatigue of the thoracic wall and the diaphragm due to the higher pressure exerted by intra abdominal adipose accumulation.

In the present study, clear association was found between indices of spirometry i.e. FVC, FEV1 and PEFR and increasing BMI in overweight and obese study group of young adult males as compared to young adult males of normal BMI.

Thus it is evident from the present study that being overweight /obese significantly affects the pulmonary functions which may give rise to long term complications and may lead to increased morbidity and mortality. But these hazardous effects of increasing BMI might be reversible and sustained loss of excessive weight by lifestyle interventions can improve lung function in obesity.

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