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RESEARCH ARTICLE

The study of pulmonary functions tests and fat distribution in overweight and obese adult males

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ABSTRACT

Background: Obesity is a global health hazard and its prevalence is increasing worldwide. Studies have shown that obesity, in particular, abdominal obesity is negatively associated to pulmonary functions. **Aims and Objectives:** The objectives of this study were as follows: (1) To compare the pulmonary function tests in non-obese, overweight, and obese individuals and (2) to find out the correlation of body mass index (BMI) with severity of pulmonary dysfunctions among obese individuals. **Materials and Methods:** The study was done in 90 adult males with the age group of 18–45 years having moderate sedentary lifestyle. All the anthropometric measurements are performed including BMI. Pulmonary functions tests were performed using SPIROLAB II (MIR) software. Statistical analysis was done using GraphPad Instat software and appropriate statistical test was applied. **Results:** Forced vital capacity (FVC%), peak expiratory flow rate, and maximal voluntary ventilation values were negatively correlated with BMI values in obese individuals and forced expiratory volume in one second/FVC% was positively correlated with BMI values suggestive of restrictive pattern of lung disease. **Conclusion:** The study shown that increased BMI and increased abdominal fat are associated with pulmonary dysfunction. However, large sample and subjects with all ages and both sexes are required to strengthen the results.

KEY WORDS: Body Mass Index; Pulmonary Function Tests; Obesity

INTRODUCTION

Overweight and obesity represent a rapidly growing threat to the health of populations in an increasing number of countries. Indeed, they are now so common that they are replacing more traditional problems such as undernutrition and infectious diseases as the most significant causes of ill health. Obesity comorbidities include coronary heart disease, hypertension and stroke, certain types of cancer, non-insulin-dependent diabetes mellitus, gallbladder disease, dyslipidemia, osteoarthritis and gout, and pulmonary diseases including sleep apnea.[1]

Nowadays, the standards of living continue to rise, weight gain and obesity are a growing global threat to health. In 2016, >1.9 billion adults, 18 years and older, were overweight. Of these, over 650 million were obese, 39% of adults aged 18 years and over were overweight in 2016, and 13% were obese.[2]

Studies have shown that obesity, especially abdominal obesity negatively, affects pulmonary functions. Increasing body mass index (BMI) is typically associated with a reduction in forced expiratory volume in one second (FEV1), forced vital capacity (FVC), total lung capacity, functional residual capacity, and expiratory reserve volume. With severe obesity, diaphragmatic movements are restricted and thoracic compliance is reduced.[3] Reduction in the body weight by lifestyle modification and exercise can improve the pulmonary functions.

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Aims and Objectives

The objectives of this study were as follows:

1. To compare the pulmonary function tests in non-obese, overweight, and obese individuals.
2. To find out the correlation of BMI with severity of pulmonary dysfunctions among obese individuals.
3. To create awareness in the society that reducing the body weight can improve the pulmonary functions and prevent the occurrence of other health consequences due to obesity.

MATERIALS AND METHODS

The present study was conducted in the Physiology Department, SBKS Medical College, Pipariya, Vadodara, during the period from December 2009 to September 2011. A total of 90 adult males, 30 obese, 30 overweight, and 30 non-obese, in the age group of 18–45 years, were selected for the study.

All the subjects have given written and informed consent for participating in the study. Ethical approval regarding the study was given by Sumandeep Vidyapeeth Ethical Committee, Pipariya, district Vadodara.

All the subjects were undergone detailed clinical history and systemic examination. The subjects having chronic lung diseases, cardiac disease, doing regular exercise or yoga, current or history of smoking, and seasonal allergic lung disease were excluded from our study. All the respiratory parameters were taken in sitting position.

The BMI was calculated by the standard formula of weight and height of all the subjects and accordingly considered as overweight (25 kg/m^2) and obese (30 kg/m^2). Waist circumference (WC) was measured using tailor's measuring tape and WC >90 cm was defined as abdominal obesity.[4] Similarly, hip circumference was measured and waist–hip ratio was calculated (>0.9 is called obese).

The respiratory parameters including FEV1%, FVC%, FEV1/FVC%, maximal voluntary ventilation (MVV), and peak expiratory flow rate (PEFR) were measured using SPIROLAB II (MIR) software. All the parameters were repeated thrice to get the best results. Statistical analysis of all the collected data was done using GraphPad Instat software and one-way ANOVA test, and Pearson correlation coefficient was applied.

RESULTS

The anthropometric variables observed from the study of pulmonary function tests in 30 overweight, 30 obese, and 30 non-obese adult males were shown in Table 1. In the study, weight, BMI, WC, and waist–hip ratio were found statistically significant in non-obese, overweight, and obese groups. The mean BMI of non-obese, overweight, and obese groups was 22.64 ± 1.79, 26.09 ± 2.12, and 29.84 ± 2.49, respectively. The mean WC in non-obese, overweight, and obese groups was 94 ± 1.35, 98 ± 3.76, and 104 ± 4.54, respectively. The mean waist–hip ratio in non-obese, overweight, and obese groups was 0.965 ± 0.13, 0.966 ± 0.18, and 0.969 ± 0.020, respectively.

Table 2 shows observed respiratory parameters in non-obese, overweight, and obese adult males between 18 and 45 years age group. In our study, respiratory parameters such as FVC%, MVV, and PEFR values were reduced significantly in overweight and obese groups. However, FEV1% and FEV1/FVC% ratio were increased significantly in overweight and obese groups.

Table 3 shows that in obese group showed significant negative correlation of BMI with FVC (r = −0.2563), FEV1

Table 1: Anthropometric variables in comparison between non-obese, overweight, and obese group

Parameters	Non-obese	Overweight	Obese	*P* value
	Mean±SD	Mean±SD	Mean±SD	
Age (years)	30.26±7.95	29.33±6.56	31.88±7.71	NS
Weight (kg)	64.30±6.14	70.18±5.85	77.16±6.53	<0.001
Height (m)	1.68±0.037	1.64±0.027	1.61±0.039	NS
BMI (kg/m^2)	22.64±1.79	26.09±2.12	29.84±2.49	<0.001
WC (cm)	94±1.35	98±3.76	104±4.54	<0.001
WHR	0.965±0.13	0.966±0.18	0.969±0.020	<0.001

BMI: Body mass index, WC: Waist circumference, WHR: Waist–hip ratio

Table 2: Comparison of respiratory parameters in non-obese, overweight, and obese group

Parameters	Non-obese	Overweight	Obese	*P* value
	Mean±SD	Mean±SD	Mean±SD	
FEV1%	82.24±3.66	84.56±4.80	88.16±5.37	<0.001
FVC%	96.32±2.86	80.34±3.86	72.44±4.35	<0.001
FEV1/FVC%	85.36±4.86	105.25±6.54	122.7±5.38	<0.001
MVV L/min	131.4±22.64	120.45±2.87	112.7±12.65	<0.001
PEFR L/sec	9.66±2.12	7.24±3.56	4.55±4.26	<0.001

FEV1%: Forced expiratory volume in one second, FVC: Forced vital capacity, MVV: Maximal voluntary ventilation, PEFR: Peak expiratory flow rate

Table 3: Correlation coefficient of respiratory parameters with BMI in obese adult males

Parameters	FEV1%	FVC%	FEV1/FVC%	PEFR
BMI	−0.2563	−0.3659	0.001569	−0.4526
P value	0.0765	0.5261	0.7545	0.0105

FEV1%: Forced expiratory volume in one second, FVC: Forced vital capacity, PEFR: Peak expiratory flow rate, BMI: Body mass index

(r = −0.3659), and PEFR (r = −0.4526). However, FEV1/FVC% ratio showed positive correlation with BMI values in obese groups.

DISCUSSION

The present study was aimed to evaluate the lung functions in non-obese, overweight, and obese individuals. The results shown that there is reduction in FVC%, PEFR, and MVV values and FEV1% and FEV1/FVC% ratio are increased in overweight and obese individuals as compared to non-obese individuals who are consistent with restrictive lung disease. The reason for this may be due to restriction in diaphragmatic movements and reduction in thoracic compliance due to excessive abdominal fat deposition.

Devershetty *et al*.[5] concluded that there are no significant differences in FEV1, FVC, and FEF 25–75% between the obese and non-obese adult females. However, there was a significant difference in FVC/FEV1 ratio and PEFR between the two groups similar to our study.

Malini *et al*.[6] found that MVV is reduced significantly in obese adult females as compared to non-obese females which coincides with our study.

Mahajan *et al*.[7] concluded in adult males that the values of FEV1, FVC, and MVV were significantly reduced in obese males similar to our study, but FEV1/FVC ratio, PEFR, and FEF 25–75% show insignificant changes.

Collins *et al*.[8] found that comparing pulmonary function tests between patients with a waist–hip ratio (WHR) <0.950 (lower body fat distribution) and subjects with a WHR of 0.950 or greater (upper body fat distribution) revealed that FVC, FEV_1, and TLC were significantly lower in the patients with upper body fat distribution. Our study was limited to subjects with lower body fat distribution only.

CONCLUSION

The present study shows that increase in abdominal obesity may affect pulmonary functions. Decrease in WC by weight reduction through lifestyle modification and regular exercise may improve the respiratory functions. The present study was limited to small group of adult males with 18–45 years age group. However, large sample size including subjects of all age groups and both sexes is required to strengthen the study results.

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