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Original Research Article

Assessment of the Effect of Body Compositions Such as BMI, Waist Hip Ratio, Body Fat Composition on Vital Capacity Index

Anant Kumar [1], Rajiva Kumar Singh[2], Priyanka[3]

[1]Tutor, Department of Physiology, Patna Medical College & Hospital, Patna, Bihar, India.

[2]HOD, Department of Physiology, Patna Medical College & Hospital, Patna, Bihar, India.

[3]Assistant Professor, Department of Anatomy, Government Ayurvedic College, Patna, Bihar, India

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Corresponding author: Anant Kumar
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Abstract

Aim: To study the effect of body compositions such as BMI, waist hip ratio, body fat composition on lung function and also to correlate any changes with gender difference.

Materials and Methods: A total of 164 medical students aged 18-23 years were taken into study. Height, weight, waist hip ratio (Wt HR), Body M ass Index (BMI), were recorded. Data was analyzed statistically by using SPSS 20.0 software.

Results: Lung function assessed as vital capacity index (VCI) was negatively correlated ($r<0;p<0.05$) with VAT, SAT, BMI, Wt HR, BFP for both male and females. Body anthropometric measurements like

waist to hip ratio (Wt HR), BMI and lung function tests like vital cap a city index (VCI) are more in males. There was no much significant difference in Intra-abdominal adipose tissue (IAAT) in males and females.

Conclusion: There was an inverse correlation between lung function with fat accumulation in the body.

Keywords: Visceral adipose tissue, subcutaneous adipose tissue, Vital capacity index, visceral fat area, College students.

Introduction

Abdominal fat distribution has been associated with increased risk of different diseases, including cardiovascular disease, type 2 diabetes, and inflammatory bowel disease [1, 2]. Increased abdominal fat distribution has been correlated with higher levels of triglyceride, total cholesterol, and low-density lipoprotein cholesterol, which contribute to subsequent high blood pressure and cardiovascular risk [3].

The mechanics of respiratory function are determined by an interaction of the lungs, the chest wall and respiratory muscles. Since John Hutchinson published his studies on the use of the spirometer [4], factors affecting the interpretation of respiratory function measurements have been of interest. Obesity is one factor that has been shown, in most studies, to be associated with lower static lung volumes but spirometric lung volumes and airflow are usually within normal limits except in massive obesity [5-7].

Breathing is vital for survival, and any changes in respiratory function will have an effect on performance of regular activities. Past studies have shown that fat is related to impaired metabolism, along with reduction in pulmonary volumes such as total lung capacity and vital capacity.[8]

Body mass index (BMI, calculated as weight in kilograms divided by height in meters squared) that is commonly used to define overweight or obesity has been negatively associated with lung functions evaluated by vital capacity, forced expiratory volume in 1 s (FEV1), and forced vital capacity (FVC) [9,10]. In addition, increased waist circumference (WC), waist-to-hip ratio (WHR), and body fat percentage (BFP) that are used to measure body fat distribution have been linked to impaired lung functions, which is suggestive of the essential roles of fat accumulation in lung functions [9–14].

In a 2012 cross-sectional study, Park et al. found a significant correlation between body fat content and FVC in both men and women with normal weight [15]. In contrast, a study conducted by Lad et al. found a correlation between fat content and FVC in the female group but not in the male group [16].Therefore, we aim to study the effect of body compositions such as BMI, waist hip ratio, body fat composition on lung function and also to correlate any changes with gender difference.

Materials and Methods:

A total of 200 medical students of aged 18-23 in which 113 were females and 87 were males were taken into study. The study was explained and informed consent was taken from individual participant.

Participants with respiratory, cardiovascular diseases and previous history of anti-tuberculosis medication, smoking, any history of chest trauma and major surgeries were excluded from the study.

Methodology

Weight and height of the individuals were taken where the individual is having light weight clothing and with no foot wear. Height was measured in centimeters by height chart and weight in kg by using digital weighing machine. Waist-to - hip ratio, is the ratio of circumference of the waist to circumference of the hips. Waist circumference was measured by taking the mid-point between lowest palpable rib and top of iliac crest (approximately at the point of umbilicus) while the Hip measurement is at the widest part of buttocks with measuring tape. BMI was calculated as weight divided by square of height in meters (Kg/m2).

Body fat compositions were measured using Omron Karada scan – body composition monitor model HBF - 375. This device uses biochemical impedance to estimate fat percentage. Depending on where fat is accumulated it is divided into Intra-abdominal adipose tissue (IAAT) and Subcutaneous adipose tissue (ScAT). Vital capacity was estimated using alpha vital graph spirometer.

Statistical analysis was performed using the SPSS version

20.0 software. Analysis of variance (ANOVA) was used to assess the statistical significance, $P < 0.05$ was taken as statistically significant the correlation between VCI and Body fat indices was done by Pearson's correlation relation factor r is calculated and is analyzed as $r < 0$ is negatively correlated, $r=0$ is nil significant $r > 0$ positive correlation.

Results:

A total 200 students were taken into study. Their age, body compositions and vital capacity index are tabulated as mean and standard deviations in Table 1.

As revealed from Table 1 male participants showed significantly higher BMI, Wt HR, VCI, compared with females. Female participants showed relatively more BFP, ScAT than males. There was no significant difference in IAAT between females and males.

Correlation of body indices and vital capacity index for both males and females were done using Pearson's correlation.

As evident from table 2 males body indices such as BFP, IA AT, ScAT, BMI, Wt HR showed negative correlation with VCI (r<0, P<0.01). Females showed similar result as men.

Table 1: Body compositions and vital index in the participants

Parameter	Total (164)	Men (71)	Women (93)	P value
Age (years)	17.76 + 2.56	23.81 + 2.71	22.71 + 2.91	0.421
Height (cm)	182.11 + 8.21	179.2 + 8.19	187.20 + 7.72	0.000*
Weight (kg)	70.28 + 7.91	63.81 + 10.28	55.01 + 8.72	0.000*
BMI	22.10 + 1.62	27.93 + 4.82	27.81 + 8.91	0.002*
Wt HR	1.52 + 0.90	3.81 + 1.62	1.82 + 0.81	0.030*
BFP(%)	23.81 + 9.19	17.62 + 8.62	28.82 + 7.99	0.000*
ScAT(kg)	11.72 + 5.72	9.01 + 2.72	18.20 + 4.81	0.000*
IAAT(kg)	2.72 + 1.71	1.62 + 0.90	1.92 + 0.20	0.791
VCI(ml/kg)	68.10 + 14.92	70.71 + 18.28	61.89 + 16.09	0.000*

BMI- Body Mass Index, Wt HR -Waist Hip Ratio, BFP-Body Fat percentage, ScAT-subcutaneous adipose tissue, IAAT-Intra abdominal adipose tissue, VCI-Vital Capacity index
*P<0.05 is statistically significant

Table 2: Pearson's correlation analysis between body composition indices and vital capacity index

Parameter	Men r value	p value	Women r value	p value
BFP	-0.371	<0.01*	-0.301	<0.01*
IAAT	-0.401	<0.01*	-0.382	<0.01*
ScAT	-0.428	<0.01*	-0.390	<0.01*
BMI	-0.342	<0.01*	-0.327	<0.01*
Wt HR	-0.381	<0.01*	-0.356	<0.01*

BFP-Body Fat percentage, IAAT-Intra abdominal adipose tissue, ScAT-subcutaneous adipose tissue,, BMI- Body Mass Index, Wt HR-Waist Hip Ratio.
***p<0.05 is statistically significant, r<0 negatively correlated.**

Discussion:

In the present study 200 medical students were recruited to study the effects of abdominal fat distribution on lung function. We found that abdominal fat parameters such as BFP, IAAT, and ScAT are negatively correlated with Vitalcapacity index in both males and females. Abdominal fat distribution has been associated with type 2 diabetes, coronary heart disease, and irritable syndrome and also impaired lung functions. In a similar study IAAT, BMI, Waist circumference are inversely associated with impaired lung function in men aged 50-70 years with the metabolic syndrome.[17]

Dual energy X-ray absorptiometry (DXA) and bioelectrical impedance analysis are two common methods to determine body composition. DXA method is featured with high accuracy and has been recognized as a gold standard technique to measure human body composition. [18, 19]

Sex differences in fat distribution are well documented.

Women are generally characterized by having more SAT, whereas men are more prone to high amounts of VAT [20-22], which is consistent with our finding although the VAT difference between men and women was not statistically significant.

Results found by Joshi et al. and Jeelani et al. who reported a negative correlation between fat percentage and FVC [23, 24].Furthermore, the study by Jung et al. also found similar results regarding a correlation between the fat percentage and FVC in men but not in women [25,26].

In the current study VCI is inversely correlated with BFP, IAAT, ScAT in each the genders, however VCI is more negatively correlated with IAAT in males and ScAT in females, suggesting a gender difference in fat distribution and its impact on lung functions confirming our hypothesis.[27, 28]

In addition to VAT, VFA, and SAT, we also showed that the BMI, FM, BFP, and WHR were negatively correlated with the vital capacity index. The increase of BMI, body fat rate, and WHR has been related to the development of obesity, whose increase is indicative of excessive fat accumulation in the abdominal cavity and on the chest wall. These changes will impair pulmonary function by affecting vital capacity and breathing regulation, as well as increasing the work of breathing, reducing lung volumes, rendering respiratory muscles dysfunctional, and impairing gas exchange [29-32].

Conclusion:

Taken together, we conclude that lung function is highly associated with abdominal fat distribution in young adults. Female and male VCIs are more negatively correlated with SAT and VFA separately.

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