Original Article

Indian Journal of Anatomy
Volume 8 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/ija.2320.0022.8319.11

Comparative Study of Body Mass Index (BMI), Body Fat Percentage and Muscle Mass in Male and Female Medical Students

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Abstract

Objectives: According WHO increased BMI is major risk factor for major non communicable diseases like Diabetes Mellitus, Heart diseases, Some form of cancers etc. prevalence of obesity has increased significantly in past few decades. WHO considers BMI as important parameter to assess the degree of obesity. Our present study was aimed to study other better way to assess the Obesity which is a better indicator than BMI. *Materials and Methods:* Present study was conducted on 130 subjects of 18 years of age, of both sexes, of these 80 subjects were non-obese females and 50 were non-obese males. This study was conducted in the department of anatomy, GSL Medical College, Rajamahendravaram, AP by using body composition monitor (model-BHF-362, KARADA SCAN). *Results:* On analyzing the results it is found that body fat percentage in females is significantly more (p-Value < 0.0001) when compared to male subjects of same age and almost equal BMI (mean BMI 23.08 and 23.48). Significant difference was also found in the regional distribution of Fat. *Conclusion:* As there is significant difference in body fat% and its distribution among males and female subjects, body fat percentage should be consider for assessment of degree of obesity rather than BMI.

Keywords: Obesity; BMI; Body fat Percentage; Body composition monitor.

How to cite this article:
N. Surya Kumari, Amit Singh Bharati, CH. Srinivas. Comparative Study of Body Mass Index (BMI), Body Fat Percentage and Muscle Mass in Male and Female Medical Students. Indian J Anat. 2019;8(3):1204-207.

Introduction

The prevalence of obesity and overweight among children and adolescents aged *5–19 Years* has increased from 4% to 18% in a span of *41 years i.e.,* from 1975 to 2016. According to WHO in 2016, about 39% of adults *aged 18 years* and above were overweight and overall 13% were obese[9] WHO states raised Body Mass Index (BMI) is a major risk factor for major non-communicable diseases such as Diabetes mellitus, heart diseases, stroke and certain cancers like carcinoma colon and endometrium.[10]

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Received 04.07.2019 | **Accepted** 27.07.2019

WHO uses BMI as rough guide to categorize people in to overweight and obese but reliability of BMI as single dependable parameter to measure Obesity is the controversial topic among many medical and Health care researchers.

The American society of Bariatric physicians defines Obesity as ≥ 25 % body fat for males for females ≥ 30 % and these group of doctors will consider Body fat % rather than BMI when it comes to selecting patients for medical line of management for obesity and overweight.[7] Not only gender ethnicity may also be one of the important factor in relationship between BMI and Body Fat %, such differences were also found by M Deurenberg. Yap *et al.* in their study on Singaporeans, stated that they have higher body fat % at a lower BMI when compared with Caucasians.[5] But this ethnicity influence is not found in all the studies that are conducted.[6]

Apart from BMI and Body fat percentage the visceral fat is another most important indicator which correlates well with development of

conditions like Insulin resistance, cardiovascular diseases etc. Anthropometric measurements are indirect ways to assess the visceral fat, but most accurate ones are expensive CT scans and MRI scans[1] here we have opted bioelectrical impedance analysis for estimation of body fat% and visceral fat to compare with BMI.

Materials and Methods

This present research is conducted on 1st MBBS male and female medical students of *18 years of age*. College ethics committee permission obtained and informed written consent taken from all the voluntary participants. Total numbers of participants were 130 of which 50 were males and 80 female subjects. All the subjects included in the study were healthy and non-obese. Height of the subjects is measured without foot wear in meters nearest to 0.1 *cm* by using a wall mounted height measuring scale (WS-708). After feeding the data like age, gender, height of the subject the weight, BMI, Body fat%, skeletal Muscle Mass and regional distribution of the body fat and skeletal muscle mass were measured with the help of Body composition monitor with scale (Model-HBF-362, Karada Scan) which estimates the body fat% by bioelectrical impedance (BI) method. This method doesn't expose the individuals to radiation unlike CT scan.

All the measurements were taken 2 hours after consumption of food or before having lunch. The other precaution taken before the measurement was avoiding consumption of large quantity of water or liquid diet because the water content in the body may influence the accuracy of the readings.

Results

The data recorded from the subjects (50 males and 80 females) was statistically analyzed. Mean and standard deviations were calculated first and with that unpaired student *t*-test is used to test the statistical significance of the difference between body fat percentage, visceral fat percentage etc. of male and female subjects.

All the subjects are of *18 years of age* and their mean BMI was 23.0833 kg/mts^2 and 23.4833 kg/mts^2 females and males respectively. Though there is significant variation in their height and weight their BMI doesn't show any significant variation ($p < 0.5955$) (**Table 1)**.

Table 1: Comparison of Body Fat% and its distribution in the subjects

Sl. no.	Parameter		Females $n = 80$		Males $n = 50$		*t*-value	*p*-value
			Mean	STDEV	Mean	STDEV		
1	Height *cms*		160.4722	± 5.9312	172.6667	±8.6922	9.621	0.0001
2	Weight *Kg*		59.7388	± 6.8869	71.3333	±23.1415	4.213	0.0001
3	Fat %		29.3111	± 4.5658	20.2833	±7.7501	8.501	0.0001
4	BMI Kg/m^2		23.0833	± 2.7942	23.4833	± 5.5019	0.5323	0.5955
5	Visceral fat%		3.4117	± 1.4166	6.8333	± 5.3980	5.4006	0.0001
6	Whole body	Subcutaneous fat%	25.7277	± 4.1568	14.1833	± 5.6731	13.5312	0.0001
		Muscle mass%	26.3166	± 1.9336	34.4333	± 3.3174	17.6781	0.0001
7	Trunk	Subcutaneous fat%	21.6277	± 4.3509	12.6166	± 5.6333	10.3166	0.0001
		Muscle mass%	21.2111	± 2.1047	27.7833	± 4.6926	11.0950	0.0001
8	Legs	Subcutaneous fat%	39.2111	± 5.7704	21.15	± 8.3685	14.6948	0.0001
		Muscle mass%	38.7277	± 1.5726	51.6666	± 3.1982	32.1179	0.0001
9	Arms	Subcutaneous fat%	42.3722	± 5.6388	21.8	± 7.7822	17.5954	0.0001
		Muscle mass%	28.1833	± 3.4758	40.0166	± 3.0667	19.7711	0.0001

The total mean body fat% in females is more (29.3111) than the male subjects (20.2833) which is statistically significant (p-value < 0.0001). But visceral fat% is significantly more in males than in females (mean 6.8333 males, 3.4117 females with p-value < 0.0001), shown as in **(Figs. 1, 2** and **3).**

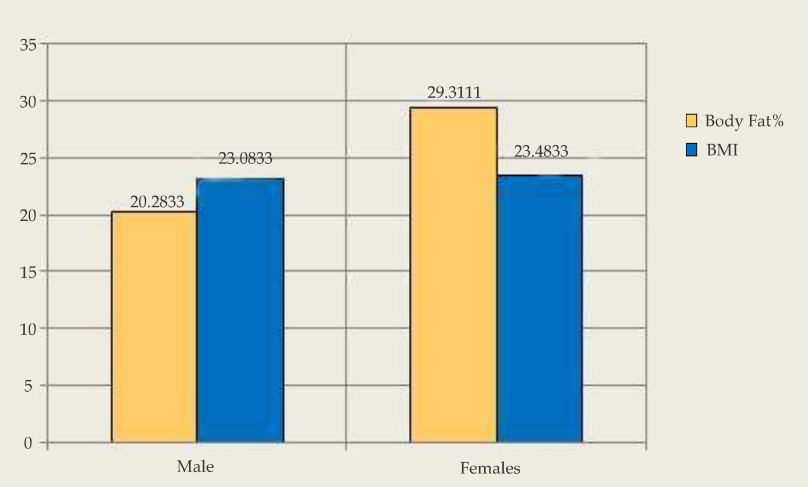

Fig. 1: Comparison of mean BMI and Body Fat% between male and female subjects

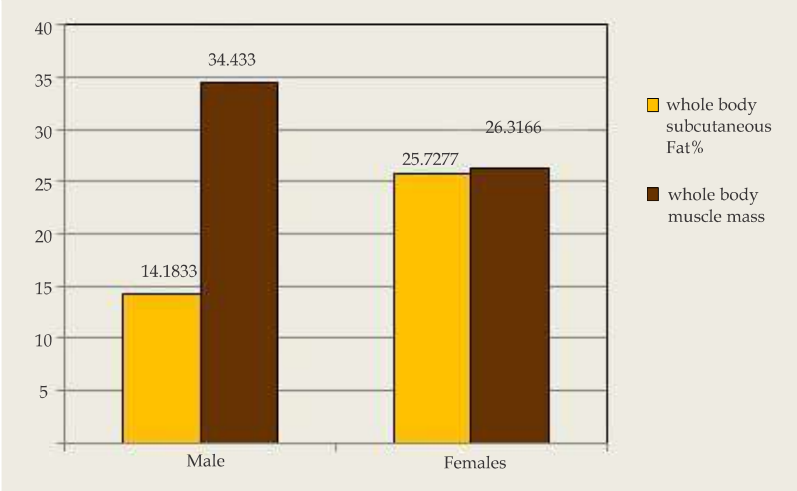

Fig. 2: Comparison of whole body subcutaneous fat % and muscle Mass% between male and female subjects

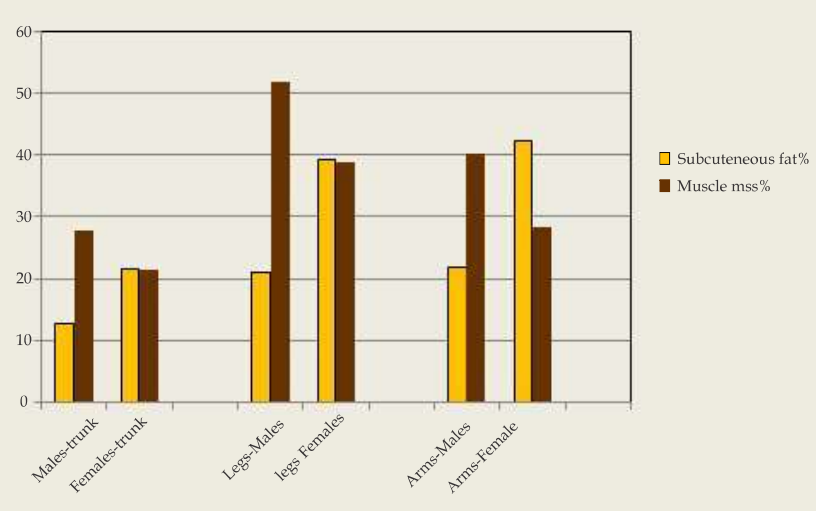

Fig. 3: Comparison of regional distribution of fat and muscle mass among male and female subjects

Discussion

The present study conducted on non-obese 130 medical student (50 Males and 80 Females) of *18 years of age*. We found that the total body fat% was more in the females when compared to males though there is no much difference in their BMI. It is also found that the visceral fat% of males is more than in females. When the regional distribution of muscle mass and subcutaneous fat% is compared, overall muscle mass in males is more than females and *i.e.*, more pronounced in their lower limbs. When it comes to subcutaneous fat% female subjects showed more amount of subcutaneous fat than males and this difference in percentage is more pronounced in the upper limbs.

According to the diagnostic accuracy of BMI to detect body adiposity diminishes with increase in age of the person[4] but our study on the subjects of same age to avoid above said dilemma. Pasco *et al.* in their population study mentioned that BMI markedly under estimate adiposity in young men (aged 20–29). If only BMI is used to assess obesity one may not distinguish the contributions of fat and muscle mass to the total body weight, as the non-fat tissues have greater densities than fat, BMI may overestimate adiposity in muscular and lean body builds.[3]

Ethnicity influences were also there on the body fat% and South Asians have more body fat% as stated by Ranasinghe *et al.* in their research, even our present study also showed that body fat% is more when compared to BMI. Their study also showed in females body fat% is significantly more than male counterparts, which is in consistency with our study.[8] In this present study we have included subjects of same age group to avoid age wise changes in the body composition as explained by Havagiray R chitme et al in their study among college students about body fat distribution. Even our present study similar pattern of body fat distribution is found in the students.[2] In our study we have studied regional distribution of fat in both male and female students and compared the patterns as mentioned in the results.

Conclusion

In female subjects the BMI appears to be less but body fat% is significantly more which opposite in males. In males though their body fat% is significantly less than females, their visceral fat% is significantly more.

Keeping these findings in mind one should not consider BMI as only parameter to assess degree of obesity but body fat% and gender differences in its distribution also be taken in to account.

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