International Journal of Medical Science and Education
pISSN- 2348 4438 | eISSN-2349-3208
Published by Association for Scientific and Medical Education (ASME)
Int.J.Med.Sci.Educ. July-Sept. 2019; 6(3):95-99
Available Online atwww.ijmse.com
www.ijmse.com

Original Research Article

USEFULNESS OF ANTHROPOMETRIC PARAMETERS AND THE BIOELECTRICAL IMPEDANCE ANALYSIS IN ASSESSMENT OF OBESITY IN YOUNG ADULTS

Dr. Chandrakant Kamariya[1], Dr.Uday Vachhani[2]
1. Associate Professor, Department of Biochemistry, PDU Medical College, Rajkot, India 2. Associate Professor, Department of Biochemistry, GMERS Medical College, Himatnagar, India
*Corresponding author – **Dr. UdayVachhani**
Email id –uday.vachhani@gmail.com

Received:11/07/2019 ***Revised:20/09/2019*** ***Accepted:25/09/2019***

ABSTRACT

Background: Overweight and obesity defined as abnormal or excessive accumulation of fat among the body which will impair health. It is one of the imperial factor in associated with increased metabolic risk and development of many chronic illnesses such as heart disease, respiratory illness, diabetes, hypertension, and some cancers. Body mass index (BMI), the most applicable anthropometric measure, is a general adiposity predictor, whereas bioelectrical impedance analysis (BIA) was established as measures of body fat percentage. **Material & Methods:** Total202 medical students, 94 males and 108 females, age between 17-20 years were enrolled in this cross sectional study. BMI and waist-to-hip ratio (WHR) were obtained by measuring Weight, height, waist circumference (WC), and hip circumference (HC). Total body fat, visceral fat and skeletal muscle mass and their distribution in different parts of the body were measured by professional bioelectrical impedance analyser. **Results:** Total body fat and visceral fat were higher in overweight males (26% and 10%) and females (34% and 7.3%) respectively. Significant positive correlation was observed between anthropometric parameters and regional distribution of subcutaneous fat and skeletal muscle mass in male and female. The correlation between BMI values and body fat percentage were 0.86 and 0.72 in males and females respectively (P<0.001) and for visceral fat were 0.99 and 0.95 in males and females respectively (P<0.001). **Conclusion:** From the findings, it could be inferred that body fat percentage analysis by BIA is as reliable as anthropometric parameters like BMI and WC for obesity assessment.

Keywords:: Body mass index, Bioelectrical impedance analyser, Overweight, Obesity

INTRODUCTION

Overweight and obesity are outlined as abnormal or excessive accumulation of fat within the body that will damage health **(1)**. During the previous couple of decades, the prevalence of obesity has exaggerated and has become a considerable world health hazard **(2).**Excessive body fat is associated with increased metabolic risk, and its measurement is important in implementing curative and preventive health measures. Urbanization, sedentary lifestyle, and high energy intake are important risk factors for obesity and increased prevalence of these risk factors, obesity is going to be a major problem in developing countries in the future.

Quality health is especially important for medical students and healthcare employees who need to be role models in terms of health awareness. Obesity is common among the medical students and health care personnel everywhere in the world together with India **(3,4)**. A range of factors are concerned as contributory factors such as, life of medical students is busy, active and stressful which would require life-style changes that could lead to the development of obesity and associated co-morbidities **(5,6).**

Measures of central obesity are superior to BMI, and for the diagnosis of metabolic syndrome BMI did not include as criteria that is found in some studies **(7,8).** BIA a comparatively simple, fast, non-invasive, highly reliable, easy-to-use and widely used method for testing body composition. BIA analysis is based on the principle that conductance of a small alternating current through the body is measured **(9).** Body fat percentage calculated by BIA was quite similar to dual energy x-ray absorptiometry (DEXA) and hydrostatic weighing method showed by ErcegDN et al. **(10).** DEXA method is considered a gold standard for the assessment of body composition, it may have some restrictions, including the cost, only be possible to use in small studies and complexity of the method.

Thus in this study an attempt have been made to determine the prevalence of overweight/obesity in young adults and to find the association of anthropometric parameters (BMI, WC) and BIA in assessment of obesity.

MATERIALS & METHODS

This cross-sectional analysis was carried out at GMERS Medical College and Hospital, Himatnagar after taking prior permission from institutional ethical committee. Total 202 medical students, 94 males and 108 females, age between 17-20 years were enrolled in the study after taking written informed consent. The students with acutely ill health or refusal to sign the consent form were excluded.

Anthropometric parameters comprised BMI, WC, HC and WHR. Body weight was measured in kilograms without shoes using Omron weighing machine and body height was taken in centimeters, with barefoot using standardized measuring tape. Quetelet's index was used to compute BMI as kilograms divided by height in meters square. The reference range of BMI is defined normal as 19.0- 24.9 kg/m^2, overweight as a BMI of 25.0 to 29.9 kg/m^2, and obesity as BMI ≥30.0 kg/m^2(11). The students' BMI was classified into 3 groups as Underweight (BMI <19.0 kg/m^2), Normal (BMI from 19.0 to 24.9 kg/m^2), and Overweight (BMI ≥25.0 kg/m^2).

Waist circumference could be a comparatively easy and convenient tool to assess the amount of abdominal fat. Variation in gluteofemoral muscle mass and bone structure is depending on hip circumference measurements. WC was measured at the level of umbilicus at top of iliac crest and HC around widest part of buttocks using non stretchable measuring tape. WHR was calculated from WC/HC ratio.BIA was used for analysis of BMI, total body fat, visceral fat, skeletal muscle mass and their distribution in different parts of the body. These parameters were recorded using professional body composition analyser, Omron Karada Scan-HBF-375 (Japan) that works on the principle of bioelectrical impedance. All the parameters were recorded by well trained technician.

Statistical Analysis was performed using the Microsoft Excel 2007. Mean, median and standard deviations were used as descriptive variables. Comparison between multiple groups was done by Student's t-tests and ANOVA analysis. Statistical relationship between BMI and data derived from BIA was tested by Pearson's correlation coefficient. For all analysis, $p < 0.05$ was taken as statistically significant.

RESULTS

A total 202 medical students were investigated during the study, of which 46.5% (94) males and 53.5% (108) females with mean age of 18.5 years (ranging from 17-20 years). Mean value of anthropometric parameter and BIA data were compared amongst males and females. p-value was <0.001 for all above parameters, which is statistically significance (Table 1). Prevalence of obesity and central obesity based on BMI was not significantly different in males and females.

Table 1: Mean value of anthropometric parameter and bioelectrical impedance analysis data based on sex

	Total(202)	Male(94)	Female(108)	p Value
Weight (kg)	57.8±12.3	63.8±11.5	52.6±10.5	<0.001
BMI (kg/m^2)	21.46±3.6	21.8±3.5	20.9±3.6	0.15
WC (cm)	77.2±9.5	78.8±9.1	75.8±9.7	0.06
WHR	0.8±0.1	0.8±0.1	0.8±0.1	<0.001
Total body fat	23.6±6.1	19.3±5.2	27.4±4.1	<0.001
Visceral fat	3.8±2.9	5.1±3.2	2.7±2.1	<0.001
WholebodySCF	18.6±6.7	13.2±3.9	23.3±4.7	<0.001
Trunk SCF	15.9±5.6	11.9±3.4	19.3±4.8	<0.001
Arms SCF	30.8±11.2	20.3±5.3	39.9±5.5	<0.001
Legs SCF	28.5±9.8	19.9±5.2	36±5.8	<0.001
Wholebody SM	30.7±4.8	35.3±2.5	26.7±1.9	<0.001
Trunk SM	25.3±4.4	28.9±3.5	22.2±2.2	<0.001
Arms SM	35.3±6.1	40.9±2.3	30.4±3.8	<0.001
Legs SM	44.6±7.6	52.4±2.6	37.8±1.6	<0.001

Table 2: Correlation between BMI and regional distribution of subcutaneous fat and skeletal muscle mass based on sex

	Parameters	Total body fat	Visceral fat	Whole body SCF	Trunk SCF	Arms SCF	Legs SCF	Wholebody SK	Trunk SK	Arms SK	Legs SK
Male	**BMI (kg/m^2)**										
	Pearson correlation	0.86	0.99	0.78	0.79	0.85	0.85	-0.90	-0.84	-0.96	-0.88
	p Value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Female	**BMI (kg/m^2)**										
	Pearson correlation	0.72	0.95	0.92	0.93	0.83	0.70	-0.72	-0.69	-0.97	-0.7
	p Value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 3: Correlation between WC and regional distribution of subcutaneous fat and skeletal muscle mass based on sex

	Parameters	Total body fat	Visceral fat	Whole body SCF	Trunk SCF	Arms SCF	Legs SCF	Wholebody SK	Trunk SK	Arms SK	Legs SK
Male	**WC (cm)**										
	Pearson correlation	0.82	0.83	0.72	0.15	0.80	0.79	-0.78	-0.75	-0.84	-0.78
	p Value	<0.001	<0.001	<0.001	0.13	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Female	**WC (cm)**										
	Pearson correlation	0.56	0.79	0.70	0.68	0.59	0.46	-0.45	-0.43	-0.75	-0.07
	p Value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.46

Table 2,3 shows correlation of BMI and WC with regional distribution of subcutaneous fat and skeletal muscle mass in male and female. Pearson's correlation coefficient (r) as well as p-value in Table 2,3 showed strong positive relationship of BMI and WC with total body fat, visceral fat and subcutaneous fat in both male and female groups. Negative value of correlation coefficient (r) in table 2,3 showed as BMI and WC increase, skeletal muscle mass all around body reduce with increase in fat distribution.

Table 4 compares fat distribution and skeletal muscle mass with three groups, underweight, normal and overweight based on BMI. Total body fat and visceral fat were higher in overweight males (26% and 10%) and females (34% and 7.3%) respectively. The visceral fat was slightly higher in males compared to female while the subcutaneous fat was higher in the females than the males and more in the arms and legs than in the trunk area in both males and females (Table 4).

The skeletal muscle mass constituted about 32% in the overweight males and 23% in the overweight females. The arm and trunk areas had less muscle mass than leg area (Table 4). Thus, BMI demonstrated significant correlation with fat distribution and skeletal muscle mass.

Table 4: Regional distribution of total body fat, visceral fat, subcutaneous fat, and skeletal muscle in underweight, normal and overweight male and female subjects.

	Male			Female		
Variable	**Underweight (22)** **BMI < 19**	**Normal (56)** **BMI 19 -24.9**	**Overweight (16)** **BMI ≥ 25**	**Underweight (34)** **BMI < 19**	**Normal (62)** **BMI 19 -24.9**	**Overweight (12)** **BMI ≥ 25**
Total body fat	12.5±2.0	20.0±2.9	26.2±3.3	23.6±2.6	28.1±2.1	34.7±3.2
Visceral fat	1.3±0.8	5.2±1.5	10.1±2.6	0.9±0.3	2.7±0.9	7.3±2.3
WholebodySCF	8.2±1.4	13.6±2.2	18.6±2.3	18.6±2.2	24.2±2.1	32.1±4.1
Trunk SCF	7.4±1.5	12.2±1.5	17.2±1.4	14.1±2.4	20.6±2.0	27.8±3.9
Arms SCF	14.1±2.4	20.8±3.3	27.3±3.9	33.8±3.5	41.6±2.5	48.4±4.3
Legs SCF	13.0±2.1	20.5±2.2	27.0±4.4	30.2±2.9	37.1±2.3	47.0±5.7
Wholebody SM	38.4±1.1	35.0±1.4	32.0±1.8	28.6±1.2	26.3±1.3	23.8±1.0
Trunk SM	33.4±1.7	28.5±2.1	24.4±2.4	24.3±1.4	21.7±1.1	18.4±1.6
Arms SM	44.0±0.9	40.6±1.2	37.8±1.2	34.1±1.6	29.7±1.5	23.2±3.7
Legs SM	55.5±1.1	52.1±1.7	49.0±1.8	38.4±1.5	37.7±1.5	36.7±1.4

DISCUSSION

Overweight is the one of the most common problems associated with today's lifestyle. The surprising increase in obesity prevalence and incidence has been demonstrated in the World Health Organization's Report. In this report, overweight is estimated to be the 10th most common disease burden in the world **(12).**

Visceral fat presents in the abdomen and it surrounds the internal organs. High amount of visceral fat is present in the individual with sedentary life style, high stress level, or having unhealthy dietary habit. Excessive deposition of visceral fat is thought to be closely related to increased levels of fat in the bloodstream, which is a major risk factor for the development of many chronic illnesses such as heart disease, respiratory illness, diabetes, hypertension, some cancers, and premature death. Metabolic obesity represents above average levels of fat, even if an individual's weight is normal or below the standard for their height. The most widely accepted method of measuring body composition is BIA, which is simple, fast and non-invasive **(10)**. It can be used to determine body composition inboth healthy individual **(13).** Thus, this study was done to correlate various body fat parameters with BMI and hence to signify the importance of implementing BIA in routine screening procedures.

In this study, we tried to correlate between the body fat measured by BIA and anthropometric indices like BMI and WC and the effect of age and sex on these parameters. Primary finding of the study reveals strong correlation of subcutaneous fat and visceral fat with BMI. Similar finding were observed by previous authors with positive correlation between anthropometric indices and body fat as well as visceral fat **(14-16).** BMI and body fat percentage correlated with each other because BMI reflects total adiposity and body fat percentage measures the total body fat. In this study we found weaker correlation of WC with body fat percentage because WC is a measure of abdominal adiposity and therefore less correlated to body fat percentage than the BMI. These findings were concordant with Camhi SM, et al. and Barreira TV, et al. **(15,16)** that BMI correlated with fat mass better than WC. Abdominal obesity is measured by WC but in our study we found weak correlation of WC with visceral fat than BMI that is also similar finding of Raimi TH, et al. **(17)**

We found average body fat percentage is 14.1-24.5% in males and 23.3–31.5% in females of age 17-20 years that is similar to Gallagher D., et al. **(18).** A number of studies have shown that high BF% is associated with an increased cardiovascular risk apart from BMI **(19)**. It was also observed that mean value of total body fat in UW, N and OW groups for males and females were 12.5%, 20%, 26.2% and 23.6%, 28.1%, 34.7% respectively while visceral fat in above groups were 1.3%, 5.2%, 10.1% and 0.9%, 2.7%, 7.3% respectively in male and female.

CONCLUSION

In summary, research data emphasize that there is requirement to initiate lifestyle modification, particularly for medical students and recommend to improve dietary habits to avert the incidence of non-communicable diseases. It also found that BIA is highly correlated and just as important as BMI in assessment of obesity and BIA can be used as simple and trustworthy indicator to assess obesity in Indian population.

REFERENCES

1. World Health Organization: Obesity and overweight: fact sheet N0 311; 2012. http://www.who.int/mediacentre/factsheets/fs311/en/index.html.
2. World Health Organization: Obesity: preventing and managing the global epidemic; WHO consultation technical report series 894. Geneva; 2000.
3. Kumar A, Ramiah S (2005) Anthropometric studies on students of the Nepal Medical College: elbow breadth. Kathmandu Univ Med J (KUMJ) 3: 345-348.
4. Goonasegaran AR1, Nabila FN, Shuhada NS (2012) Comparison of the effectiveness of body mass index and body fat percentage in defining body composition.Singapore Med J 53: 403-408.
5. Wilborn C, Beckham J, Campbell B, Harvey T (2005) Obesity: Prevalence, Theories, Medical Consequences, Management, and Research Directions. J IntSoc Sports Nutr2: 34–31.
6. Deurenberg-Yap M, Schmidt G, van Staveren WA, Deurenberg P. The paradox of low body mass index and high body fat percentage among Chinese, Malays and Indians in Singapore.Int J ObesRelatMetabDisord2000;24:1011-7.
7. Bener A, Yousafzai MT, Darwish S, Al-Hamaq AO, NasrallaEA, Abdul-Ghani M. Obesity index that better predict metabolic syndrome: body mass index, waist circumference, waist hip ratio, or waist height ratio. J Obes. 2013; 2013:269038.
8. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: Systematic review and meta-analysis. Obes Rev 2012;13:275-286.
9. Bioelectrical impedance analysis in body composition measurement: National Institutes of Health Technology Assessment Conference Statement. Am J ClinNutr1996;64:524S-32S.
10. ErcegDN, Dieli-Conwright CM, Rossuello AE, et al. The Stayhealthy bioelectrical impedance analyzer predicts body fat in children and adults. Nutr Res 2010;30:297-304.
11. GarrowJS, Webster J. Quetelet’s index (W/H2) as a measure of fatness. Int J Obesity. 1985;9:147–153.
12. Razak F, Anand SS, Shannon H, et al. Defining obesity cut points in a multiethnic population. Circulation 2007;115:2111-8.
13. Deurenberg P, Andreoli A, Borg P, et al. The validity of predicted body fat percentage from body mass index and from impedance in samples of five European populations.Eur J ClinNutr2001;55:973-9.
14. WeerarathnaTP, Lekamwasam S, Rodrigo M. Prediction of total and visceral fat contents using anthropometric measures of adiposity in women. Ceylon Med J. 2008; 53:128-132.
15. Camhi SM, Bray GA, Bouchard C, Greenway FL, Johnson WD, Newton RL, et al. The relationship of waist circumference and BMI to visceral, subcutaneous, and total body fat: sex and race differences. Obesity 2011; 19:402-408.
16. Barreira TV, Staiano AE, Harrington DM, Heymsfield SB, Smith SR, et al. Anthropometric correlates of total body fat, abdominal adiposity, and cardiovascular disease risk factors in a biracial sample of men and women. Mayo Clin Proc. 2012; 87:452-460.
17. Raimi TH, et al. Anthropometric Correlates and Prediction of Body Fat Measured by Bioelectric Impedance Analysis among Women. Ann Med Health Sci Res. 2017; 7: 32-35.
18. Gallagher D., Heymsfield S. B., Heo M., Jebb S. A., Murgatroyd P. R.,and Sakamoto Y.,. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index1–3. Am. J. Clin. Nutr., September 2000; 72 (3): 694-701.
19. Zeng Q, Dong SY, Sun XN, Xie J, Cui Y. Percent body fat is a better predictor of cardiovascular risk factors than body mass index. Braz J Med Biol Res 2012; 45: 591-600.

How to cite this article: Kamariya C., Vachhani U.Usefulness of anthropometric parameters and the bioelectrical impedance analysis in assessment of obesity in young adultsInt.J.Med.Sci.Educ 2019;6(3):95-98.