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Correlation of Three Bioelectric Method with Skin Fold Thickness in Body Fat Measurement in Indian Obese

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ABSTRACT

Obesity is one of the most common disorders and major health concern worldwide. There are many standard procedures to assess obesity. Though body mass index is the most commonly used method, there are many other methods like bioelectric impedance analysis (BIA), waist to hip ratio, near -infrared measurement, Skin fold thickness, under water weighing, dual energy x-ray absorptiometry, Air displacement plethosmography, and Computed tomography. The main objective of the study was to establish a correlation between the BIA and skin fold thickness measurement so that BIA can also be routinely used in clinical practice for body fat measurement. All healthy obese and overweight college students and faculty of well known University who volunteered to participate were recruited in to the study. The cross-sectional study included 30 participants using sample of convenience and the assessment was performed by a qualified physical therapist. The instruments used in this study were Bioelectric impedance analyzer (OMRON, HBF – 361), Bioelectric impedance analyzer (TANITA, BC-571), Bioelectric impedance analyzer (OMRON, HBF-302), Weighing machine, Skin fold caliper. There was a positive correlation between skin fold thickness (SKF) and other methods of body impedance analyzer (BIA) while estimating the body fat percentage. The correlation of SKF with LBIA, CBIA and HBIA was high with r=0.069, 0.796, 0.859 respectively. Hand BIA has the highest correlation with SKF compared to the other two BIA methods; therefore HBIA can be used for body fat analysis in clinical practice with greater accuracy and reliability.

Keywords: Obesity, Skin fold thickness, Bioelectric Impedance Analysis, Body Fat Measurement.

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INTRODUCTION

Obesity is one of the most common disorders and a major health concern worldwide. The global obesity rate has nearly doubled since 1980 and currently 200 million men and 300 million women are diagnosed with the disease worldwide [1].This also indicates a higher prevalence of obesity among women. Childhood obesity is yet another major health concern among the developed countries. However the developing countries are not lagging with a higher margin. A study done by Mishra et al showed that the prevalence rate of childhood obesity in India (Delhi) was the highest among all the countries rising up to 29 percent in children of age group 14-18 years [2].

Obesity is an alarming metabolic disorder that can substantially raise the risk of morbidity from hypertension, dyslipidemia, Type 2 Diabetes Mellitus, Coronary Heart Disease, Stroke, Gall bladder disorders, osteoarthritis, sleep apnea, respiratory problems and also endometrial breast, prostate and colon cancers [3]. The current data on prevalence and impact of the obesity is more alarming in India. India is third top most country after U.S and China to give rise to this health calamity. The major cause for this is attributed to lower socioeconomic status, lack of education as well as lack of knowledge to use obesity and overweight detective methods and devices. The parameters and guidelines to detect obesity and overweight have been very distinctly given by world health organization (WHO) [4]. Therefore is it essential to understand the difference between obesity and overweight. The values of body weight adjusted for height, referred to as body mass index (BMI: in kg/m^2), in excess of 25 and 30 are considered to indicate overweight and obesity respectively. Though the term is often interchangeably used, they have different meanings and guidelines given by WHO. Overweight is defined as a body weight which exceeds the normal or standard weight for particular person based on height and frame size. Obesity refers to excess body fat versus body weight. An ideal fat percentage for good health is between 10% to 15% for young men and between 20% and 25% in women. Body fat percentage greater than 20% for men and 30% for women are considered an indication of obesity [5].

There are many standard procedures to detect obesity. Though BMI is the most commonly used method, there are many other procedures like bioelectric impedance analysis (BIA), waist to hip ratio, Near - infrared measurement, Skin fold thickness, under water weighing, dual energy x-ray absorptiometry, Air displacement plethosmography, Computed tomography [6].

Skin fold thickness method has been commonly used as a method to estimate body fat in clinical practice. Skin fold thickness at one or more sites is an indirect method of body fat estimation. It is generally recommended that the sum of measurement from seven skin fold sites should be used in a quadratic, curvilinear equation to estimate body density to estimate body density, relative body fat, fat free mass (Pollock et al 1984). Skin fold fat thickness measurement that use quadratic equation provide reasonably accurate estimates of total body fat or relative fat, with correlations ranging from .90 to .96[6]. However, bioelectric impedance analysis(BIA) has some additional advantages over skin fold thickness method while estimating the body fat percentage. It provides a rapid, noninvasive, and relatively accurate estimation of total body water, from which body composition is derived [7]. It is portable method of estimating body composition which is based on theoretical relation between the volume of conductor and its electrical impedance [8] Though both these methods have good individual body fat estimation reliability compared to a gold standard of Hydrostatic Weighing, the correlation between BIA and Skin fold thickness has not been studied yet in clinical settings. Therefore the study aims to establish a correlation between the BIA and skin fold thickness measurement so that BIA can also be routinely used in clinical practice for body fat measurement. The main objective of the study was to find a correlation between BIA and skin fold thickness in body fat measurement.

METHODOLOGY

Participants

All healthy obese and overweight college students and staffs were voluntarily recruited in the University campus in South India. The participants included were normal healthy obese and overweight Indians, Individual between 20 – 50 years of age and both the genders. The participants with any metal implants, morbid obesity and those not willing to participate in the study were not included in the study.

Study Design and Methods

The cross-sectional study included 30 participants with the sample of convenience and the assessment was performed by a qualified physical therapist.

Study procedure

The institutional ethical committee approval was obtained from KH hospital, Manipal University following which all the participants were recruited based on the inclusion and exclusion criteria. The following instruments were used in this study:

Inch tape
Stature meter
Bioelectric impedance analyzer (OMRON, HBF – 361)
Bioelectric impedance analyzer (TANITA, BC-571)
Bioelectric impedance analyzer (OMRON, HBF-302)
Weighing machine
Skin fold caliper

Body fat measurement was done early morning, empty stomach under the standard guidelines and precautions [9]. Body fat content was calculated using BIA devices (Leg to leg TANITA BC-571, Hand to hand OMRON, HBF-302 Cross sectional OMRON HBF-361), Body mass index (BMI), skin - fold thickness .The procedure of using these instruments has been detailed below:

Fat assessment with Leg to leg analyzer

Subject were instructed to stand straight on the analyzer for few seconds after feeding the demographic data like subject age ,height and weight after which fat percentage was noted in the machine.

Fat assessment with Hand to hand analyzer

Subject were instructed to stand with insulated foot wear and hold hand BIA with firm grip, After feeding the demographic data of the subject, the values of fat percentage is noted in the machine.

Fat assessment with cross sectional analyzer

Subjects were instructed to stand on the machine and hold the probe in hands with firm grip and after obtaining the same procedure percentage is noted in the machine.

Body mass index

BMI was calculated as the ratio between the weights (Kg) divided by the height (m^2)

Waist hip ratio

Waist to hip ratio was calculated by measuring the waist circumference measured at the narrowest diameter between the costal margins and the iliac crest and the hip circumference measured at the greatest diameter over the buttocks around the greater trochanter.

Skin fold thickness

Skin fold thickness was taken by skin fold calipers directly over skin without clothes. It was taken from seven sites (abdomen- a vertical fold measured 2cm to the right of umbilicus, Chest-a diagonal fold measured midway between the anterior axillary line and nipple for men, and one-third the distance between the anterior axillary line and nipple for women, Subscapular-a diagonal fold 1to 2cm below the inferior angle of scapula, Supraillium- a diagonal fold along the natural angle of the iliac crest, taken superiorly to the iliac crest in the anterior axillary line, Triceps: a vertical fold taken midway between the acromion and olecranon process

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while arm is relaxed and to the side of the body, Midaxillary: a vertical fold taken on the midaxillary line at the level of xiphoidprocess, Thigh: a vertical fold taken midway between the top of the patella and inguinal crease on the anterior midline of the thigh). The sum of these seven sites was put in SIRI's equation and % body fat was obtained.

Statistical Analysis

Descriptive statistics was used to calculate the means and standard deviation for various demographic characteristics of the participants like age, weight, height etc. SPSS v.15 was used to find a correlation between BIA and skin fold methods using Pearson's correlation coefficient.

RESULTS

The results obtained from the given study have been systematically illustrated in the table 1. Table 1 shows that there was a statistically significant correlation between skin fold thickness and other BIA methods.

Table 1: Correlation between skin fold thickness and body impedance analyser.

		SKF	LBIA	CBIA	HBIA
	Pearson Correlation	**1**	**.679(**)**	**.796(**)**	**.859(**)**
SKF	Sig. (2-tailed)	.	.000	.000	.000
	N	29	29	29	29
	Pearson Correlation	**.679(**)**	**1**	**.860(**)**	**.833(**)**
LBIA	Sig. (2-tailed)	.000	.	.000	.000
	N	29	29	29	29
	Pearson Correlation	**.796(**)**	**.860(**)**	**1**	**.927(**)**
CBIA	Sig. (2-tailed)	.000	.000	.	.000
	N	29	29	29	29
	Pearson Correlation	**.859(**)**	**.833(**)**	**.927(**)**	**1**
HBIA	Sig. (2-tailed)	.000	.000	.000	.
	N	29	29	29	29

SKF=skin fold thickness, LBIA=Leg to leg impedance analyser,
CBIA-cross-sectional impedance analyser,
HBIA=hand to hand impedance analyser.

**shows a positive higher correlation 'r' value

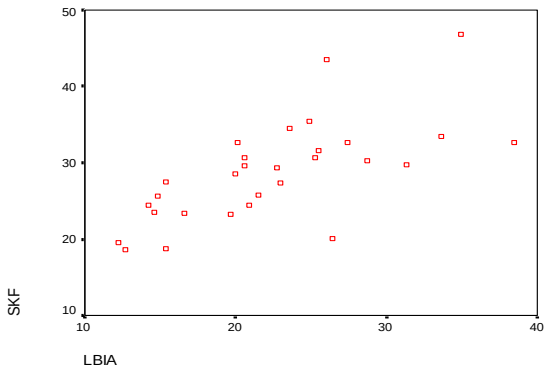

Figure 1: Scatter diagram (Skin fold Vs Leg BIA)

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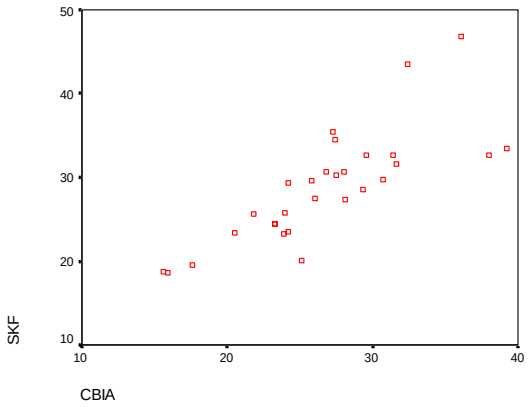

Figure 2: Scatter diagram (Skin fold Vs Cross sectional BIA)

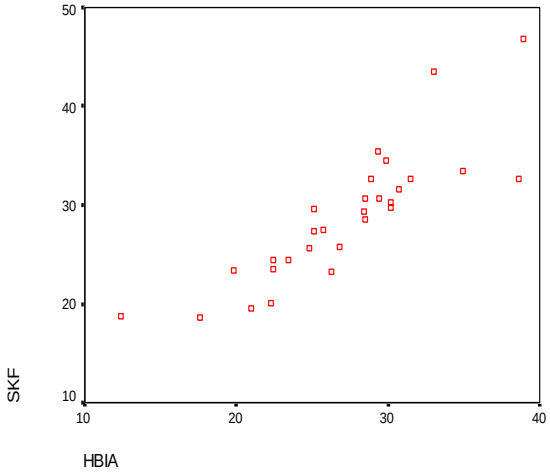

Figure 3: Scatter diagram (Skin fold Vs Hand BIA)

Fig.1, 2, 3 suggests that there was a positive correlation between skin fold thickness and other methods of body impedance analyzer while estimating the body fat percentage. Table1. Shows that the correlation of SKF with LBIA, CBIA and HBIA was high with r=0.069, 0.796, 0.859 respectively. It should also be noted that the highest correlation was found between CBIA and HBIA (table1).Bio-impedance analyzer is most commonly used method to check the fat% in human body. At present there are different types of Body impedance analyzers are available. There is a dearth of studies which have proved the consistency in producing the results with different types of Body impedance analyzer. The impedance to fat in human body may vary with site of testing. There was a slight difference in fat% that was calculated with three different methods but there was no statistical difference among all the three methods and fat % values have correlated well in all the participants (n=29) we have studied. The skin fold method has been found to be a good method in analyzing body composition as previous studies have shown that skin fold method correlates well with DEXA which is currently the gold standard [10]. Skin fold method is a good method but it also needs a qualified and skilled person to measure the skin fold thickness. It may give wrong results if the caliper is not of good quality. The caliper should be kept only for few seconds else the values could be different and wrong. Calculation with skin fold thickness method is very cumbersome the equation used to calculate the % body fat needs a good calculation skill. Reproducibility is also found to be good with all three types of Body impedance analyzer to reduce the tester bias; the researcher was trained to use skin fold method and practiced it for two months prior to the commencement of the study. Although BIA is a simple and cost-effective method to estimate and all the available models can reliably measure the body fat percentage, more research is required to identify the best method among the currently available devices. However, it is very important that the tester understands the limitations of these methods and also need to follow standard precautions during evaluation.

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CONCLUSION

There is a positive correlation of Skin fold thickness (SKF) with all various methods of body impedance analysis method in estimating the body fat percentage. Hand body impedance analysis has the highest correlation with SKF compared to the other two BIA methods; therefore HBIA can be used for body fat analysis in clinical practice with greater accuracy and reliability. However a study with larger sample size and correlation with DEXA may be done in further research.

REFERENCES

[1] World Health Organization (WHO. Obesity and Overweight factsheet from the WHO. World. 2015 Nov 13.
[2] Misra A, Khurana L. The Journal of Clinical Endocrinology & Metabolism 2008 ; 93 (11_supplement_1) : s9-30.
[3] Kyrou I, Randeva HS, Weickert MO. Clinical Problems Caused by Obesity.
[4] World Health Organization. The world health report 2002: reducing risks, promoting healthy life. World Health Organization; 2002.
[5] Frankenfield DC, Rowe WA, Cooney RN, Smith JS, Becker D. Nutr 2001;17(1):26-30.
[6] Webera DR, Zemelb BS. Body Composition Assessment.
[7] Martin AD, Ross WD, Drinkwater DT, Clarys JP. Int J Obesity 1984 Dec;9:31-9.
[8] Hu F. Measurements of Adiposity and Body Composition. In: Hu F, ed. Obesity Epidemiology. New York City: Oxford University Press, 2008; 53–83.
[9] Duren DL, Sherwood RJ, Czerwinski SA, et al. J Diabetes Sci Technol 2008; 2(6):1139-1146.
[10] MullieP, Vansant G, HulensM, ClarysP, Degrave E. Mil Med 2008; 173(3): 266–70.
[11] Dehghan M, Merchant AT. Nutr J 2008; 7:26.
[12] Mialich MS, Sicchieri JMF, Junior AAJ. International Journal of Clinical Nutrition 2014;2(1), 1-10.