

A COMPARATIVE STUDY OF BODY FAT PERCENTAGE USING BIO-ELECTRICAL IMPEDANCE ANALYSER AND SKINFOLD CALLIPER IN SPORTS PERSONS

Abstract

The study was conducted for comparing the body fat percentage of sportsperson obtained from two methods, skinfold Calliper and bio-electrical impedance analyser. The study was conducted on 100 subjects with their ages ranging from 18-24 years. For the purpose of this study, three-sites measurement were taken as mentioned in the equation of Jackson et al. (1980) for females and Jackson & Pollock (1978) for males. The mean and Standard deviation of measurements obtained from Bioelectrical Impedance Analyser (17.2253 ± 7.17358) was considerably greater than measurements from Skinfold Calliper (12.8311 ± 6.11422). The results clearly show that the measurements of bodyfat percentage obtained from bioelectrical impedance analyser were slightly higher than that of skinfold Calliper. The obtained t-value of 4.662 and ($p < 0.05$) makes it very evident that there is a significant difference in bodyfat percentage measured from both the variables

Keywords: Body Composition, Bodyfat Percentage, Skinfold Calliper and Bio-electrical Impedance Analyser

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I. INTRODUCTION

Kinanthropometry is a scientific area that focuses on measuring various aspects of the human body to understand its capability for function and movement in different settings. These measurements include body proportions, composition, somatotype, maturation, motor ability, cardiorespiratory capacity, and physical performance. The field of Kinanthropometry is closely related to disciplines of sports science such as biomechanics, growth and development, human sciences, nutrition, physical therapy, healthcare and ergonomics.

One of the key interests in Kinanthropometry is measurement of body fat concerning health status and sports performance. However, with advancements in technology, there has been a growing interest in measuring other components of the body. As a result of the increasing number of methods for assessing body composition, validation becomes a critical issue. There is some confusion over which method is the most accurate. This chapter attempts to discuss the various methods for assessing body composition, their validation hierarchy, practical details for measuring different body constituents, and suggestions for future research.

Bio-electrical Impedance Analysis or Bioimpedance Analysis (BIA): It is a technique used to evaluate body composition, specifically the measurement of body fat in relation to lean body mass. It plays a crucial role in health and nutrition assessments. By utilizing BIA, one can detect and address improper body composition early, enabling timely intervention and prevention strategies. Furthermore, BIA provides valuable insights into fluid and body mass, serving as a critical tool in assessing one's current state of health. The BIA test is non-invasive and straightforward. It involves placing two electrodes on the right hand and foot of the individual, through which a low-level, imperceptible electrical current is passed. The current's flow is affected by the body's water content, with tissues containing more fluid and electrolytes, like blood, displaying higher conductivity, while fat and bone slow down the signal. By measuring the resistance of the current as it passes through the body, BIA can estimate body water, from which body fat is then calculated using specific equations.

Skinfold Calliper: The Skinfold Calliper is a precise instrument used for measuring skinfold thickness at various sites on the body. The main objectives of skinfold Calliper are to develop proficiency in measuring skinfolds accurately and to compare different methods of estimating proportionate fatness.

II. PROCEDURE/ METHODOLOGY

1. Selection of Subjects: For the purpose of study, 100 students from Sports Authority of India Lakshmi Bai National College of Physical Education were selected purposively as subject with their ages ranging from 18-24 years.

2. Selection of Variables

- Bio-electrical Impedance Analyser
- Skinfold Calliper

- 3. Plan for Administration of Test/Collection of Data:** For the purpose of the study, the subjects [N=100] (P.E. students) were selected. A consent was obtained from each selected subject to voluntarily participate in the study. They were assured of the fact that the data collected from them would only be used for research purpose and it was treated as confidential otherwise.

The following procedure was followed to determine the anthropometrical data:

- **Skinfold Thickness:** The purpose of measuring skinfold thickness is to determine body density and, therefore, bodyfat.
 - **Equipment:** The Harpenden's Calliper was used to determine skinfold thickness.
 - **Procedure:** For the purpose of this study, body density was obtained from three-sites measurement as mentioned in the equation of Jackson et al. (1980) for females and Jackson & Pollock (1978) for males. These measurements were
 - **Pectoral (only for male):** oblique skinfold raised along the borderline of the pectoralis major between the anterior axillary fold and the nipple.
 - **Triceps (only for female):** vertical skinfold raised on the posterior aspect of the medial triceps, exactly halfway between the olecranon process and the acromion process when the hand is supinated.
 - **Suprailliac:** diagonal fold raised immediately above the crest of the ilium on a vertical line from the mid-axilla. Location of the axilla and chest 2 skinfold sites. It is also referred to as the 'suprailliac' by Durnin and Womersley (1974) and 'illiocristale' by Parizkova (1978)
 - **Mid-thigh:** vertical skinfold raised on the anterior aspect of the thigh midway between the inguinal crease and the proximal border of the patella.

The body density thus derived was then substituted in the below mentioned equation to obtain percentage bodyfat.

$$\%F \text{ (Siri, 1956)} = [(4.95 / \text{Body Density}) - 4.5] \times 100$$

Where $\Sigma 3M = \Sigma 3$ skinfolds (mm) as specified for males and females both.

- **BIA:** The following procedure was followed for taking measurements from BIA
 - **Equipment:** SECA Bioelectric Impedance Analyser.
 - **Description/Procedure:** The device used in the study requires the subject to stand straight on the BIA machine with feet and hands placed on the electrodes. An additional information of height was measured from stadiometer and the value was entered in the BIA machine.
- 4. Statistical Technique:** The descriptive statistics applied to the study were Mean and Standard Deviation of body fat percentages obtained from Skinfold Calliper and BIA. Independent T Test was used to serve the purpose of comparison of body fat percentage obtained using BIA and Skinfold Calliper.

III. RESULTS

The t-ratio was tested for significance at 0.5 level of confidence. The t-value required for the significance is 4.662 Mean, Standard Deviation and the t-ratio of the bodyfat percentage obtained through Bioelectrical Impedance Analyser and Skinfold Calliper is presented in Table- 2 and Figure 1.

Table 1: The Levene's Test for Equality of Variances

		Levene's Test for Equality of Variances	
		F	Sig.
	Equal variances assumed	2.685	.103
BODY_FAT_PERCENT	Equal variances not assumed		

The Levene's Test for Equality of Variances for bodyfat percentage has F-value 2.685 and $p > 0.05$. As it is very much evident that the data of BIA and Skinfold Calliper in relation to percentage of bodyfat follow the normal probability curve, therefore it is assumed that the data obtained is normal.

Table 2: Comparison of Mean, Standard Deviation and T-Ratios of Both Modes of Measuring Bodyfat Percentage

Variables	N	MEAN	SD	t-value	Sig.
Bioelectrical ImpedanceAnalyser	100	17.2253	7.17358	4.662*	.000
Skinfold Calliper	100	12.8311	6.11422		

The mean and Standard deviation of Bioelectrical Impedance Analyser and Skinfold Calliper was (17.2253 ± 7.17358) and (12.8311 ± 6.11422) . The obtained t-value of 4.662 and ($p < 0.05$). it is very much evident that there is significant difference in the percentage of bodyfat measured from both the variables

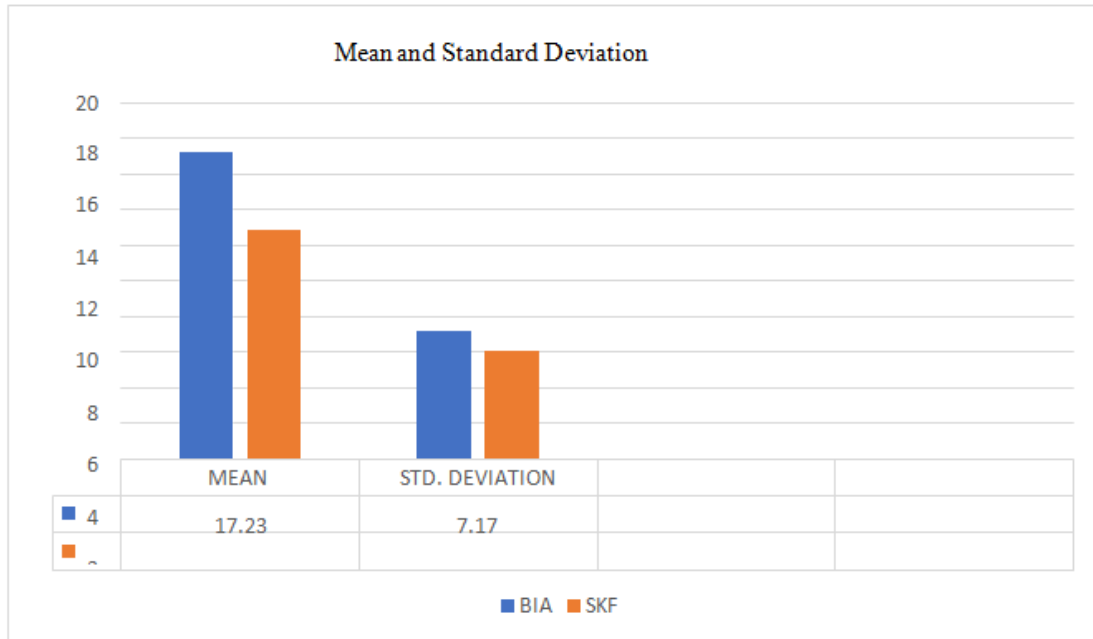


Figure 1: Mean and S.D. of bodyfat from BIA and SKF

IV. CONCLUSION

Body composition study is vital in sports and physical education due to its impact on performance optimization, injury prevention, and talent identification. It helps monitor athletes' health and weight management, set realistic goals, and design periodized training. Understanding body composition fosters positive body image and overall well-being, guiding tailored nutrition and exercise plans for optimal results in different sports. Assessing muscle, fat, and bone distribution allows coaches and athletes to make informed decisions, improving athletic performance while reducing injury risks. In summary, body composition assessment plays a crucial role in enhancing sports performance, health, and mental well-being.

In accordance with the study conducted by Thakur H. et al., it was found that BIA tends to overestimate body fat percentages when compared to SKF (skinfold thickness measurements). However, it is important to note that the two methods are not interchangeable. While evaluating anthropometric measurements, such as SKF, is valuable for assessing regional changes in subcutaneous adiposity, BIA offers practical applicability in body composition analysis.

In a similar study conducted by Williams C.A., et al., three methods were employed to assess body fat percentages in male and female athletes: hydro-densitometry (HYD), bioelectrical impedance (BIA), and skinfold Callipers (SKF). The results indicated that BIA tended to overestimate body fat measurements compared to the other methods.

In McRae M. P.'s study, it was observed that there was no significant difference between skinfold measurements and BIA when estimating percentage body fat for men. However, for women, BIA underestimated body fat by 3.4%. These differences could potentially be attributed to variations in skinfold compressibility between men and women.

Within the limitation of the present study and based on the results following conclusions can be drawn

- There was a significant difference between the bodyfat measurements received from Skinfold Calliper and BIA.
- It was observed that BIA generally overestimates the percentage bodyfat.
- Hence, we can conclude that between the two variables selected for the study, the Skinfold Calliper is a more reliable measure.

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