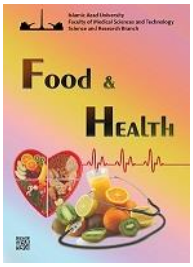

Food & Health Journal
Journal homepage: fh.srbiau.ac.ir

The validity of a bioelectrical impedance analyzer, Xiaomi MI scale 2, for measurement of body composition

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ARTICLE INFO

Short Communication

Article history:
Received 02 September 2019
Revised 12 October 2019
Accepted 03 December 2019
Available online 15 December 2019

Keywords:
Body composition
Validity
Xiaomi MI scale 2

ABSTRACT

The purpose of this study was to evaluate the validity of a BIA device, Xiaomi MI, against X-scan plus 970. A total of 30 university students and employees (18 women and 12 men) aged between 19 and 50 years were selected. Weight and body composition were measured using Xiaomi MI and X-scan plus 970. The mean age of subjects was 28.9±9.1 for men and 30.4±9.4 for women. There was a strong correlation between X-scan plus 970 and Xiaomi MI scale 2 results ($p<0.000$). Our results suggest that Xiaomi MI scale 2 is a valid device to measure body composition which makes it appropriate for clinical use.

1. Introduction

During the past few decades, obesity has turned into a global health concern which has urged researchers and practitioners to develop various diagnostic criteria and tools for early detection of overweight and obesity. Body composition has been introduced as an excellent measure for calculating body fat percentage as well as fat-free mass and thus, predicting the risk of obesity-related diseases. In this regard, a variety of credible methods have been suggested such as computed tomography, magnetic resonance imaging, densitometry and dual x-ray absorptiometry (DEXA) which are expensive, time-consuming and often inaccessible to the general population (1). Alternatively, bioelectrical Impedance analysis (BIA) was suggested as one of the relatively economical measurement techniques which utilize conventional adhesive electrodes to analyze body composition (1). Over the years, a wide range of consumer-grade BIA devices have been introduced and advancements in their technology and design have improved the accuracy of fat percent measurements. The purpose of the present study was to evaluate the validity of a widely-used BIA device, Xiaomi MI scale 2, using another less convenient one, X-scan plus 970. In contrast to X-scan plus 970, Xiaomi MI scale 2 is portable, easy to use and inexpensive, making it a competent alternative in large sample clinical assessments.

2. Materials and methods

A total of 30 adults aged between 19 and 50 (18 women and 12 men) were selected from university students and employees. All participants were healthy individuals and had no disabilities. The research subjects were informed of the purpose and procedure of the survey and showed their interest to participate in the study by signing the written informed consent. The study procedure has been confirmed by the ethics committee of the Islamic Azad University Science and Research Branch. Anthropometric characteristics of participants are shown in Table 1. They were proposed to have a good sleep, avoid having vigorous physical activity and drinking alcoholic or caffeinated beverage 24 h prior to the measurement. They were also refrained from eating or drinking 4 h before tests and make sure to empty their bladder before measurements. On the day of measurement subjects rested for 30 min and put on light cloth without any metal accessories before getting the test done. Body composition measurements were conducted at the clinical nutrition lab of

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Islamic Azad University, Science and Research Branch. Height was measured by a digital stadiometer to the nearest 0.1 cm while individuals were barefoot. Also, weight was evaluated by a measuring device with a precision of 0.1 kg. Body Mass Index was calculated by dividing body weight (kg) by height (m)2 (2). First, participants' body composition was measured by X-scan plus 970 which took about 1 min for each individual while they were prohibited from any movements or talking as possible.

Table 1. Anthropometric characteristics of participants.

Variables	Men (n=12)	Women (n=18)
Age (yr)	28.9±9.1	30.4±9.4
Weight (kg)	74.7±11.6	62.7±13.2
Height (cm)	174.9±8	163.7±4.8*
Body Mass Index (kg/m2)	24.6±5.2	23.2±4

Values are presented as mean±standard deviation.
*P<0.05, a significant difference.

Age, height, and gender were entered and other variables including body weight and body composition elements (body fat, lean body mass, total body water, etc.) were calculated by device and the results were printed out for further comparisons. Then subjects stood up on the Xiaomi MI scale2 with barefoot and light clothing to have body composition measurement. All data ported to the mobile app of the device and saved for validity analysis. Among data evaluated, total body fat (%), total body water (%), muscle (kg) and bone weight (kg) were applied. Statistical analysis was performed using version 25 of SPSS (SPSS Inc.® headquarter, Chicago, USA). Descriptive statistics and independent t-test were used to determine physical characteristics of subjects. The correlation of measurements between the two devices was analyzed using the Pearson correlation test. P-values less than 0.05 were considered as statistically significant.

3. Results

The mean age of subjects was 28.9±9.1 for men and 30.4±9.4 for women. Measurements revealed that body weight and body mass index were higher in men, but there was no significant relation between them.

Table 2. Descriptive statistics of body composition and weight.

Variables	Mean±SD (n=30)	Min-Max
X-scan plus 970		
Weight (kg)	67.5±13.7	38.9-92.9
BMI (Kg/m2)	23.8±4.5	15.2-33.3
Body water (%)	53.2±5.7	44.6-66.7
Body Fat (%)	26.2±8	7.4-38.1
Muscle weight (kg)	45.5±8.6	30.4-63.4
Bone weight (kg)	3.9±0.8	2.3-5.4
Xiaomi MI scale 2		
Weight (kg)	68.2±13.8	39.4-93.3
BMI (Kg/m2)	24.1±4.5	15.3-33.4
Body water (%)	50.4±5.6	42.2-61.9
Body Fat (%)	28.0±9.2	9.7-40.8
Muscle weight (kg)	45.8±8.4	31.7-61.4
Bone weight (kg)	2.7±0.4	1.8-3.3

Only height showed a statistically significant difference between two groups of males and females (p<0.05) (Table 1).

In Table 2 descriptive statistics of weight and body composition related data is shown. All measurements of X-scan plus 970 except for body water and bone weight are less than measures evaluated by Xiaomi MI scale 2. The bigger difference between bone weights is because X-scan plus 970 assesses whole minerals of the body. However, Xiaomi MI scale 2 calculates only bones weight. As shown in Table 3, Pearson correlations between X-scan plus 970 and Xiaomi MI scale 2 results were all strongly significant (p<0.000). The correlation coefficients for women were higher than in men.

Table 3. The correlation coefficient (r) between X-scan plus 970 and Xiaomi MI scale 2.

	Men (n=12)		Women (n=18)		Total (n=30)	
Variables	r	P-value	r	P-value	r	P-value
Water percentage (%)	0.914	0.000	0.940	0.000	0.945	0.000
Fat percentage (%)	0.917	0.000	0.949	0.000	0.949	0.000
Muscle weight (kg)	0.779	0.003	0.965	0.000	0.969	0.000
Bone weight (kg)	0.872	0.000	0.979	0.000	0.936	0.000

4. Discussion

Body composition data are frequently collected in health-related fields; thus, the validity and reliability of analysis devices are essential. Although DEXA can produce reliable data, it is often inaccessible to the general population which throws the balance in favor of using portable and economic devices. We have assessed the validity and reliability of the Xiaomi MI scale 2 body composition analyzer in 30 adults, using X-scan plus 970. Former validation studies in adults and children have reported that BIA devices tend to either underestimate or overestimate body fat percentage compared to DEXA (3). When using BIA, body fat percentage data may be overestimated in relatively lean subjects; whereas it tends to be underestimated in obese subjects (3, 4). In general, the Xiaomi MI scale 2 data illustrated great compatibility with that of X-scan plus 970 with p<0.00 for muscle weight (kg), bone weight (kg), water percentage and fat percentage. Although few differences were detected, they were negligible (total r-value for all four data categories was >0.93); mean water scans and bone mass assessed by Xiaomi MI scale 2 were understated by approximately 3% and 1kg respectively, compared to that of X-scan plus 970. In contrast, Xiaomi MI scale 2 tends to overestimate fat percentage by roughly 2%. Muscle mass data measured by Xiaomi MI scale 2 matched with that of X-scan plus 970. Fitness level and hydration status may be the cause of these discrepancies (5). In conclusion, Xiaomi MI scale 2 is safe, quick and easy to use with little or no training. The strengths of the present study are that our data are representative of a mixed population, comprising of underweight, healthy, overweight and obese individuals; thus, they can be applied to compromised populations. Our study is limited by a small sample size. Future validation studies with larger sample sizes and various disease conditions are warranted.

References

1. Dolezal BA, Lau MJ, Abrazado M, Storer TW, Cooper CB. Validity of

two commercial grade bioelectrical impedance analyzers for measurement of body fat percentage. *Journal of Exercise Physiology Online*. 2013;16(4).
2. Deurenberg P, Weststrate JA, Seidell JC. Body mass index as a measure of body fatness: age- and sex-specific prediction formulas. *British Journal of Nutrition*.1991;65(2):105–14.
3. Sun G, French CR, Martin GR, Younghusband B, Green RC, Xie Y, et al. Comparison of multifrequency bioelectrical impedance analysis with dual-energy X-ray absorptiometry for assessment of percentage body fat in a large, healthy population. *The American Journal of Clinical Nutrition*. 2005;81(1):74–8.
4. Hosking J, Metcalf BS, Jeffery AN, Voss LD, Wilkin TJ. Validation of foot-to-foot bioelectrical impedance analysis with dual-energy X-ray absorptiometry in the assessment of body composition in young children: the EarlyBird cohort. *British Journal of Nutrition*.2006;96(6):1163–8.
5. Jensky-Squires NE, Dieli-Conwright CM, Rossuello A, Erceg DN, Cauley S, Schroeder ET. Validity and reliability of body composition analysers in children and adults. *British Journal of Nutrition*. 2008;100(4):859–65

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