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Body Composition Assessment: A Comparison of the DXA, InBody 270, and Omron

Research Brief

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Abstract

Introduction: The purpose of this study was to compare three body composition methods in a cohort of exercise-trained men and women: dual energy x-ray absorptiometry (DXA), a multifrequency bioelectrical impedance (MF-BIA) device (InBody® 270) and the Omron handheld BIA.

Methods: Subjects (n=47; 22 male, 25 female) came to the laboratory for body composition assessment (i.e., percent body fat, fat-free mass and fat mass).

Results: There were no statistically significant differences between the InBody 270 and DXA for any measure of body composition. Nor were there any significant differences between the InBody 270 and Omron. However, the Omron under-predicted percent body fat and fat mass in comparison to the DXA.

Conclusions: In general, the Omron underestimates percent body fat and fat mass versus the DXA. However, the mean data for body composition assessment were quite similar between the InBody 270 and DXA. It should be noted that the DXA and InBody 270 are acceptable for body composition analysis.

Key Words: fat mass, fat-free mass, lean body mass, exercise

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Introduction

When assessing body composition, dual energy x-ray absorptiometry (DXA) and bioelectrical impedance (BIA) are both widely used methods. The advantage of the DXA is that it provides bone mineral content and density in addition to fat mass and fat-free mass data.[3] It is typically held to a higher standard than BIA devices. This is likely due to the method used by the device, which involves a full-body x-ray scan and a compartmentalization of body segments.[2,3,8,11] BIA involves sending an electrical impulse throughout the body paired with an algorithm based on physical characteristics (i.e. height, age, sex, etc.) to generate an estimate of total body fat and lean body mass.[2] The BIA method has become increasingly popular recently due to its accessibility, noninvasive nature, and rapid generation of results.[2,6,9] The multifrequency InBody 270 and the handheld Omron were the two BIA devices used in this study. It is generally accepted that multifrequency devices such as the InBody tend to produce more accurate results than that of single-frequency BIA devices such as the Omron.[3,9] The purpose of this investigation was to compare estimates of fat mass, fat-free mass, and body fat percentage between the DXA, InBody 270 and Omron in exercise-trained men and women.

Methods

Participants

Forty-seven research participants (22 male, 25 female) came to the laboratory for body composition assessment. The University's Institutional Review Board approved all human subjects procedures. Written informed consent was obtained prior to participation.

Protocol

Body composition was assessed with a dual-energy X-ray absorptiometry machine (DXA) (Model: Hologic Horizon W; Hologic Inc., Danbury CT USA), InBody 270 multifrequency bioelectrical impedance (BIA) device and the Omron handheld BIA. All testing was performed between 9:00am and 4:00pm. For the DXA, quality control calibration procedures were performed on a spine phantom. Subjects were instructed to come to the laboratory after at least a 3-hour fast and no prior exercise. Subjects wore typical athletic clothing and removed all metal jewelry. They were positioned supine on the DXA within the borders delineated by the scanning table. Each whole body scan took approximately seven minutes. For the InBody BIA, subjects stood on the platform of the device barefoot with the soles of their feet on the electrodes. Subjects then grasped the handles of the unit with their thumb and fingers to maintain direct contact with the electrodes. They stood still for ~0.5 minutes while maintaining their elbows fully extended and their shoulder joint abducted to about a 30 degree angle. For the Omron handheld BIA, subjects held the device with their hands with the shoulder and elbow joint in a fully extended position in front of their torso (i.e., it took ~10 seconds to get a reading).

Statistical Analysis

An ANOVA was used to determine differences between the three methods. Sidak's multiple comparisons test was used to determine which pairs differed. All data is presented as the mean±SD. GraphPad (Prism 6) software was used for statistical analyses.

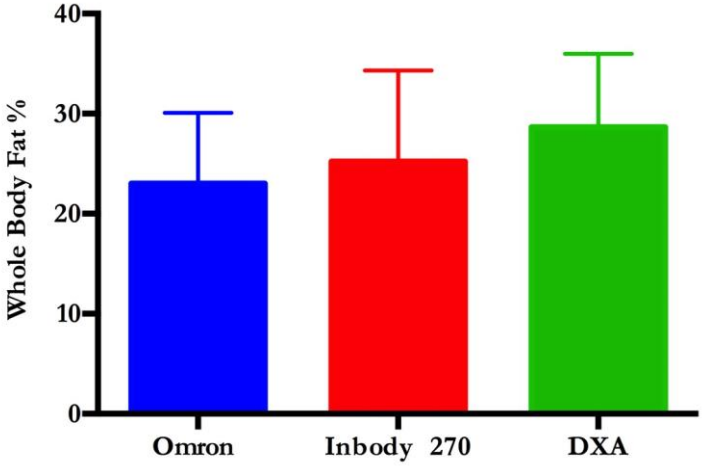
Results

Forty-seven recreationally active college students volunteered for this investigation (n=25 female, n=22 males; Age 21±6 years, Height 169±11 centimeters, Weight 69.7±16.4 kilograms). There were no significant differences between the InBody 270 and the DXA. Nor were there any significant differences between the Inbody 270 and Omron. However, percent body fat and fat mass was significantly lower in the Omron versus the DXA.

Table 1. Body Composition

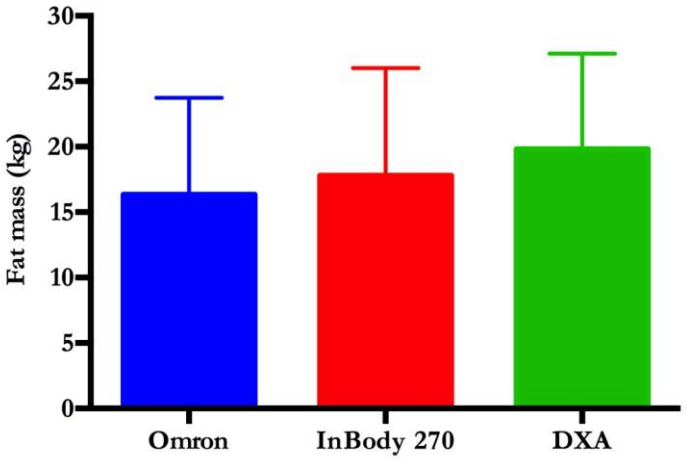
	Omron	**DXA**	**InBody**	*p value Omron vs InBody*	*p value Omron vs DXA*	*p value DXA vs InBody*
% Body Fat	23.0±7.1	28.6±7.4	25.2±9.1	0.4458	0.0022	0.1085
Fat Mass (kg)– All	16.3±7.4	19.8±7.3	17.8±8.2	0.7413	0.0860	0.4890
FFM (kg) – All	53.9±11.9	46.3±13.8	52.5±13.4	0.9260	0.0113	0.0534

Data are expressed as the mean±SD. Legend: kg – kilogram; FFM – fat-free mass.



Data are expressed as the mean±SD. n=47
Omron vs. DXA (p=0.0022).
Omron vs. Inbody 270 (p=0.4458).
Inbody vs. DXA (p=0.1085)

Figure 1. Body Fat Percentage



Data are expressed as the mean±SD. n=47
Omron vs. DXA (p=0.0860)
Omron vs. Inbody (p=0.7413)
Inbody vs. DXA (p=0.4890)

Figure 2. Fat Mass

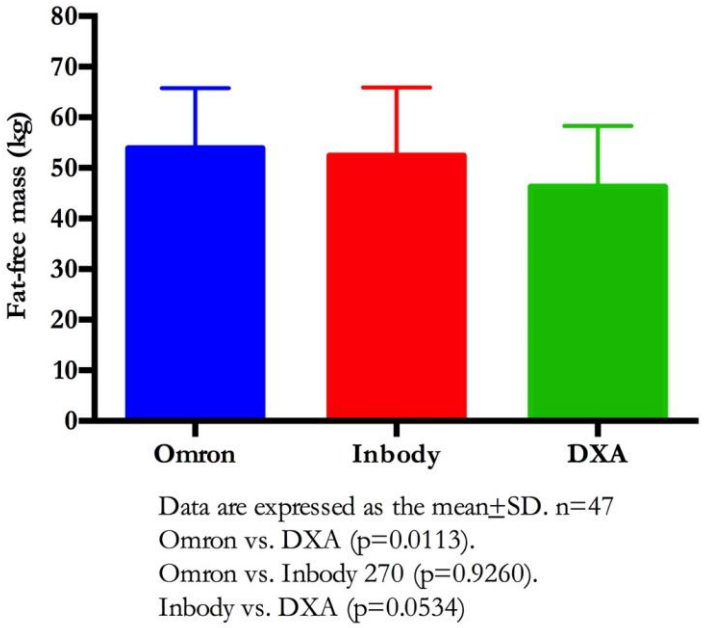


Figure 3. Fat-free Mass

Discussion

This investigation found no significant differences in body fat percentage, fat-free mass, or fat mass between the InBody 270 and the DXA. The fat mass and fat percentage values were similar, whereas a slight discrepancy can be observed in the measurement of lean mass between the two. The InBody produced slightly greater values in lean mass than the DXA. However, the Omron significantly under-predicted body fat percentage and over-predicted fat-free mass when compared to the DXA. Although the Omron seemed to under-predict fat mass as well, the difference was not statistically significant. Previous studies have questioned the validity of the Omron. Rockamann et al. determined that the Omron significantly under-predicted body fat percentage when using the DXA results as a baseline value.[10] The underprediction of body fat by the Omron could possibly be explained by the bipolar (two-electrode) nature of the device. Bipolar BIA devices have been shown to be less accurate than BIA devices with more electrodes,[3,4,6] such as the InBody 270. Hand-held bipolar BIA devices such as the Omron send an impulse that only travels throughout the upper portion of the body and neglects potential fat content in the lower portion. The difference in the study aforementioned was more prevalent in women, likely due to the tendency in females to hold more adipose tissue in the hip and thigh area.[7] Additionally, it has been suggested that the algorithm used by the Omron to estimate body fat is associated with error.[3,6] Other studies found that the Omron was not statistically equivalent with DXA, and levels of hydration could potentially affect how fat percentage is predicted.[3-4] Overall, it is recommended to use caution when relying on handheld BIA devices to assess body composition.

The primary finding of this investigation is that the Omron handheld BIA device significantly under-predicted body fat percentage and over-predicted fat-free mass when compared to the DXA. In contrast, the InBody 270 was in greater agreement with values produced by the DXA. However, it is worth noting that the InBody 270 appeared to agree more with the Omron on fat-free mass values rather than the DXA, despite no significant difference being found. This discrepancy has been shown in previous studies involving BIA.[5] Although the DXA may be considered to be a gold standard of body

composition assessment, it can be very costly and inconvenient.[4] When looking for a more affordable and accessible alternative to the DXA, the InBody may be utilized. However, the Omron should be approached with skepticism.

Conclusions

In a sample of exercise-trained individuals, both the Bod Pod and InBody 770 underestimated percent body fat and fat mass in comparison to the DXA while overestimating fat-free mass versus the DXA. Moreover, there was no difference between the Bod Pod and InBody 770. All three methods are acceptable for assessing body composition (i.e., for group data).

Media-Friendly Summary

The InBody 270 and DXA produce similar body composition values (based on the average of a group). The Omron handheld BIA device however severely underestimates body fat percentage and fat mass. If you prefer lower percentage body fat values, then using a handheld may make you feel better, but at the end of the day, it's a bit misleading.

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Conflicts of Interest: The authors declare no conflict of interest.

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