Validity of Hand-to-Foot and Foot-to-Foot Consumer Bioimpedance Analyzers: A Four-Compartment Model Comparison

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ABSTRACT

Body fat percentage (BF%) is a useful variable for predicting disease risk and determining overall fitness. Consumer-grade bioimpedance analyzers seek to provide accurate body composition data while remaining affordable and accessible. **PURPOSE**: The purpose of this study was to compare body fat percentages obtained from hand-to-foot and foot-to-foot consumer bioimpedance analyzers to a gold standard 4-compartment (4C) model. **METHODS**: Seventy-five adults (40 F, 35 M; age: 27.2 ± 7.3 y; height: 168.1 ± 8.8 cm; BM: 72.1 ± 16.6 kg; 4C model BF%: 25.0 ± 9.2%) were evaluated by a 4C model, a consumer-grade hand-to-foot bioimpedance analyzer (BIA-HF; Tanita BC568) and two consumer-grade foot-to-foot bioimpedance analyzers (BIA-FF; Tanita BC554 and Tanita UM081). The 4C model comprised dual-energy X-ray absorptiometry, air displacement plethysmography, and bioimpedance spectroscopy. BF% estimates obtained by each bioimpedance analyzer were compared to the criterion 4C using the coefficient of determination (R^2), standard error of the estimate (SEE), and Bland-Altman analysis. **RESULTS**: BIA-HF underestimated BF% by 1.4 ± 4.1%, and both BIA-FF overestimated BF% by 0.5 to 0.6 ± 5.7%. The R^2 value was higher for BIA-HF as compared to both BIA-FF analyzers (0.81 vs. 0.64). The SEE and 95% limits of agreement (LOA) were lower for BIA-HF (SEE: 4.0%; LOA: 8.1%) as compared to both BIA-FF (SEE: 5.6%; LOA: 11.2%). No method demonstrated proportional bias based on Bland-Altman analysis. **CONCLUSION**: While both hand-to-foot and foot-to-foot consumer-grade bioimpedance analyzers demonstrated potentially meaningful errors when compared to a gold standard method, the hand-to-foot device exhibited better overall performance. Specifically, a stronger linear agreement with the 4C model and lower individual-level errors were observed with the hand-to-foot model as compared to both foot-to-foot models from the same manufacturer. The superior performance of the hand-to-foot analyzer could be due to its direct testing of both the upper and lower body, which is more similar to the methods used in the 4C model and a better representation of an individual's overall body composition.