The Accuracy & Reliability of Using a Handheld Indirect Calorimeter for Assessing Body Fat in Overweight Adults

Scott O. McDoniel, Ph.D [1] , Heather A. Haugen, Ph.D [2] , Zung V. Tran, Ph.D. [2] , & David C. Nieman, D.PH. [3]

[1] College of Health Sciences, Walden University; [2] School of Medicine, University of Colorado-Denver;
[3] College of Health Sciences & Allied Professions, Appalachian State University

The Obesity Society 27th Annual Scientific Meeting; October 25, 2009; Washington, D.C.

BACKGROUND

- Weight management programs often assess patient percent body fat (% BF) to evaluate changes in fat and fat-free mass (FFM).
- FFM is commonly assessed by dual-energy x-ray absorptiometry (DEXA), bioelectrical impedance (BIA), skin-fold, & hydrostatic methods.
- FFM explains approximately 70% to 80% of the variance of resting energy expenditure (REE) (1-3).
- The " gold standard" for assessing REE is through indirect calorimetry (IC) since many REE estimation equations are in accurate in ill and overweight patients (4-6) .
- In theory, measured REE from IC should be able to estimate FFM and % BF.
- The purpose of this study was to compare the accuracy & reliability of using IC, with a proprietary algorithm, for the assessment of FFM and % BF in overweight adults.

METHODS

- 83 overweight (BMI > 25.0 kg/m2) men (n= 50) and women (n= 33) participated in the study.
- FFM and % BF were measured by DEXA using a Discovery™ QDR Series bone densitometer (Hologic, Inc., Bedford, MA) and BIA using a Tanita® Body Fat Analyzer- TBF 310 (Tanita Corporation of American, Inc., Arlington Heights, IL) systems.
- REE was measured in duplicate by IC using a MedGem® handheld device (Medical Home Solutions, Inc., Golden, CO) following a 12-hour fast and 15-minute resting protocol.
- IC with a proprietary algorithm estimated FFM and % BF following REE measurement.
- Paired sample t-test and Spearman's Rho correlation was conducted using SPSS 13.0.

RESULTS

Table 1. Descriptive Statistics of Participant Demographics. (N=83)

	Mean ± SD	Range
Age (yrs)	47.8 ± 15.5	18 - 75
Weight (kg)	84.5 ± 12.8	64.1 – 127.3
BMI (kg/m2)	28.9 ± 3.1	25.1 – 40.6
REE (kcal/day)	1823 ± 398	1195 - 3055
DEXA BF (%)	28.4 ± 9.1	10.2 – 47.4

Table 2. Spearman Rho Correlation (% Body Fat) Between Reference Systems. (N=83)

	DEXA	BIA	IC
DEXA	1.00	0.89 *	0.89 *
BIA	0.89 *	1.00	0.88 *
IC	----	----	1.00

* p ≤ 0.001

Figure 1. Level of Relationship between FFM (DEXA) and REE (IC). *r* = 0.72; *P* =0.001

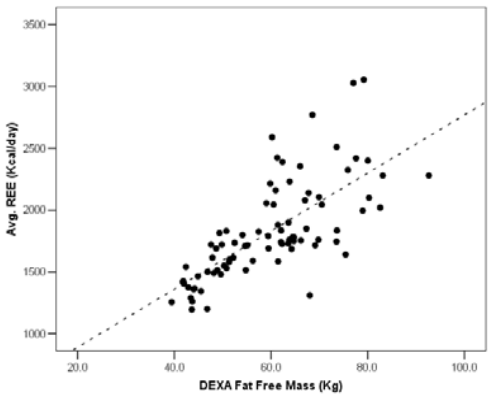


Table 3. FFM and % BF (Mean ± SD) comparison between reference systems.

	FFM	% BF
DEXA	59.7 ± 12.1	28.4 ± 9.1
BIA	60.2 ± 11.5	29.0 ± 8.7
IC	59.7 ± 11.2	29.8 ± 7.4 *

* Significantly different from DEXA p ≤ 0.05

Figure 2. Bland Altman Analysis between DEXA and IC % Body Fat.

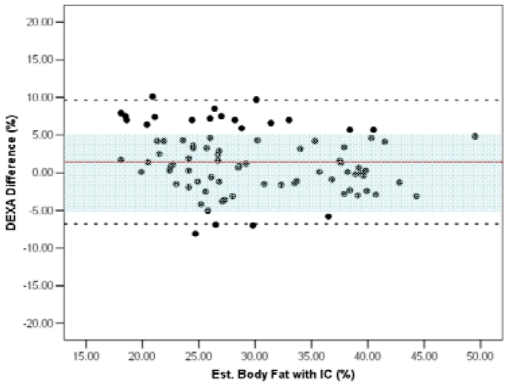
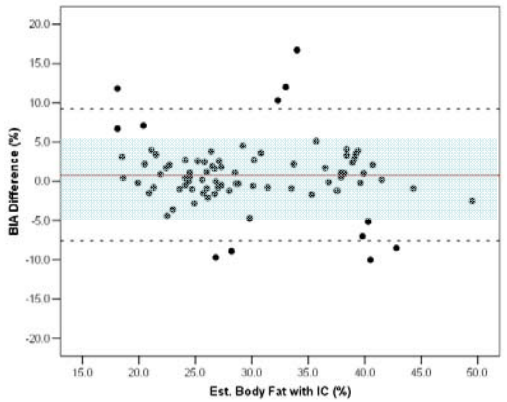


Figure 3. Bland Altman Analysis between BIA and IC % Body Fat.



CONCLUSION

- This is the first study comparing the accuracy and reliability of using a handheld IC device with a proprietary algorithm for assessing FFM and % BF.
- Similar to previous studies (1-3), these data indicate FFM is highly correlated with REE $r = 0.72$; $p \leq 0.001$
- There appears to be a small difference between DEXA and IC % BF (-1.4 ± 4.1%; p≤ 0.05). However, there was no difference between IC and BIA % BF.
- The level of agreement with IC % BF is reliable to DEXA ($r = 0.89$; p≤ 0.05) and BIA ($r = 0.88$ p≤ 0.05). Approximately 80% of IC % BF values were within ± 5% of DEXA values.
- Based on these data, the use of a handheld IC device with a proprietary algorithm appears to accurately and reliably assess FFM and % BF in overweight adults.

REFERENCES

1. Johnstone AM, Murison SD, Duncan JS, Rance KA, Speakman JR. Factors influencing variation in basal metabolic rate include fat-free mass, fat mass, age, and circulating thyroxine but not sex, circulating leptin, or triiodothyronine. *American Journal of Clinical Nutrition* 2005; 82: 941-948.

2. Heymsfield SB, Gallagher D, Kotler DP, Wang Z, Allison DB, Heshka S. Body-size dependence of resting energy expenditure can be attributed to nonenergetic homogeneity of fat-free mass. *American Journal of Physiology- Endocrinology and Metabolism* 2002; 282: E132-138.

3. Weinsier, R., Schutz, Y., & Bracco, D. (1992). Reexamination of the relationship of resting metabolic rate to fat-free mass and to the metabolically active components of fat-free mass in humans. *American Journal of Clinical Nutrition, 55*(4), 790-794.

4. Molini M, Krenkel J, St Jeor ST. Comparison of five predictive equations to measured resting metabolic rate of overweight/obese subjects in a weight management clinic: 703-P. *NAASO's Annual Scientific Meeting*. 14 vol. Boston, MA: Obesity; 2006:A223.

5. Frankenfield D, Roth-Yousey L, Compher C. Comparison of predictive equations for resting metabolic rate in healthy nonobese and obese adults: A systematic review. *Journal of the American Dietetic Association* 2005; 105: 75-789.

6. Boullata J, Williams J, Cottrell F, Hudson L, Compher C. Accurate determination of energy needs in hospitalized patients. *Journal of the American Dietetic Association* 2007; 107: 393-401.

Disclosure: HealtheTech, Inc. funded this study. Microlife Medical Home Solutions, Inc. purchased the assets (i.e. MedGem) to HealtheTech. Dr. McDoniel is employed by Microlife Medical Home Solutions, Inc.