InBody VALIDATION STUDIES

Vs

GOLD STANDARD

(DEXA, D2 dilution, doubly labeled water, Bromide dilution, CT, Underwater weighing, BOD POD, indirect calorimetry)

AND COMPETITORS

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
1	Brazil	**Agreement Between Body Composition Assessed by Bioelectrical Impedance Analysis and Doubly Labeled Water in Obese Women Submitted to Bariatric Surgery : Body Composition, BIA, and DLW.**	2019	Obesity Surgery	Doubly Labeled Water vs InBody230	20 class III obese women	FM (r = 0.84-0.92, CCC = 0.84-0.95), FFM (r = 0.73-0.90, CCC = 0.68-0.80), and TBW (r = 0.76-0.91, CCC = 0.72-0.81) before and after bariatric surgery.

Abstract

INTRODUCTION: Bariatric surgery has a significant influence on body composition (BC), which should be monitored. However, there is a need to recommend low-cost practical methods, with good estimation of BC for class III obese and/or bariatric patients. **OBJECTIVE**: The aim of this study was to determine accuracy and agreement between BC assessed by direct segmental multifrequency bioelectrical impedance analysis (DSM-BIA) and doubly labeled water (DLW) as reference method. **MATERIAL AND METHODS:** Twenty class III obese women (age 29.3 ± 5.1 years; body mass index 44.8 ± 2.4 kg/m2) underwent Roux-en-Y gastric bypass surgery. BC (fat mass [FM], fat-free mass [FFM], and total body water [TBW]) was assessed by InBody 230 and DLW in the following periods: before and 6 and 12 months after surgery. Accuracy between the methods was evaluated by the bias and root mean square error. Pearson's correlation, concordance correlation coefficient (CCC), and Bland-Altman method were used to evaluate agreement between the methods. **RESULTS**: Correlations were significant ($p < 0.001$) and CCC was good/excellent between both methods for the evaluation of FM (r = 0.84-0.92, CCC = 0.84-0.95), FFM (r = 0.73-0.90, CCC = 0.68-0.80), and TBW (r = 0.76-0.91, CCC = 0.72-0.81) before and after bariatric surgery. In addition, no significant bias was observed between DSM-BIA and DLW for FM (mean error [ME] = - 1.40 to 0.06 kg), FFM (ME = 0.91-1.86 kg), and TBW (ME = 0.71-1.24 kg) measurements. **CONCLUSION**: The DSM-BIA was able to estimate the BC of class III obese women submitted to bariatric surgery with values consistent with those of the DLW method.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
2	USA	**Reliability and Agreement of Various InBody Body Composition Analyzers as Compared to Dual-Energy X-Ray Absorptiometry in Healthy Men and Women.**	2018	Journal of Clinical Densitometry	DEXA vs InBody230-720-770	31 males and 36 females	Intraclass correlation coefficients for BF% (≥0.98), FM (≥0.98), and FFM (≥0.99).
Abstract	**BACKGROUND**: Bioelectrical impedance analysis has evolved over the years to include the use of multiple frequencies and impedance measurements to improve the accuracy and reliability of body composition estimates. The purpose of this investigation was to evaluate the reliability of the InBody230, InBody720, and InBody770 to measure body fat percent (BF%), fat mass (FM), and fat-free mass (FFM) in the general population and to compare results to dual-energy X-ray absorptiometry (DXA). **METHODS**: A total of 31 males and 36 females participated in 2 d of testing separated by 24-72 h. Each visit consisted of a DXA scan, and analysis with the InBody230, InBody720, and InBody770. **RESULTS**: All 3 bioelectrical impedance devices (InBody230, InBody720, and InBody770) were reliable in men and women as indicated by high intraclass correlation coefficients for BF% (≥0.98), FM (≥0.98), and FFM (≥0.99) and low standard error of measurement for BF% (0.77%-0.99%), FM (0.54-0.87 kg), and FFM (0.58-0.84 kg) and minimum difference for BF% (2.12%-2.73%), FM (1.49-2.39 kg), and FFM (1.60-2.32 kg), respectively. When examining the agreement between the 3 InBody analyzers with DXA, systematic bias (underestimation of BF% and FM and overestimation of FFM) was present for all comparisons ($p < 0.05$) while proportional bias was present for FM in women and FFM in men. However, there was small individual error for all comparisons as indicated by the standard error of estimate and 95% limits of agreement. **CONCLUSION**: The InBody analyzers produce small individual error, which suggest these methods can be used as a surrogate when DXA is not available; however, practitioners should be aware of the systematic bias for all comparisons and proportional bias for FM in women and FFM in men. Furthermore, findings revealed that the research grade models, InBody720 and InBody770, added minimal benefit over the portable InBody230 when assessing BF%, FM, and FFM.						

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
3	Thailand	**Evaluation of Body Composition in Hemodialysis Thai Patients: Comparison between Two Models of Bioelectrical Impedance Analyzer and Dual-Energy X-Ray Absorptiometry.**	2018	Journal of Nutrition and Metabolism	DEXA(Lunar) vs InBodys10 and InBody720	69 subjects	DXA and InBody S10 fat mass index r=0.95, fat-free mass index r=0.78 DXA and InBody 720 FMI: r=0.96, FFMI: r=0.81

Abstract

BACKGROUND: Body composition measurement is very important for early nutritional care in hemodialysis patients. Dual-energy X-ray absorptiometry (DXA) is a gold standard test, but clinically limited. Bioelectrical impedance analysis (BIA) with multifrequency technique is a practical and reliable tool.

OBJECTIVE: This cross-sectional study was aimed to compare the agreement of BIA with DXA in measurement of body composition in hemodialysis patients and to evaluate their associated factors.

METHODS: Body composition was measured by 2 BIA methods (InBody S10 and InBody 720) and DXA after a hemodialysis session. A total of 69 measurements were included. Pearson's correlation and Bland and Altman analysis were used to determine the correlation of body composition between methods and to compare the methods agreement, respectively.

RESULTS: The correlation coefficients of body compositions were strong between DXA and InBody S10 (fat mass index (FMI): r=0.95, fat-free mass index (FFMI): r=0.78) and also between DXA and InBody 720 (FMI: r=0.96, FFMI: r=0.81). Comparing to DXA, the means of each body composition measured by InBody S10 method were not significantly different in each gender, but differences were found in FM, %FM, and FMI measured by InBody 720.

CONCLUSIONS: In maintenance hemodialysis patients, the measurement of body composition with DXA and both BIA methods had highly significant correlations; practically, BIA method could be used as an instrument to follow FM and FFM and to measure the edematous stage. Further studies with large populations are warranted.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
4	USA	**Validity of the InBody 520™ to predict metabolic rate in apparently healthy adults.**	2018	The Journal of Sports Medicine and Physical Fitness	Indirect calorimetry VS InBody 520	26 apparently healthy adults	Relationship between pRMR and mRMR (r=0.87, P<0.001)

Abstract

BACKGROUND:
The present study seeks to assess the validity of the InBody 520™ device to predict RMR in apparently healthy adults relative to a metabolic cart (the standard, yet time-intensive, method for determining resting metabolic rate).

METHODS:
Twenty-six apparently healthy adults participated in the study. Predicted RMR (pRMR) was calculated by the InBody 520™ and measured RMR (mRMR) was determined by 30-minute gas analysis and ventilated hood system. Of the 78 measurement trials conducted, 64 yielded acceptable measurement trials.

RESULTS:
A Pearson product-moment correlation was used to determine the relationship between pRMR and mRMR (r=0.87, P<0.001). No significant difference existed between the pRMR (1650.89±295.96 kcal) and mRMR (1675.36±278.69 kcal) values (P=0.19).

CONCLUSIONS:
Study findings suggest that the InBody520™ provides valid measurements of RMR in apparently healthy adults and can be an effective and efficient method for collecting data in a clinical setting.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
5	USA	**Comparison of total and segmental body composition using DXA and multi-frequency bioimpedance in collegiate female athletes**	2015	Journal of Strength and Conditioning Research	DEXA(Lunar) vs InBody720	45 American Female Collegiate Athletes	Percent body fat r=0.94
Abstract	The purpose of this investigation was to determine the agreement between multifrequency bioelectrical impedance analysis (BIA) and dual-energy x-ray absorptiometry (DXA) for measuring body fat percentage (BF%), fat-free mass (FFM), and total body and segmental lean soft tissue (LST) in collegiate female athletes. Forty-five female athletes (age = 21.2 ± 2.0 years, height = 166.1 ± 7.1 cm, weight = 62.6 ± 9.9 kg) participated in this study. Variables measured through BIA and DXA were as follows: BF%, FFM, and LST of the arms (ARMS(LST)), the legs (LEGS(LST)), the trunk (TRUNK(LST)), and the total body (TOTAL(LST)). Compared with the DXA, the InBody 720 provided significantly lower values for BF% (-3.3%, $p < 0.001$) and significantly higher values for FFM (2.1 kg, $p < 0.001$) with limits of agreement (1.96 SD of the mean difference) of ±5.6% for BF% and ±3.7 kg for FFM. No significant differences ($p < 0.008$) existed between the 2 devices (InBody 720-DXA) for ARMS(LST) (0.05 kg), TRUNK(LST) (0.14 kg), LEGS(LST) (-0.4 kg), and TOTAL(LST) (-0.21 kg). The limits of agreement were ±0.79 kg for ARMS(LST), ±2.62 kg for LEGS(LST), ±3.18 kg for TRUNK(LST), and ±4.23 kg for TOTAL(LST). This study found discrepancies in BF% and FFM between the 2 devices. However, the InBody 720 and DXA appeared to provide excellent agreement for measuring total body and segmental LST. Therefore, the InBody 720 may be a rapid noninvasive method to assess LST in female athletes when DXA is not available.						

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
6	India	**Estimation of bone mineral content from bioelectrical impedance analysis in Indian adults aged 23-81 years: a comparison with Dual energy X-ray absorptiometry**	2012	International Journal of Biomedical Engineering and Technology	DEXA(Lunar) vs InBody720	113 individuals (28 men and 85 women) in the age group of 23-81 years.	Bone mineral content r=0.9136
Abstract	The purpose of this study was to validate a Bioelectrical Impedance Analysis (BIA) equation for prediction of Bone Mineral Content (BMC) against Dual energy X-ray Absorptiometry (DXA) in Indian adults. Healthy 113 subjects were investigated by two methods: BMC was measured by DXA and bioelectrical impedance at various frequencies was measured by a commercial segmental multi-frequency BIA instrument. Body parameters were derived from impedance data and a new BIA equation was developed for the estimation of BMC, which exhibited high correlation and low prediction error. It was found valid in subjects with large variations in Body Mass (BM) and age.						

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
7	Korea	**Body composition measurements determined by air displacement plethysmography and eight-polar bioelectrical impedance analysis are equivalent in African American College students**	2012	Health med Journal	Bod-Pod vs InBody720	143 African American Collegiate	Fat free mass M:r=0.911 F:r=0.918 Body fat mass M:r=0.938 F:r=0.931
Abstract	The purpose of this study was to compare body composition measurements taken with air displacement plethysmography (BOD POD) to eight-polar bioelectrical impedance analysis (BIA) in African American college students. The 143 subjects, aged 17–39 years, visited the participating Human Performance & Leisure Studies laboratory at North Carolina A&T State University, Greensboro, NC, United States, between June 1, 2011 and December 31, 2011. Measurements of body composition, including fat mass (FM), fat free mass (FFM), and % body fat were determined using BOD POD (Life Measurement Inc., California, USA) and an eightpolar BIA (Inbody-720, Biospace, Seoul, Korea). The relationships between body composition measurements taken using BOD POD and eight-polar BIA were assessed using Pearson's r correlation. Results showed that body composition measurements taken using the BOD POD and the eightpolar BIA correlated significantly with respect to FFM. […] The authors concluded that measurements taken using BOD POD and eight-polar BIA were similar in African American students. These methods are useful for field tests requiring body composition measurements and can be used interchangeably in the field.						

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
8	UK	**Comparison of multifrequency bioelectrical impedance analysis and dual-energy x-ray absorptiometry assessments in outpatient hemodialysis patients**	2011	American Journal of Kidney Diseases	DEXA(Hologic) vs InBody720	53 British Hemodialysis Patients	Fat free mass r2=0.845 Body fat mass r=0.93
Abstract	**BACKGROUND:** Malnutrition is common in hemodialysis patients and closely related to increased morbidity and mortality. As such, simple, reliable, and easily available methods of determining nutritional status and recognition of short-term changes in body composition are desirable for routine clinical practice. **STUDY DESIGN:** Diagnostic test study. **SETTING & PARTICIPANTS:** 53 stable adult hemodialysis patients attending for thrice-weekly outpatient hemodialysis in a university tertiary hospital dialysis center. **INDEX TEST:** Comparison of dual-energy x-ray absorptiometry (DEXA) and multifrequency bioelectrical impedance analysis (BIA) using a tetrapolar 8-point tactile electrode system as 2 index tests of body composition. **REFERENCE TEST:** None. **RESULTS:** Assessment of whole-body composition showed that lean body mass measured using the 2 techniques correlated highly, with good method agreement shown using a Bland-Altman plot (r = 0.92; P < 0.001; bias, +1 g [95% CI, -1,173 to 1,175]), as did fat mass (r = 0.93; P < 0.001; bias, -157 g [95% CI, -1,251 to 937]). Similarly, segmental analysis of lean body mass showed strong correlations between lean body mass of the trunk and right and left legs with small bias (r = 0.85, 0.89, and 0.86, respectively; P < 0.001; Bland-Altman bias, -859, +364, and +552 g, respectively), but weaker correlations for lean body mass for the right and left arm (r = 0.69 and 0.75, respectively; P < 0.001; Bland-Altman bias, -240 and +12 g, respectively). Bone mineral content derived using multifrequency BIA overestimated that measured using DEXA (r = 0.77; P < 0.001; bias, +530 g [95% CI, 422-638]). **LIMITATIONS:** Retrospective study in a healthy ambulant outpatient cohort. **CONCLUSIONS:** Compared with DEXA, multifrequency BIA appears to be a robust tool for measuring and monitoring total-body fat and lean body mass in hemodialysis patients; however, there is less agreement in bone mineral content assessment between the 2 methods.						

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
9	Netherlands	**Accuracy of direct segmental multi-frequency Bioimpedance analysis in the assessment of total body and segmental body composition in middle-aged adult population**	2011	Clinical Nutrition	DEXA(Hologic) vs InBody720	484 middle-aged Cocassian	Body fat mass M:r=0.93 F:r=0.97

Abstract

BACKGROUND & AIMS: Body composition measurement is a valuable tool for assessing nutritional status and physical fitness in a variety of clinical settings. Although bioimpedance analysis (BIA) can easily assess body composition, its accuracy remains unclear. We examined the accuracy of direct segmental multi-frequency BIA technique (DSM-BIA) in assessing different body composition parameters, using dual energy X-ray absorptiometry (DEXA) as a reference standard.

METHODS: A total of 484 middle-aged participants from the Leiden Longevity Study were recruited. Agreements between DSM-BIA and DEXA for total and segmental body composition quantification were assessed using intraclass correlation coefficients and Bland-Altman plots.

RESULTS: Excellent agreements were observed between both techniques in whole body lean mass (ICC female = 0.95, ICC men = 0.96), fat mass (ICC female = 0.97, ICC male = 0.93) and percentage body fat (ICC female = 0.93, ICC male = 0.88) measurements. Similarly, Bland-Altman plots revealed narrow limits of agreements with small biases noted for the whole body lean mass quantification but relatively wider limits for fat mass and percentage body fat quantifications. In segmental lean muscle mass quantification, excellent agreements between methods were demonstrated for the upper limbs (ICC female≥0.91, ICC men≥0.87) and lower limbs (ICC female≥0.83, ICC male≥0.85), with good agreements shown for the trunk measurements (ICC female = 0.73, ICC male = 0.70).

CONCLUSIONS: DSM-BIA is a valid tool for the assessments of total body and segmental body composition in the general middle-aged population, particularly for the quantification of body lean mass.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
10	UK	**Assessment of body composition in peritoneal dialysis(PD) Patients using bioelectrical impedance and dual-energy x-ray absorptiometry**	2011	American journal of nephrology	DEXA(Hologic) vs InBody720	104 British Peritoneal Dialysis Patients	Fat free mass r=0.95 Body fat mass r=0.93

Abstract

INTRODUCTION: Protein energy wasting is closely related to increased morbidity and mortality in peritoneal dialysis (PD) patients. Simple reliable and easily available methods of determining nutritional status and recognition of short-term changes in body composition are therefore important for clinical practice.

METHODS: We compared whole-body and segmental composition using multifrequency bioelectrical impedance analysis (MF-BIA) and dual-energy X-ray absorptiometry (DEXA) in 104 stable PD patients.

RESULTS: Assessment of whole-body composition showed that lean body mass (LBM) was highly correlated with good method agreement using DEXA as the reference test ($r = 0.95$, $p < 0.0001$; bias -0.88 kg, 95% CI -1.53 to 0.23 kg). Similarly, high correlation and good method agreement were found for fat mass ($r = 0.93$, $p < 0.0001$; bias 0.69 kg, 95% CI 0.03-1.36 kg). Segmental analysis of LBM revealed strong correlations between LBM for trunk, left and right arms and legs ($r = 0.90$, 0.84, 0.86, 0.89 and 0.90, respectively, $p < 0.0001$). Bone mineral content derived by MF-BIA overestimated that measured by DEXA (bias 0.740 kg, 95% CI 0.66-0.82 kg).

CONCLUSION: MF-BIA may potentially be a useful tool for determining nutritional status in PD patients and serial estimations may help recognize short-term changes in body composition.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
11	India	**Single prediction equation for bioelectrical impedance analysis in adults aged 22-59 years**	2011	Journal of Medical Engineering & Technology	DEXA(Lunar) vs InBody720	64 subjects ((34 men and 30 women) in the age group of 22-59 years.	Bone mineral content r = 0.9531

Abstract

The purpose of this study was to validate a single bioelectrical impedance analysis (BIA) equation in healthy Indian subjects aged 22-59 years with a body mass index (BMI) between 16.8 and 47.3 kg m^{-2}. Healthy subjects (34 men and 30 women) were measured by two methods: bone mineral content (BMC) was measured by a commercial body composition analyser and bioelectrical impedance at various frequencies was measured by a newly developed bioelectrical impedance measurement system. As correlations were high and prediction error was low, a single equation was developed using all subjects as follows: BMC = -3.5268 + (0.0279 x h) + (0.0145 x w) + (184 x (h^2/Z(body50)))-(1.08 x (w x h^2/Z(body6.25)))-(0.0032 x (age))-(0.103 x (sex); men = 1, women = 0). BMC measured from commercial instrument InBody720 was 2.552 ± 0.457 kg. BMC predicted by equation was 2.554 ± 0.447 kg (R = 0.976, adjusted R^2 = 0.948, standard error of estimate = 0.104 kg, total error = 0.09987 kg). The results of this study show that the newly developed multi-frequency bioelectrical impedance measurement system with the single prediction BIA equation can be used in screening the subjects suspected with osteoporosis and for follow-up study of the patient under the therapy for osteoporosis. For validation of commercial instrument InBody720, BMC of 22 healthy subjects was measured by InBody720 and dual-energy X-ray absorptiometry. High correlation (R = 0.9531) and low error (total error = 0.0913 kg) was found between these two methods.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
12	Japan	**InBody720 as a new method of evaluation visceral obesity**	2011	Hepato-Gastroentertology	CT vs InBody720	50 Stomach Cancer surgery Patients, 37-85 years old	Visceral fat area values r= 0.759
Abstract	BACKGROUND/AIMS: This study was conducted to assess the efficacy of bioelectrical impedance analysis by InBody 720 as a new tool for measuring visceral fat area. METHODOLOGY: A total of 53 consecutive patients elected to undergo surgical resection of primary gastric cancer received preoperative measurement of visceral fat area at the umbilical level with both computed tomography and bioelectrical impedance analysis by InBody 720. RESULTS: Visceral fat area values measured by InBody 720 significantly correlated with those by computed tomography (R = 0.759). CONCLUSION: Bioelectrical impedance analysis by InBody 720 was shown to be useful as a more convenient substitute for computed tomography when measuring visceral fat area.						

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
13	Switzerland	**Cross-validation of bioelectrical impedance analysis for the assessment of body composition in a representative sample of 6-to 13-year-old children**	2009	European Journal of Clinical Nutrition	DEXA(Hologic) vs RJL vs InBody3.0 (720)	333 Swedish Children,6-13 years old	Fat free mass r2=0.98

Abstract

BACKGROUND/OBJECTIVES: (1) To cross-validate tetra- (4-BIA) and octopolar (8-BIA) bioelectrical impedance analysis vs dual-energy X-ray absorptiometry (DXA) for the assessment of total and appendicular body composition and (2) to evaluate the accuracy of external 4-BIA algorithms for the prediction of total body composition, in a representative sample of Swiss children.

SUBJECTS/METHODS: A representative sample of 333 Swiss children aged 6-13 years from the Kinder-Sportstudie (KISS) (ISRCTN15360785). Whole-body fat-free mass (FFM) and appendicular lean tissue mass were measured with DXA. Body resistance (R) was measured at 50 kHz with 4-BIA and segmental body resistance at 5, 50, 250 and 500 kHz with 8-BIA. The resistance index (RI) was calculated as height(2)/R. Selection of predictors (gender, age, weight, RI4 and RI8) for BIA algorithms was performed using bootstrapped stepwise linear regression on 1000 samples. We calculated 95% confidence intervals (CI) of regression coefficients and measures of model fit using bootstrap analysis. Limits of agreement were used as measures of interchangeability of BIA with DXA.

RESULTS: 8-BIA was more accurate than 4-BIA for the assessment of FFM (root mean square error (RMSE)=0.90 (95% CI 0.82-0.98) vs 1.12 kg (1.01-1.24); limits of agreement 1.80 to -1.80 kg vs 2.24 to -2.24 kg). 8-BIA also gave accurate estimates of appendicular body composition, with RMSE < or = 0.10 kg for arms and < or = 0.24 kg for legs. All external 4-BIA algorithms performed poorly with substantial negative proportional bias (r> or = 0.48, P<0.001).

CONCLUSIONS: In a representative sample of young Swiss children (1) 8-BIA was superior to 4-BIA for the prediction of FFM, (2) external 4-BIA algorithms gave biased predictions of FFM and (3) 8-BIA was an accurate predictor of segmental body composition.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
14	Korea	**Cross-calibration of multi-frequency bioelectrical impedance analysis with eight-point tactile electrodes and dual-energy X-ray absorptiometry for assessment of body composition in healthy children aged 6 –18 years**	2009	Pediatrics International	DEXA(Lunar) vs InBody720	166 Korean Children and Adolescents under 18 years old	Fat free mass r2= 0.990 Body fat mass r2= 0.934 Percent body fat r2= 0.940

Abstract

BACKGROUND: In diagnosis and treatment of obesity, body composition analysis including percent body fat (%BF) is useful in the clinical setting. Because bioelectrical impedance analysis (BIA) could be used quickly, easily and was non-invasive in clinical setting, the purpose of the present study was to evaluate the usefulness of multi-frequency BIA with eight-point tactile electrodes (MF-BIA8; InBody 720, Biospace) compared with dual-energy X-ray absorptiometry (DXA) in healthy children and adolescents.

METHODS: A total of 166 children and adolescents under 18 (male, n = 86; female, n = 80) were recruited. Height, weight, body mass index (BMI) and Tanner stage were measured for each subject. The body composition such as fat-free mass (FFM), fat mass (FM), and %BF was measured on BIA and DXA and compared.

RESULTS: On linear regression analysis, DXA FFM = 1.006(BIA FFM) + 0.554, R(2) = 0.99 and the standard error of the estimate (SEE) was 1.16 kg; DXA FM = 0.971(BIA FM) - 0.596, R(2) = 0.93; SEE, 1.34 kg; and DXA %BF = 0.940(BIA %BF) - 1.026, R(2) = 0.858; SEE, 3.03%. Limit of agreement in FFM, FM, and %BF was 0.7 +/- 2.3 kg, -0.9 +/- 2.9 kg and -2.2 +/- 6.1%, respectively.

CONCLUSIONS: Although the %BF was not interchangeable with DXA, MF-BIA8 (InBody 720; Biospace) could be used to measure body composition of children and adolescents in the clinical field because of its high precision.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
15	Italy	**Body water distribution in severe obesity and its assessment from eight-polar bioelectrical impedance analysis**	**2005**	European Journal of Clinical Nutrition	D2 dilution, Bromide dilution vs InBody 3.0 (720)	75 Italian Female, 18-66 years old (non obese =25, Obese I-II = 25, Obese III = 25)	Total body water r2=0.82 Extracellular water r2=0.87

Abstract

OBJECTIVE: To measure body water distribution and to evaluate the accuracy of eight-polar bioelectrical impedance analysis (BIA) for the assessment of total body water (TBW) and extracellular water (ECW) in severe obesity.

DESIGN: Cross-sectional study**.**

SETTING: Obesity clinic.

SUBJECTS: In all, 75 women aged 18-66 y, 25 with body mass index (BMI) between 19.1 and 29.9 kg/m(2) (ie not obese), 25 with BMI between 30.0 and 39.9 kg/m(2) (ie class I and II obese), and 25 with BMI between 40.0 and 48.2 kg/m(2) (ie class III obese).

METHODS: TBW and ECW were measured by (2)H(2)O and Br dilution. Body resistance (R) was obtained by summing the resistances of arms, trunk and legs as measured by eight-polar BIA (InBody 3.0, Biospace, Seoul, Korea). The resistance index at a frequency of x kHz (RI(x)) was calculated as height (2)/R(x).

RESULTS: ECW : TBW was similar in women with class III (46+/-3%, mean+/-s.d.) and class I-II obesity (45+/-3%) but higher than in nonobese women (39+/-3%, P<0.05). In a random subsample of 37 subjects, RI(500) explained 82% of TBW variance (P<0.0001) and cross-validation of the obtained algorithm in the remaining 38 subjects gave a percent root mean square error (RMSE%) of 5% and a pure error (PE) of 2.1 l. In the same subjects, RI(5) explained 87% of ECW variance (P<0.0001) and cross-validation of the obtained algorithm gave a RMSE% of 8% and a PE of 1.4 l. The contribution of weight and BMI to the prediction of TBW and ECW was nil or negligible on practical grounds.

CONCLUSIONS: ECW : TBW is similar in women with class I-II and class III obesity up to BMI values of 48.2 kg/m(2). Eight-polar BIA offers accurate estimates of TBW and ECW in women with a wide range of BMI (19.1-48.2 kg/m(2)) without the need of population-specific formulae.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
16	Japan	**Percentage of Total Body Fat as Estimated by Three Automatic Bioelectrical Impedance Analyzers**	2004	Journal of Physiological Anthropology and Applied Human Science	DEXA(Lunar) vs Underwater weighing vs Tanita (BC118, TBF101) vsInBody3.0 (720)	45 Healthy Japanese Female Collegiate	Percent body fat DEXA r=0.94 UW r=0.81
Abstract	The present study aimed to compare the accuracy of estimating the percentage of total body fat (%TBF) among three bioelectrical impedance analysis (BIA) devices: a single-frequency BIA with four tactile electrodes (SF-BIA4), a single-frequency BIA with eight tactile electrodes (SF-BIA8) and a multi-frequency BIA with eight tactile electrodes (MF-BIA8). Dual-energy x-ray absorptiometry (DXA) and hydrostatic weighing (HW) were used as references for the measured values. Forty-five healthy college student volunteers (21 males: 172.9 +/- 5.5 cm and 65.8 +/- 9.1 kg and 24 females: 160.7 +/- 6.6 cm, 52.6 +/- 6.2 kg) were the subjects. Correlation coefficients between the BIA measurements and the references were calculated. The standard error of estimation (SEE) was calculated by regression analysis when estimating the reference measures (DXA and HW) from the predictor (SF-BIA4, SF-BIA8 and MF-BIA8). The differences in %TBF between the reference and the predictor, calculated by the reference minus the predictor, were plotted against the %TBF measured by the references. The MF-BIA 8 here showed the highest correspondence to the reference and the least estimation error compared with the other BIA methods. It is considered that there is a limit to directly estimate FFM from a regression equation using impedance, weight, height and age as independent variables, and that %TBF can be more accurately estimated by measuring segmental impedances using eight electrodes and multi-frequency electric currents and then estimating total body water from these impedances.						

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
17	Finland	**Body Composition Assessment with Segmental Multifrequency Bioimpedance Method**	2003	Journal of Sports Science and Medicine	DEXA vs Underwater weighing vs InBody3.0 (720)	58 Healthy Finnish Adults, 36-53 Years old	Fat free mass r=0.83 Body fat mass r=0.91 Percent body fat r=0.81

Abstract	Body composition assessment is an important factor in weight management, exercise science and clinical health care. Bioelectrical impedance analysis (BIA) is widely used method for estimating body composition. The purpose of this study was to evaluate segmental multi-frequency bioimpedance method (SMFBIA) in body composition assessment with underwater weighing (UWW) and whole body dual energy x-ray absorptiometry (DXA) in healthy obese middle-aged male subjects. The measurements were carried out at the UKK Institute for Health Promotion Research in Tampere, Finland according to standard procedures of BIA, UWW and DXA. Fifty-eight (n=58) male subjects, aged 36-53 years, body mass index (BMI) 24.9-40.7, were studied. Of them forty (n=40) underwent also DXA measurement. Fat mass (FM), fat-percentage (F%) and fat free mass (FFM) were the primary outcome variables. The mean whole body FM (±SD) from UWW was 31.5 kg (±7.3). By DXA it was 29.9 kg (±8.1) and by SMFBIA it was 25.5 kg (±7.6), respectively. The Pearson correlation coefficients (r) were 0.91 between UWW and SMFBIA, 0.94 between DXA and SMFBIA and 0.91 between UWW and DXA, respectively. The mean segmental FFM (±SD) from DXA was 7.7 kg (±1.0) for arms, 41.7 kg (±4.6) for trunk and 21.9 kg (±2.2) for legs. By SMFBIA, it was 8.5 kg (±0.9), 31.7 kg (±2.5) and 20.3 kg (±1.6), respectively. Pearson correlation coefficients were 0.75 for arms, 0.72 for legs and 0.77 for trunk. This study demonstrates that SMFBIA is usefull method to evaluate fat mass (FM), fat free mass (FFM) and fat percentage (F%) from whole body. Moreover, SMFBIA is suitable method for assessing segmental distribution of fat free mass (FFM) compared to whole body DXA. The results of this study indicate that the SMFBIA method may be particularly advantageous in large epidemiological studies as being a simple, rapid and inexpensive method for field use of whole body and segmental body composition assessment.

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
18	Italy	**Cross-calibration of eight-polar bioelectrical impedance analysis versus dual-energy X-ray absorptiometry for the assessment of total and appendicular body composition in healthy subjects aged 21–82 years**	2003	Annals of Human Biology	DEXA(Lunar) vs InBody3.0 (720)	110 Healthy Italian Adults, 21-82 yearsold	Fat free mass r2=0.92
Abstract	**AIM**: To calibrate eight-polar bioelectrical impedance analysis (BIA) against dual-energy X-ray absorptiometry (DXA) for the assessment of total and appendicular body composition in healthy adults. **RESEARCH DESIGN**: A cross-sectional study was carried out. **SUBJECTS**: Sixty-eight females and 42 males aged 21-82 years participated in the study. **METHODS**: Whole-body fat-free mass (FFM) and appendicular lean tissue mass (LTM) were measured by DXA; resistance (R) of arms, trunk and legs was measured by eight-polar BIA at frequencies of 5, 50, 250 and 500 kHz; whole-body resistance was calculated as the sum R of arms, trunk and legs. **RESULTS**: The resistance index (RI), i.e. the height(2)/resistance ratio, was the best predictor of FFM and appendicular LTM. As compared with weight (Wt), RI at 500 kHz explained 35% more variance of FFM (vs 0.57), 45% more variance of LTM(arm) (vs 0.48) and 36% more variance of LTM(leg) (vs 0.50) ($p < 0.0001$ for all). The contribution of age to the unexplained variance of FFM and appendicular LTM was nil or negligible and the RI x sex interactions were either not significant or not important on practical grounds. The percent root mean square error of the estimate was 6% for FFM and 8% for LTM(arm) and LTM(leg). **CONCLUSION**: Eight-polar BIA offers accurate estimates of total and appendicular body composition. The attractive hypothesis that eight-polar BIA is influenced minimally by age and sex should be tested on larger samples including younger individuals.						

	Country	Research	Publication Year	Journal	Device	Subjects	Correlation Coefficient
19	Italy	**Accuracy of an eight-point tactile-electrode impedance method in the assessment of total body water**	2002	European Journal of Clinical Nutrition	D2dilution vs InBody3.0 (720)	50Healthy Adults, Average age: 40 years old	Total body water r2=0.81

Abstract

OBJECTIVE: To establish the accuracy of an eight-polar tactile-electrode impedance method in the assessment of total body water (TBW).

DESIGN: Transversal study.

SETTING: University department.

SUBJECTS: Fifty healthy subjects (25 men and 25 women) with a mean (s.d.) age of 40 (12) y.

METHODS: TBW measured by deuterium oxide dilution; resistance (R) of arms, trunk and legs measured at frequencies of 5, 50, 250 and 500 kHz with an eight-polar tactile-electrode impedance-meter (InBody 3.0, Biospace, Seoul, Korea).

RESULTS: An algorithm for the prediction of TBW from the whole-body resistance index at 500 kHz (height (2)/R(500) where R is the sum of the segmental resistances of arms, trunk and legs) was developed in a randomly chosen subsample of 35 subjects. This algorithm had an adjusted coefficient of determination (r2(adj)) of 0.81 ($P<0.0001$) and a root mean square error (RMSE) of 3.6 l (9%). Cross-validation of the predictive algorithm in the remaining 15 subjects gave an r2(adj) of 0.87 ($P<0.0001$) and an RMSE of 3.0 l (8%). The precision of eight-polar BIA, determined by measuring R three times a day for five consecutive days in a fasting subject, was < or =2.8% for all segments and frequencies.

CONCLUSION: Eight-polar BIA is a precise method that offers accurate estimates of TBW in healthy subjects. This promising method should undergo further studies of precision and its accuracy in assessing extracellular water and appendicular body composition should be determined.

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