BODY COMPOSITION USING BIO-IMPEDANCE ANALYSIS IN PEDIATRIC PATIENTS WITH INFLAMMATORY BOWEL DISEASE. CONCORDANCE WITH DUAL ENERGY X-RAY ABSORPTIOMETRY AND COMPARISON WITH HEALTHY CONTROLS

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BACKGROUND:

Growth is a central process in paediatrics. Weight and height evaluation are therefore routine exams for every child but in some situation, particularly inflammatory bowel disease (IBD), a wider evaluation of nutritional status needs to be performed.

Twenty-five percent of Crohn's diseases (CD) are diagnosed during puberty, with growth failure often being the predominant initial manifestation.

The underlying mechanisms of growth retardation are not fully understood but may be primarily related to malnutrition and to the strong inflammatory reaction occurring during active disease.

Assessment of body composition therefore is crucial in order to maintain acceptable growth using the following techniques: Dual-energy-x-ray absorptiometry (DEXA), bio-impedance-analysis (BIA) and anthropometric measurements (skinfold thickness).

Even though DEXA is known as the gold standard for body composition assessment, its availability, invasiveness and relatively high cost renders it rather impractical. Therefore a technique like BIA showing the simplicity of skinfold measurements and the precision of DEXA in the same time could be used as a bedside tool.

OBJECTIVES:

1. Assess the accuracy of BIA in estimating body composition (percentage fat mass: FM% and percentage fat free mass: FFM%) in children with IBD, compared with DEXA (gold standard)
2. To compare FM% and FFM% levels between IBD patients and healthy controls

PATIENTS AND METHOD: (figure 1)

21 patients with inflammatory bowel disease were assessed (11 females, 10 males, 15 with Crohn's disease and 6 with ulcerative colitis). Mean age was 14.8 years (range 12-16 years). The patients were compared to a group of 29 healthy controls (12 females, 17 males). Mean age was 12.7 years (range 10-16 years).
The patients were recruited from August 2011 to October 2012 at our institution.

In both groups, BIA using BIA 101 – Body impedance analyser (AKERN, Florence, Italy) was performed. This technique is based on the properties of tissues to conduct electrical current. Using values of TBW derived from BIA, one can then estimate fat-free mass (FFM) and body fat (adiposity).

BodyGram Pro® is a multi-functional BIA software for medically validated analysis of body composition and hydration covering both sexes, all age ranges and constitutional types. The equations used are protected by the manufacturer but probably look like this (ref. 1-3)

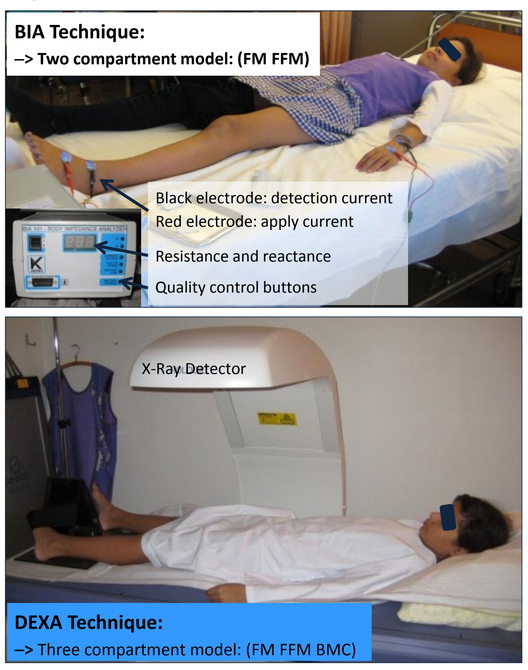
$$\textbf{TBW [kg]} = \text{coeff } 1 \times (H^2/R) + \text{coeff } 2 \times (\text{sexe}) + \text{coeff } 3 \times (W) - \text{coeff } 4 \times (\text{age[y]})$$

coefficient 1-4 vary according to author and manufacturer.
H:height, R:resistance [Ω], W:weight [kg]

$$\textbf{FFM [kg]} = \text{TBW}/(0.73) \quad \text{and} \quad \textbf{FM [kg]} = \text{Weight [kg]} - \text{FFM}$$

BIA was performed in all children and DEXA in patients only. Concordance between BIA and DEXA was assessed using Lin's concordance correlation and the Bland-Altman method. Between-group comparisons were made using analysis of variance adjusting for age.

Figure 1:



BIA:

+ easy and quick to perform
+ inexpensive
+ non-invasive and painless
+ portable

– depending on hydration
– need exact position of electrode and a proper maintenance
– equation program by the manufacturer
– validity discuss for obese children

DEXA

+ a validate gold standard for healthy children
+ good reproducibility and accuracy

– expensive
– limited accessibility
– small irradiation of subjects tested

RESULTS

Results for agreement between BIA and DEXA for body composition are summarized in table 1 and in figures 2 to 3.

BIA values showed a good correlation with DEXA for both FM% and FFM%.
FM% assessed by BIA showed a very good agreement with DEXA (figure 2a), most differences being less than 2% (figure 2b). FFM% assessed by BIA also showed a good agreement with DEXA (figure 3a), but BIA tended to overestimate FFM% by 1.1% on average (figure 3b).

No differences in body mass index (BMI) were found between IBD children and healthy controls: mean BMI: 19.3±3.3 (mean ± standard deviation) vs. 20.1±2.8 kg/m2, respectively, p=0.39.
After stratifying on gender, no differences in FM% were found between IBD children and controls: for boys, 25.3±10.2 vs. 22.6±7.1%, p=0.42; for girls, 28.2±5.7 vs. 26.4±7.7%, p=0.54 for IBD children and controls, respectively. Similar findings were obtained after adjusting for age.

Figure 2a: BIA FM%
Lin's concordance representation

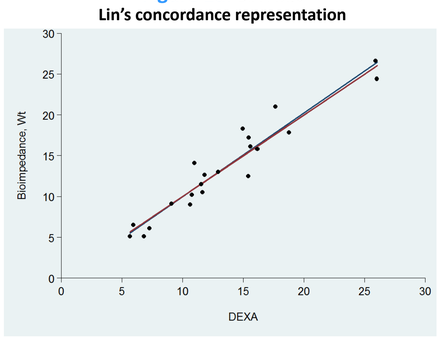


Figure 2b: BIA: FM%
Bland-Altmann representation

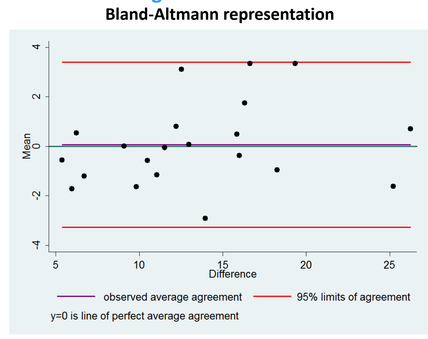


Figure 3a: BIA: FFM%
Lin's concordance representation

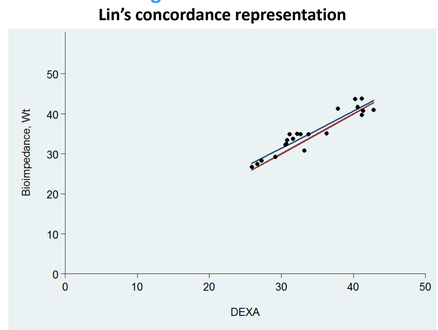


Figure 3b: BIA: FFM%
Bland-Altmann representation

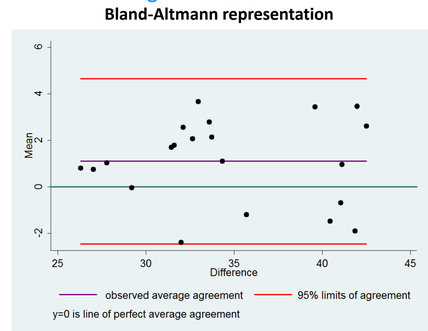


Table 1 : results of the agreement between body composition as assessed by skinfold equations and DEXA

	SPEARMAN	LIN'S CONCORDANCE		BLAND-ALTMAN Limits of agreement			BRADLEY-BLACKWOOD	
	correlation	Coefficient	95% CI	Difference	SD	Correlation §	Test	P-value
FM %	0.937 ***	0.957	0.921–0.994	0.07	1.71	0.244	0.616	0.55
FFM %	0.907 ***	0.922	0.857–0.987	1.10	1.81	-0.032	3.70	<0.05

§ between difference and mean. CI, confidence interval; SD, standard deviation of the difference. ***, p<0.001

CONCLUSION

BIA adequately assesses body composition of IBD children.

Because of clinical advantages (figure 1) it could adequately replace DEXA in clinic !

No significant difference was found regarding body composition of IBD children relative to healthy controls.

BIBLIOGRAPHY:

1. Lukaski H C, *Aviation, space, and environmental medicine* 59, nº 12 (december 1988): 1163-1169.
2. Houtkooper L B, *Journal of applied physiology* (Bethesda, Md: 1985) 66, nº 2 (february 1989): 814-821.
3. Pietrobelli A, *Acta diabetologica,* nº 40 Suppl 1 (October 2003)
4. Lukaski H C, *The Journal of nutrition 123*, nº 2 Suppl (february 1993): 438-443.
5. Ogle G D, *The American journal of clinical nutrition 61*, nº 4 (April 1995): 746-753.
6. Wiskin A E, *Clinical nutrition (Edinburgh, Scotland) 30*, nº 1 (february 2011)