ASSESSMENT OF SKINFOLD THICKNESS EQUATIONS IN ESTIMATING BODY COMPOSITION IN CHILDREN WITH INFLAMMATORY BOWEL DISEASE

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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), the latter being the easiest available and most cost-effective one.

OBJECTIVES: To assess the accuracy of skinfold equations in estimating body fat percent in children with inflammatory bowel disease, compared with a gold standard method: Dual energy x-ray absorptiometry (DEXA).

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).
Body composition of these children was assessed using the following anthropometric measurements: weight, height, BMI and skinfolds thicknesses (biceps, triceps, subscapular and suprailiac).

The following 5 published equations were used in order to calculate Body Density (D): Deurenberg (1), Weststrate (2), Durnin & Rahaman (3), Johnston (4) and Brook (5). FM percentage then was calculated using the equation from Deurenberg (1).

$$\mathbf{D} = \mathbf{coefficient\ 1} - \mathbf{coefficient\ 2} \times \mathbf{Log(sum\ of\ 4\ skinfolds)} - \mathbf{coefficient\ 3}$$

Coefficient 1, 2 and 3: vary according to author, sex and Tanner scale.

$$\mathbf{FM\ \%} = \frac{562 - 4.2 \times (\mathrm{age} - 2)}{\mathrm{D}} - (525 - 4.7 \times (\mathrm{age} - 2))$$

Deurenberg equation's to assess %FM from density.

$$(\mathbf{FFM\ \%} = \mathbf{100} - \mathbf{FM\ \%})$$

Fat mass also can be assessed directly from skinfolds using the equation from Slaughter(6).

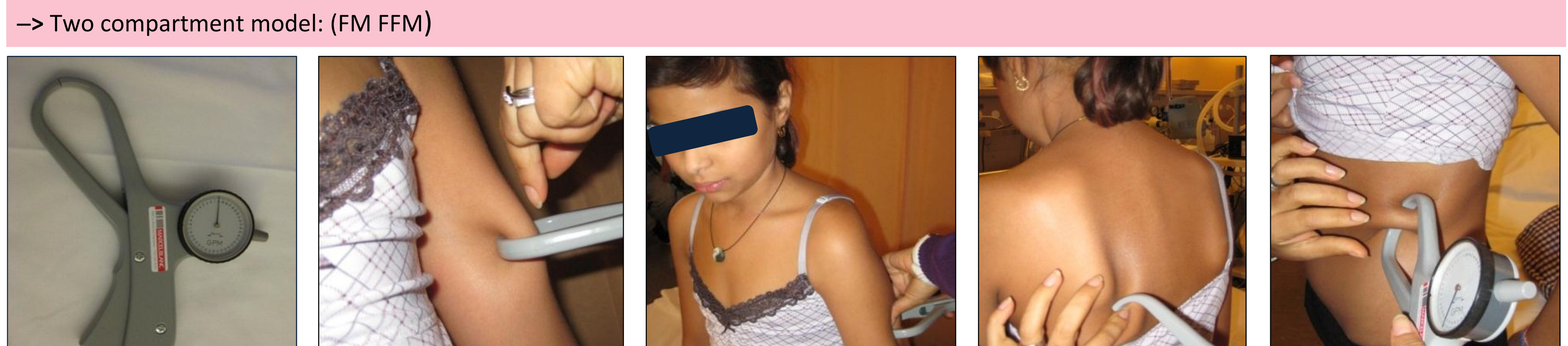
$$\mathbf{FM\%} = \mathbf{coefficient\ 1} \times (\mathbf{tric} + \mathbf{subsc}) - \mathbf{coefficient\ 2} \times (\mathbf{tric} + \mathbf{subsc})^2 - \mathbf{coefficient\ 3}$$

Coefficient 1, 2 and 3: vary according to sex, Tanner scale and skinfold sum.

The results of these 6 equations then were compared with DEXA, serving as gold standard. The statistical analysis was performed using Lin's concordance correlation, The Bland Altman limits of agreement method, the Spearman correlation and the Bradley-Blackwood test. Calculations of mean, SD, z-score, Absolut errors, min and max values were also performed.

Figure 1:

SKINFOLD THICKNESS Technique:
–> Two compartment model: (FM FFM)



Skinfold calipers | Biceps skinfold | Triceps skinfold | Subscapular skinfold | Suprailiac skinfold

SKINFOLD THICKNESS
- \+ easy and quick to perform
- \+ inexpensive
- \+ non invasive
- \+ portable
- – lack of accuracy with healthy children reported by some authors
- – non valid in obese children
- – need a trained observer
- – many different equations, depending on author, age, sex, Tanner scale

DEXA
- \+ validate gold standard for healthy children
- \+ good reproducibility and accuracy
- – expensive
- – limited accessibility
- – small irradiation of subjects tested

DEXA Technique:
–> Three compartment model: (FM FFM BMC)

RESULTS

Results of agreement between body composition assessed by skinfold equations and DEXA are summarized in table 1.

Overall, the results of the Durnin & Rahaman equation correlated best (Spearman and Lin test: table 1 and figure 2) with DEXA.

In the Bland-Altman analysis (table 1 and figure 3), the Durnin & Rahaman equation showed the second smallest difference from the reference values and also the second smallest correlation between difference and mean.

Finally, the Durnin & Rahaman equation was the only equation to present a non-significant Bradley-Blackwood test.

Because of the limited sample size (21 children) both sexes were analysed together. In the future, evaluation of theses equations separately for IBD Females and Males should be performed as well as factor influencing individual variability.

Figure 2
Durnin and Rahaman equation
Lin's concordance representation

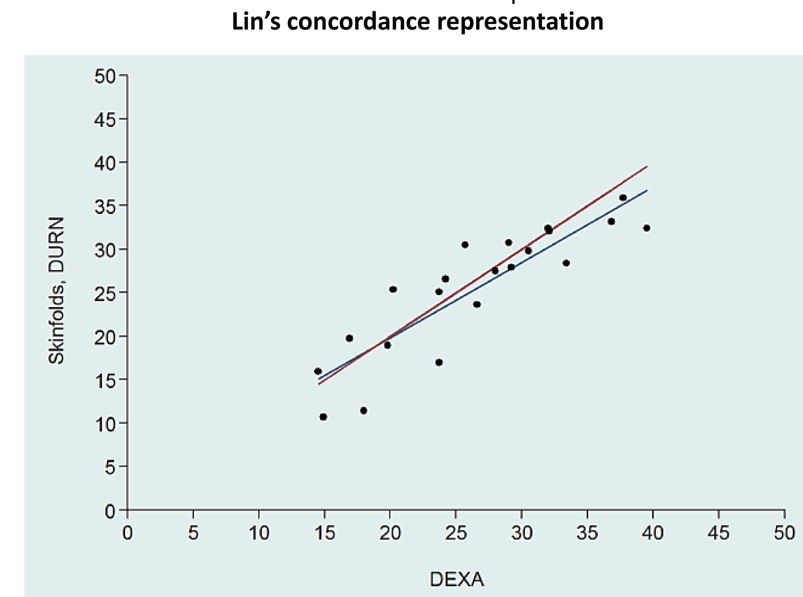


Figure 3
Durnin and Rahaman equation
Bland-Altman representation

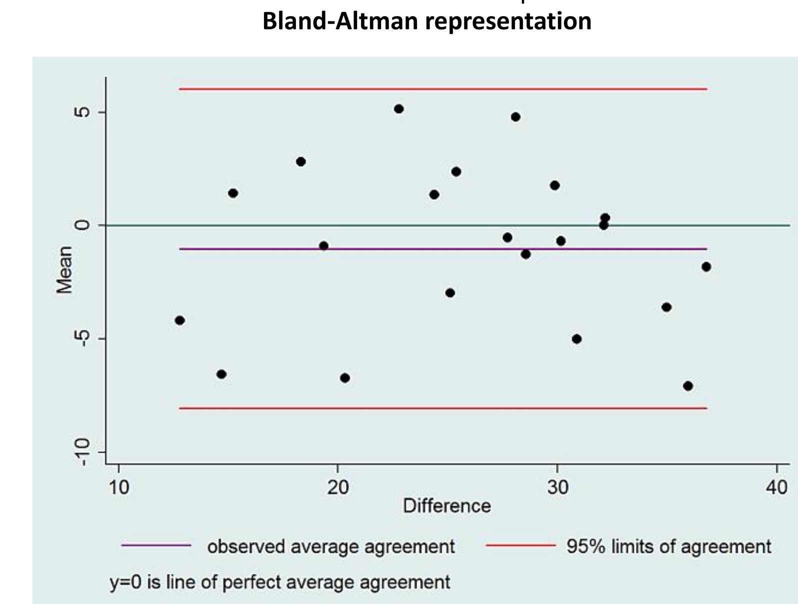


Table 1: results of the agreement between body composition as assessed by skinfold equations and DEXA

	SPEARMAN	LIN'S CONCORDANCE		BLAND-ALTMAN Limits of agreement			BRADLEY-BLACKWOOD	
	Correlation	Coefficient	95% CI	Difference	SD	Correlation §	Test	P-value
Deurenberg	0.852 ***	0.702	0.512 – 0.891	-3.6	4.2	-0.343	9.84	<0.001
Weststrate	0.898 ***	0.850	0.734 – 0.966	2.5	3.3	0.003	5.62	<0.05
Slaughter	0.906 ***	0.848	0.744 – 0.952	0.003	4.9	0.570	4.57	<0.05
Durnin & Rahaman	0.915 ***	0.871	0.764 – 0.979	-1.0	3.6	-0.033	0.80	0.46
Johnston	0.919 ***	0.810	0.676 – 0.945	-3.4	3.3	-0.040	10.5	<0.001
Brook	0.900 ***	0.876	0.779 – 0.972	1.8	3.6	0.355	4.18	<0.05

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

CONCLUSION

Evaluation of body composition in children with IBD was most accurate compared to DEXA using the Durnin and Rahaman skinfold equations.

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