LETTERS TO THE EDITOR

Vertical segmental tetrapolar bioimpedance for excess body fat assessment in adolescents☆,☆☆

Bioimpedanciometria tetrapolar segmentada vertical para a avaliação do excesso de gordura corporal em adolescentes

Dear Editor,

Volume 91, Issue 6 of the Journal of Pediatrics published an article entitled ''Evaluation of the predictive capacity of vertical segmental tetrapolar bioimpedance for excess weight detection in adolescents''.[1] The authors aimed to analyze, in a sample of adolescents, the predictive capacity of a vertical segmental tetrapolar bioimpedance device in the detection of excess weight, using horizontal tetrapolar bioimpedance as a reference method. However, we would like to address a few points to contribute to the aforementioned subject.

Electrical bioimpedance is a technique used for assessing body composition that is considered to be double-indirect,[2] as it assumes conceptual premises based on biological, physical, and mathematical principles, with regression equations validated from an indirect method, most commonly hydrostatic weighing or dual energy X-ray absorptiometry (DEXA).

In this technique, the guiding principle is the ratio between body water content and amounts of the different body components, based on the finding that lean tissue, which contains a large amount of water ($\sim$73%) and electrolytes, is a good electrical conductor. On the other hand, fat tissue, which has a small amount of water, is a poor conductor.[3]

A substance's resistance is proportional to the voltage variation of an electrical current applied to it. Therefore, through a tetrapolar system, in which two electrodes are attached to the right hand dorsum and two to the right foot dorsum of the assessed individual, the bioimpedance device identifies the levels of body resistance and reactance to the passage of an electric current to estimate total body water, amount of lean body mass, and fat mass.[4]

Segmental bioimpedance use is not new, having been first used in the 1980s,[5] based on the observation that 85% of the total body impedance was the sum of the impedances of the upper and lower limbs, although these segments constitute only 35% of total body volume. Subsequently, the segmental bioimpedance approach became incorporated into multiple devices, initially only through the measurement of the lower limbs, in bioimpedance scales,[4] and more recently in tetrapolar equipment, but still lacking studies that demonstrate its validity.

This fact justifies the need for studies to assess the predictive capacity of vertical segmental tetrapolar bioimpedance to estimate body fat in different population groups and age groups. However, this is only possible when using a technique considered a ''gold standard'' as reference, such as DEXA; or even, in order to assess the total body water, dilution techniques with bromide or deuterium, for instance, always followed by adequate statistical analysis of the aforementioned validity.[6]

Based on careful reading of the manuscript, some doubts have arisen regarding the methodological techniques, which in our opinion deserve clarification in order to allow readers that do not have a profound knowledge of body composition assessment to understand the assessment of the predictive capacity of bioelectrical impedance equipment.

First, the authors used a double indirect technique as the standard to define excess body fat and assess the predictive capacity of another device model of the same double indirect technique. In order to justify this procedure, the authors stated that the horizontal tetrapolar bioimpedance showed high correlation coefficients compared with the gold standard DEXA device, citing four articles. However, one of them is a systematic review that concluded that bioimpedance is a technique that does not have satisfactory validity; and none of the other three studies correlated the bioimpedance with DEXA.

Second, the authors state that ''the resistance and reactance values were provided by Biodynamics® (model 450,

Biodynamics®, WA, USA)'' and the percentage of fat was calculated using the predictive equations of Chumlea et al.; however, the cited article addresses the proposition of equations for predicting body mass of elderly patients using anthropometric measurements, with no relation to the bioelectrical impedance technique.

Third, there are some considerations about the statistical analysis used in the study. The authors did not mention whether they tested the assumption of normal data distribution, and used the parametric statistics for data description (mean ± standard deviation), comparing the results between the genders using Student's t-test. Observing the deviation of some variables, we can assume that they had non-normal distribution, such as segmental trunk fat (TF%) in girls (9.59% ± 8.33%) and boys (16.33% ± 6.94%), with coefficients of variation of 86.9% and 42.5%, respectively. Therefore, the data should have been shown as median and interquartile range, and the comparisons performed by the Mann–Whitney U test, when a non-normal distribution was detected. As the aim of the study was to evaluate predictive capacity, the positive and negative predictive values should have been given. Additionally, the comparison between the mean/median values obtained by the utilized standard and those tested should also be included in the results. A concordance analysis technique, such as kappa, concordance correlation coefficient, or Bland–Altman plot, should also be used. For a good performance analysis of a body composition prediction technique, regression analysis (slope and intercept) is usually employed, as well as the calculation of the estimated standard error (ESE).

In conclusion, we want to emphasize that the scarcity of studies to test the validity of bioelectrical impedance equipment and its predictive capacity for fat body assessment in adolescents of the Brazilian population demonstrates the importance of the authors' concern and the need for such investigations. However, the absence of a reference method based on multi-compartment models or a gold standard weakens the study considerably and cannot be overlooked in the discussion. Thus, the methodological care mentioned here must be observed in order to increase the quality of the results.

Funding

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Neves FS, Leandro DA, da Silva FA, Netto MP, Oliveira RM, Candido AP. Evaluation of the predictive capacity of vertical segmental tetrapolar bioimpedance for excess weight detection in adolescents. J Pediatr (Rio J). 2015;91:551–9.
2. Martin AD, Drinkwater DT. Variability in the measures of body fat. Assumptions or technique? Sports Med. 1991;11:277–88.
3. Kushner RF. Bioelectrical impedance analysis: a review of principles and applications. J Am Coll Nutr. 1992;11:199–209.
4. Chumlea WC, Sun SS. Biolectrical impedance analysis. In: Heymsfield SB, Lohman TG, Wang Z, Going SB, editors. Human body composition. 2nd ed. Champaign: Human Kinetics; 2005. p. 79–88.
5. Settle R, Foster K, Epstein B, Mullen J. Nutritional assessment: whole body impedance and body fluid compartments. Nutr Cancer. 1980;2:72–80.
6. Sun SS, Chumlea WC. Statistical methods. In: Heymsfield SB, Lohman TG, Wang Z, Going SB, editors. Human body composition. 2nd ed. Champaign: Human Kinetics; 2005. p. 151–60.

Roberto F. Costa*, Edilson S. Cyrino

Universidade Estadual de Londrina (UEL), Londrina, PR, Brazil

* Corresponding author.
E-mail: roberto@robertocosta.com.br (R.F. Costa).