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Evaluation of the predictive capacity of vertical segmental tetrapolar bioimpedance for excess weight detection in adolescents ☆

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Abstract

Objective: To analyze the predictive capacity of the vertical segmental tetrapolar bioimpedance apparatus in the detection of excess weight in adolescents, using tetrapolar bioelectrical impedance as a reference.

Methods: This was a cross-sectional study conducted with 411 students aged between 10 and 14 years, of both genders, enrolled in public and private schools, selected by a simple and stratified random sampling process according to the gender, age, and proportion in each institution. The sample was evaluated by the anthropometric method and underwent a body composition analysis using vertical bipolar, horizontal tetrapolar, and vertical segmental tetrapolar assessment. The ROC curve was constructed based on calculations of sensitivity and specificity for each point of the different possible measurements of body fat. The statistical analysis used Student's *t*-test, Pearson's correlation coefficient, and McNemar's chi-squared test. Subsequently, the variables were interpreted using SPSS software, version 17.0.

Results: Of the total sample, 53.7% were girls and 46.3%, boys. Of the total, 20% and 12.5% had overweight and obesity, respectively. The body segment measurement charts showed high values of sensitivity and specificity and high areas under the ROC curve, ranging from 0.83 to 0.95 for girls and 0.92 to 0.98 for boys, suggesting a slightly higher performance for the male gender. Body fat percentage was the most efficient criterion to detect overweight, while the trunk segmental fat was the least accurate indicator.

Conclusion: The apparatus demonstrated good performance to predict excess weight.

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Avaliação da capacidade preditiva da bioimpedância tetrapolar segmentada vertical na detecção do excesso de peso em adolescentes

Resumo

Objetivo: analisar a capacidade preditiva da bioimpedância tetrapolar segmentada vertical na detecção do excesso de peso em adolescentes, utilizando a bioimpedância tetrapolar horizontal como referência.

Métodos: estudo transversal realizado com 411 alunos de 10 a 14 anos, de ambos os sexos, matriculados em escolas públicas e privadas, selecionados por processo amostral aleatório simples e estratificados de acordo com sexo, idade e proporção em cada instituição. Foi realizada avaliação antropométrica e analisada a composição corporal através das bioimpedâncias bipolar vertical, tetrapolar horizontal e tetrapolar segmentada vertical. Foram construídas as curvas ROC com base nos cálculos de sensibilidade/especificidade para cada ponto das diferentes medições possíveis de gordura corporal do equipamento em questão. Posteriormente, foram executados os seguintes testes estatísticos: T de Student, correlação de Pearson e qui-quadrado de McNemar. Para a interpretação das variáveis, utilizou-se o software SPSS 17.0.

Resultados: a amostra foi composta por 53,7% meninas e 46,3% meninos. Do total, 20% e 12,5% exibiram, respectivamente, sobrepeso e obesidade. Os gráficos das medidas dos segmentos corporais refletiram-se em altos valores de sensibilidade e especificidade, além de elevadas áreas sob a curva ROC, que variaram de 0,83 a 0,95 para meninas e de 0,92 a 0,98 para meninos, sugerindo um desempenho levemente superior para o sexo masculino. O percentual de gordura total foi apontado como o critério mais eficiente do equipamento para a detecção do excesso de peso, enquanto a gordura segmentar do tronco apresentou-se como um indicador de precisão inferior.

Conclusão: o aparelho comportou-se satisfatoriamente na predição do excesso de peso.

Introduction

According to data from the World Health Organization (WHO), the current prevalence of excess weight among developing countries, particularly in urban societies, is already as high as that of developed countries.[1] Physical inactivity and the continuing practice of inadequate diet stand out as the possible reasons for the increase in these diseases.[2] Additionally, there are strong indications that chronic and metabolic diseases of adulthood begin in childhood, increasing the necessity of clinical monitoring and nutritional surveillance for adequate assessment of health status.[3–5]

When defining the methods for determining nutritional status, preference should be given to those that better detect alterations that need to be corrected in the study population.[6–8] It is also important to consider the financial resources involved, the time and the skill level required to perform them, and the receptivity of the individuals to assessment and the possible risks associated with the methodological processes, such as radiation exposure.[9,10]

The use of laboratory procedures provides very accurate estimates of fat and fat-free mass components.[9] However, because of the high cost of equipment, the methodological sophistication, and the difficulties involved in enrolling the assessed individuals into the measurement protocols, their applications have been limited.[10,11] Doubly indirect techniques, among them bioimpedance and anthropometry, are less stringent, but show better practical performance and lower cost, allowing them to be used in both field research and clinical studies.[11,12]

Although the measurement of body mass index, skin fold thickness, and perimeters – waist circumference, conicity index, and waist/hip and waist/height ratios – are usually among the most widely used methods for determining the body composition of adolescents, both in population and individual nutritional assessment studies, it is noteworthy that the alternative methods of vertical bioimpedance became the most modern, practical, and inexpensive.[9–12] In contrast, the real efficiency and reliability of the data obtained through these currently available devices have been poorly explored.[13]

Thus, this study aims to analyze, in a sample of adolescents, the predictive capacity of a vertical segmental tetrapolar bioimpedance device for detecting excess weight, using the horizontal tetrapolar bioimpedance method as a reference.

Methods

Population and study design

A cross-sectional epidemiological study was carried out in 2012 with a representative sample of adolescents – aged 10–14 years old – of both genders, enrolled in public elementary municipal, state, and federal schools, as well as private schools in the urban area of the municipality of Juiz