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Specific BIVA recognizes variation of body mass and body composition: Two related but different facets of nutritional status

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ABSTRACT

Objective: The aim of this study was to demonstrate the different information provided by body mass index (BMI) in combination with *specific* bioelectrical impedance vector analysis (*specific* BIVA) in the measure of relative body fat.
Methods: Anthropometric and bioelectrical values and dual-energy x-ray absorptiometry measurements from a sample of 1590 US adults of both sexes were retrieved from the National Health and Nutrition Examination Survey 2003–2004. The sample distribution of the BMI of each sex was divided into deciles. Quartiles were calculated for percent fat mass (FM%) after stratifying by BMI deciles. Body composition and bioelectrical characteristics of groups below the first and above the third quartile were compared using analysis of variance and the Hotelling's T-square test.
Results: BMI and *specific* BIVA showed a different accuracy in detecting body composition variations: BMI showed similar values in groups represented by different FM percentages, whereas the bioelectrical differences were statistically significant. The mean impedance vectors corresponding to cases below the first FM% quartiles were shorter and located on the left side of the ellipses (the region of higher fat-free mass), whereas those above the third FM% quartiles were on the right and toward the upper pole (the region of higher FM%).
Conclusions: Specific BIVA is a technique for the evaluation of body composition which can add relevant information regarding BMI.

Introduction

Body mass index (BMI) is a straightforward and useful index for classifying nutritional status. Based primarily on the association with mortality, BMI cutoff points have been defined to evaluate the full spectrum of malnutrition (thinness, overweight, and obesity) [1]. This valuable screening tool is widely used for identifying individuals or groups with increased risk for morbidity or mortality, and for planning and evaluating interventions.

However, BMI does not actually give a measure of body composition and is considered not adequate to account for body composition differences between individuals or populations [1]. In fact, although correlated with relative body fat, BMI considers weight as a whole and does not reveal the proportion of muscle and fat associated with weight changes. However, the relationship with fat mass (FM) varies across sexes, ages, populations, and according to body build and proportions [2–6]. Inaccuracies in the estimation of body composition and misclassifications of malnutrition have been observed as a consequence, especially in old or diseased individuals [3,7,8].

In particular, BMI alone does not allow the recognition of normal-weight obesity (NWO), which is the condition of normal-weight individuals with high body fat content. Not recognizing NWO, which is associated with cardiovascular risk factors [9], metabolic syndrome, and insulin resistance [10], can have serious health consequences.

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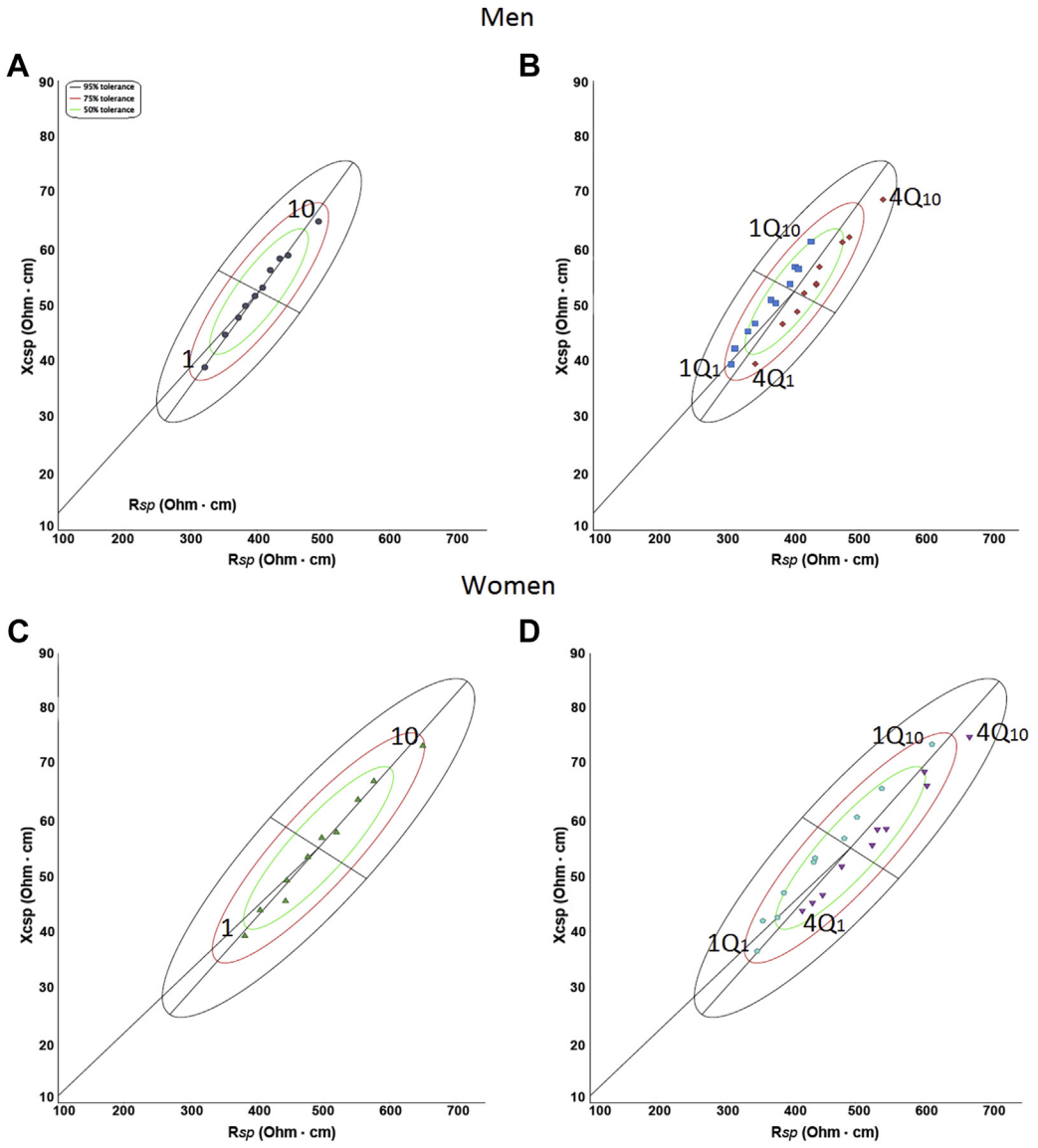

Fig. 1. Trend of bioelectrical values in groups defined by BMI deciles (A, C) and FM% quartiles (B, D) of both sexes. 1 Q: cases below the first FM% quartiles; 4 Q: cases above the third FM% quartiles. 1, …, 10: BMI deciles.

Furthermore, BMI cannot provide information on the distribution of FM in various body compartments. In particular, it does not provide information on visceral FM, a physiological component highly related to health risks [11]. To account for such weakness, scientific institutions, such as the National Institutes of Health [12] and The Obesity Society [13], have recommended adding the measure of waist circumference, and charts based on BMI and waist circumference have been recently published [14].

However, to obtain a more precise assessment of adiposity, methods able to evaluate body composition, such as hydrodensitometry or imaging techniques, should be used. Unfortunately, such methods are costly and involve practical difficulties, so their suitability is limited [1].

Bioelectrical impedance analysis (BIA) is an economical, safe, and easy to use technique for the assessment of body composition [15]. Multifrequency BIA is considered particularly appropriate for assessing water compartments, even if single-frequency BIA also can be used and showed to be well correlated with water compartments [16]. The recently proposed variant *specific* bioelectrical impedance vector analysis (*specific* BIVA) [17] has been validated against dual-energy x-ray absorpitometry (DXA) in a sample of US adults [18] and elderly Italians [19] and has demonstrated accuracy in evaluating the relative quantity of FM. *Specific* bioelectrical reference values for US adults [18], European adults [20], and the Italian elderly [21] have been proposed.

The aim of the present study was to demonstrate the different information provided by BMI and *specific* BIVA in the measure of relative body fat. Moreover, we offer practical advice for analyzing body composition and recognizing nutritional conditions not detectable by BMI.

Materials and methods

Participants

A sample of 1590 adults (836 men and 754 women; ages 21–49 y) was retrieved from the National Health and Nutrition Examination Survey