CONFERENCIA

Techniques to measure body composition in children: uses in population studies

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The human body is composed of tissue compartments that confer different metabolic capacities (1). In addition, some tissues, such as fat (adipose), may even become a risk factor for metabolic diseases if they reach a great enough mass (2). Therefore, the study of human body composition, and a thorough understanding of the various techniques used to measure or estimate tissue compartments, is essential for improving our knowledge of human nutrition.

Fundamental components of human body composition include bone mass, total body water, fat mass, and lean body mass. Lean body mass, the tissue containing mitochondria and composes highly energetic organs and muscle, account for most of the daily energy expenditure (3,5). On the other hand, fat mass is a major contributor to disease risk since an excess amount of adipose tissue increases the free fatty acid concentration in circulation and is associated with heart disease, type 2 diabetes, hypertension, and even some cancers (6,7). Therefore, to better understand body composition, it is essential to use precise methods that differentiate tissue compartments to obtain an accurate estimate of fat and lean body mass.

Currently, several different methods to assess body composition exist (8,11). First, the simplest method to estimate body composition is the use of skinfold measurements. Basically, by obtaining measurements of skinfolds at specific body sites, such as the tricep, subscapular, or suprailiac crest, these values can be entered into age and gender, and sometimes race, specific prediction equations that estimate body density and fat mass. Subtracting this estimate from body weight provides an estimate of lean body mass. However, there are several limitations to using skinfold calipers, such as technical error or the use of prediction equations that are not valid for a specific group (12).

Second, the use of bioelectrical impedance (BIA) is gaining popularity in many field studies as it reduces technician errors and may be more valid across racial groups (13). Basically, BIA involves measuring the impedance of the body after a small electric current is passed through the body. The impedance of the current is directly proportional to the amount of fat mass, as only tissue with water, will conduct electricity. The limitations of BIA include body hydration, age, and specific monitor as some measure only lower or upper body fat mass, but more expensive models do estimate total body fat mass.

Third, is the use of stable isotopes, either oxygen-18 or deuterium, is a precise method to assess body composition in field settings (14,16). As deuterium is much less expensive, it is generally the preferred isotope for large studies. The use of stable isotopes involves the ingestion of a safe, non-toxic dose of the isotope and a fluid sample (e.g. urine, saliva, or blood) taken approximately five hours later, a precise estimate of total body water can be obtained. This estimate can then be used to calculate fat and lean body mass. However, beyond the cost of the isotope, investigators must analyze several samples of body fluids using a mass spectrometer that is capable of measuring the enrichment of the isotope. Very few laboratories have this capability and introduces additional cost and technical expertise that may not be available or possible for all investigators.

Finally, imaging techniques, such as magnetic resonance (MRI), dual energy x-ray absorptiometry (DXA), computed tomography (CT), are among the most precise, but technically complicated and cost prohibitive, techniques available to assess total and regional body composition (17). The major drawback to these methods is that they require a major investment in infrastructure and require that study subjects go to a hospital or clinic for their measurement. Thus, they are not practical for large, field studies and are not ethical methods for children or infants given the time involved and/or exposure to radiation.

Studying body composition in children, especially with regards to population studies in developing countries, presents many challenges. While most techniques have now been validated against more precise techniques (18,20), investigators are often left with the choice of practicality and cost over precision and accuracy. For example, when we evaluated the use of BMI versus skinfolds or DXA in a cohort of children in Brazil who were growth retarded or normal height, it was found that BMI had the same relationship with adiposity in both groups. More importantly, despite the fact that skinfold prediction equations underestimated body fatness in both groups, they were useful to differentiate the groups by degree of fatness. The main conclusion of this study was that BMI is acceptable as an index of adiposity in children living in a developing country, but that prediction equations are most useful in cohort studies and not as an individual estimate of body fatness.

In conclusion, while many techniques are available to estimate body composition in children, not all are valid for all populations and most require technical expertise or are prohibitively expensive, making them inappropriate for either clinical or field studies in developing countries. Investigators should first clearly define the objective of their study as this will dictate the best choice of body composition technique to use. The next step is to develop a funding plan if they are to use a more advance technique. The last step should be the thorough training of technicians who will actually carry-out the measurements as technician error can invalidate even the simplest of methods available. In the end, it is important to emphasize that even choosing a simple body composition techniques can be used to better understand changes in body composition or differences between groups, thereby improving our knowledge of human nutrition (21, 22).

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