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Feasibility of bioelectrical impedance analysis in persons with severe intellectual and visual disabilities

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ABSTRACT

Background: Body composition measurements provide important information about physical fitness and nutritional status. People with severe intellectual and visual disabilities (SIVD) have an increased risk for altered body composition. Bioelectrical impedance analysis (BIA) has been evidenced as a reliable and non-invasive method to asses body composition in healthy persons and various patient populations; however, currently, there is no feasible method available to determine body composition in people with SIVD. In this study, therefore, we aimed to assess the feasibility of BIA measurements in persons with SIVD.

Methods: In 33 participants with SIVD and Gross Motor Functioning Classification System (GMFCS) Scale I, II, III, or IV, two BIA measurements were sequentially performed employing Resistance and Reactance in Ohm and fat-free mass (FFM) in kg as outcome variables, utilizing the Bodystat® QuadScan 4000. Feasibility was considered sufficient if ≥80% of the first measurement was performed successfully. Agreement between two repeated measurements was determined by using the paired *t*-test and Intraclass Correlation Coefficient (ICC; two way random, absolute agreement). Bland–Altman analyses were utilized to determine limits of agreement (LOAs) and systematic error. Agreement was considered acceptable if LOAs were <10% of the mean of the first measurement.

Results: The first BIA measurements were completed successfully in 88% of the participants. The paired *t*-test demonstrated no significant differences in Resistance, Reactance, and FFM between BIA Measurements 1 and 2 ($P = 0.140$, 0.091, and 0.866). ICC was 0.965 (95% CI: 0.922–0.984) for Resistance; 0.858 (95% CI: 0.705–0.934) for Reactance; and 0.992 (95% CI: 0.982–0.996) for FFM. LOAs expressed as a percentage of the mean of Measurement 1 were 6.1% for Resistance, 17.6% for Reactance, and 3.8% for FFM.

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Conclusions: The results of this study suggest that BIA measurements seem to be feasible in persons with SIVD. Although these results require confirmation in a more extensive sample of persons with SIVD, the findings of this study are an important first step in the assessment of applicability of BIA measurements for non-invasive monitoring of physical fitness and nutritional status of persons with SIVD.

1. What this paper adds?

Persons with severe intellectual and visual disabilities (SIVD) may be at risk for under- and overnutrition, which is characterized by altered body composition. Several methods to assess body composition in persons with intellectual disabilities (ID) have been described, such as Body Mass Index (BMI), waist circumference, skinfold measurements, and bioelectrical impedance analysis (BIA). Skinfold measurements produce high levels of non-compliance in persons with ID.

Previous research on body composition in persons with ID or SIVD has focused on assessment of fat mass only, whereas fat-free mass (FFM), is specifically related to physical functioning and considered as the most important body compartment in the assessment of nutritional status.

Thus far, there is only minimal evidence on feasibility of BIA measurements in adult persons with SIVD. The results of our study suggest that feasibility of BIA measurements in persons with SIVD is sufficient, and that agreement between two BIA measurements in people with SIVD is very good. Although these results require confirmation in a more extensive sample of persons with SIVD, the findings of this study are an important first step in the assessment of applicability of BIA measurements, for non-invasive monitoring of physical fitness and nutritional status of persons with SIVD.

2. Introduction

Body composition is defined as a component of health-related physical fitness (Bouchard & Sheppard, 1994). Moreover, body composition measurement, especially assessment of fat-free mass (FFM), is a key component of nutritional assessment to evaluate malnutrition or malnutrition risk (Lochs et al., 2006). Persons with severe intellectual and visual disabilities (SIVD) may be at risk for malnutrition, which may be characterized by either overnutrition, i.e. overweight or obesity, or undernutrition (Humphries, Traci, & Seekins, 2009). Prevalence of over- and undernutrition in persons with intellectual disabilities (ID) is estimated at about 30–65% and about 5–20%, respectively (Bryan, Allan, & Russell, 2000; Emerson, 2005; Marshall, McConkey, & Moore, 2003; Robertson et al., 2000; Waninge, van der Weide, Evenhuis, van Wijck, & van der Schans, 2009). However, comprehensive data on over- and undernutrition in persons with SIVD are lacking, because these persons are not accustomed to generally used measurements. Persons with both severe intellectual and visual disabilities have an intelligence quotient below 35 points or a developmental age below 48 months (Pawlyn & Carnaby, 2009) and are thus severely limited in terms of self-care, continence, communication, and mobility (Schalock et al., 2002a,b). Persons with both severe intellectual and visual disabilities also have a visual disability, classified as lightly limited, partially sighted or blind, and as a consequence have, next to problems in understanding, also difficulties seeing their environment.

Overnutrition, characterized by overweight or obesity, in persons with SIVD may be the result of low levels of physical activity, including exercise, and use of an imbalanced diet, i.e. insufficient intake of micronutrients and overconsumption of high caloric products (Humphries et al., 2009). In addition, the insufficient level of physical activity may result in decreased muscle mass. Undernutrition in persons with SIVD may be the result of presence of nutrition-impact symptoms, like dysphagia (Chadwick & Jolliffe, 2009), chewing problems, gastroesophageal reflux and loss of appetite (Humphries et al., 2009). Not only undernutrition, but also overnutrition, for example due to the lower level of physical activity, may be characterized by decreased FFM (Lochs et al., 2006). Also, both overnutrition and undernutrition may result in diminished physical fitness (Frey & Chow, 2006). Therefore, body composition assessment is an important activity when caring for persons with SIVD, to monitor physical fitness and nutritional status.

Several methods to assess body composition in persons with ID have been described, such as Body Mass Index (BMI), waist circumference, skinfold measurements, and bioelectrical impedance analysis (BIA) (Casey, 2013; Soeters et al., 2008). Similar to findings in persons with ID (Casey, 2013), in persons with SIVD, the feasibility and reliability of measuring waist circumference and BMI are acceptable (Waninge et al., 2009). However, the results of a recent scoping review indicated that skinfold measurements produce high levels of non-compliance in persons with ID (Casey, 2013). For example, Waninge et al. found that it appears to be impossible to comply with the measurement conditions, which require skinfold measurements to be taken three times in exactly the same place on a person's body (Waninge et al., 2009). However, previous research on body composition in persons with ID or SIVD has focused on assessment of fat mass only (Casey, 2013), whereas FFM, of which muscle mass is a major component, is specifically related to physical functioning and considered as the most important body compartment in the assessment of nutritional status (Thibault, Genton, & Pichard, 2012).

In general, BIA is a well-known method for determining both FFM and fat mass. It is advantageous in that it is an inexpensive, easy to use, and non-invasive bedside method with a low intra-observer variation and high reproducibility