Sarcopenic obesity: clinical diagnostic potential of 8-electrode multi-segment BIA

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Abstract

Background: Phase angle (θ), derived from bioelectrical impedance analysis (BIA) resistance and reactance, decreases with adult age and is associated with changes in nutritional status, skeletal muscle (SM) function, and insulin resistance. Another measure of SM quality is the light fraction (LF) measured with ultrasound (US) followed by image processing; echogenic light SM is produced with fat and fibrous tissue infiltration of normally dark SM. While BIA systems automatically measure θ, technical training is needed for operation of the US system and subsequent image analysis.

Methods: The aim of this study was to examine the associations between these two age-related measures of SM quality: θ and LF, infiltration of normally dark SM. While BIA systems automatically measure θ, technical training is needed for operation of the US system and subsequent image analysis.

Results: Significant correlations (p<0.05) were present for key associations, including: bicep LF and arm θ; triceps LF and arm θ; thigh LF and leg θ; age and biceps and thigh LF, and leg θ. Our findings thus show concordant relations between the two different measures of SM quality, θ and LF.

Conclusions: Measurement of θ may be a simple, practical, and clinically-useful measure of age-related changes in SM quality that can be studied in the context of sarcopenia and related metabolic disorders.

Objectives

Sarcopenic obesity, a pathological state with excess fat and depleted skeletal muscle mass (SM), is increasingly being recognized as a phenotype associated with adverse clinical outcomes.

STUDY AIMS

To answer the question: how does 8-electrode multi-segment BIA (BIA; MC780 and MC980) compare to dual-energy x-ray absorptiometry (DXA) as the reference for estimating SM? Similarly, how well do the BIA systems associate with %fat measured using 4-component reference methods?

Methods

Appendicular lean soft tissue (LST, a measure of SM; arm, leg, and total) was measured by DXA (GE, iDXA) and compared to predicted SM by the two BIA systems, MC-780 and MC-980 (Tanita Corp, Tokyo, Japan) in 130 healthy men and women age ≥18 yrs varying in BMI.

%body fat measured with multicomponent models (Wang [W] and Lohman [L]) as the reference were compared to BIA results. 4-component models: body volume by Bod Pod; total body water by deuterium dilution; and bone mineral mass by DXA.

Both BIA systems are based on an 8-electrode configuration that separately captures each arm and leg along with trunk and right and left-body electrical properties.

Results

Subject Characteristics. 68 F, 62 M; 4 Asian, 27 African American, 97 Caucasians, 2 Other. Age (X±SD), 34±18.6 yrs; 22 <age 18 yrs. Height 167.6±13.6 cm; Weight 78.9±22.8 kg

The MC-780 and 980 results were similar for all measures. Leg, arm, and total limb fat mass and LST for DXA and limb fat and SM mass by BIA (MC980; kg, X± SD) are shown in the table. There were no significant differences between the appendicular DXA and BIA measures; the Tanita MC980 and DXA results were highly correlated as shown the example presented in Figure 1.

<table>
<thead>
<tr>
<th>Fat</th>
<th>DXA</th>
<th>Tanita</th>
<th>LST</th>
<th>DXA</th>
<th>Tanita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg</td>
<td>9.0</td>
<td>8.7</td>
<td>16.8</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>Arm</td>
<td>4.7</td>
<td>4.8</td>
<td>4.8</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14.1</td>
<td>16.6</td>
<td>22.4</td>
<td>22.2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5.9</td>
<td>6.1</td>
<td>7.1</td>
<td>7.3</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Tanita MC980 appendicular SM vs. DXA LST. The line of identity is shown in the figure.

Correlations (r-values) between %fat measured by BIA, 4-component models, Bod Pod, DXA, and total body water are shown in the table; all methods were highly inter-correlated. A BIA example is shown in Figure 2.

<table>
<thead>
<tr>
<th>4C-W</th>
<th>4C-L</th>
<th>MC780</th>
<th>MC980</th>
<th>BodPod</th>
<th>DXA</th>
<th>TBW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>1.00</td>
<td>0.94</td>
<td>0.94</td>
<td>1.00</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>%FM-4C-L</td>
<td>1.00</td>
<td>1.00</td>
<td>0.94</td>
<td>0.94</td>
<td>1.00</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Figure 2. Tanita MC980 %fat vs. 4C %fat. The line of identity is shown in the figure.

Conclusion

• 8-electrode multi-segment BIA has the potential for diagnosing sarcopenic obesity in the clinical setting