ABSTRACT

Introduction: The Basal Energy Expenditure (BEE) is the amount of energy necessary to the human body to keep the normal physiological processes and homeostasis. Currently, BEE is calculated from equations based on the North American and/or European population. Objective: To compare the Harris-Benedict, Food and Agriculture Organization and Institute of Medicine equations with indirect calorimetry in men living in Goiânia. Methods: Forty-four male volunteers with average age of 29.80, standard deviation – SD = 6.21 years; stature 1.79, SD = 0.06m; weight 77.79, SD = 8.49 kg; BMI 24.30, SD = 1.96 kg/m²; body fat 15.84, SD = 4.49% and waist circumference 80.48, SD = 5.89 cm were evaluated. BEE was determined by direct gas analyses; therefore, the VO2000 gas analyzer was used. Results: There was significant difference (p < 0.05) for the BEE estimated by the Harris-Benedict (1824.66 ± 138.25 kcal/day) and Food and Agriculture Organization (1821.77, SD = 115.39 kcal/day) equations when compared to the BEE acquired by the indirect calorimetry (1709.81, SD = 329.75 kcal/day). BEE estimated by the IOM/2005 equation (1791.81, SD = 329.74) did not present significant difference when compared to the measured BEE. Conclusion: The Food and Agriculture Organization and Harris-Benedict equations can overvalue the BEE of healthy young men with characteristics similar to those recorded on this work.

Keywords: BEE, indirect calorimetry, equations.
by simple convenience method in a universe of 900 men, members of a club in the city of Goiânia were evaluated. Inclusion criteria were: absence of chronic diseases; absence of smoking habit; absence of loss or gain diet in the last six months and no use of pharmacological substances or ergogenic food supplements which are considered metabolism accelerators.

The work was performed after consent given by the individuals, who received information about all the procedures involved in the research. The evaluations were carried out in the Flex Center of Nutrition/ Qualitatis Vitae in Goiânia.

Body composition was evaluated through data of body density and body fat percentage. Body density was calculated using the protocol of seven skinfolds, as described by Pollock and Wilmore17. Body fat percentage was evaluated with application of reference values by Pollock and Wilmore17.

Basal Energy Expenditure (BEE) was obtained by indirect calorimetry and mathematical equations (FAO/85, Harris-Benedict and IOM/2005). The indirect calorimetry was measured with the VO2000 metabolic gas analyzer (MEDGRAPH, USA), which was calibrated with gas with known composition (16% O2 and 5% CO2) before each measurement. BEE was calculated based on the mean of the O2 consumption and CO2 release, applying the formula [(3.9 x O2) + (1.1 x VCO2)] x 1.44018.

BEE measured by indirect calorimetry required the individuals to refrain from practicing intense physical activity for 24 hours and drinking alcohol. Additionally, they should remain 12 hours at fasting. After eight hours of sleep, the individuals went to the evaluation premises being still at fasting from liquid or solid food, without having engaged in any kind of activity, including having a bath. The volunteers were placed at rest for 30 minutes before the collection. Subsequently, during further 30 minutes, they remained connected to the gas analyzer through a mouth piece, with a nasal clip on to avoid they breathe through their noses11,19.

The BEE values obtained by indirect calorimetry through the equations were expressed as mean and standard deviation (SD). Data normality was evaluated through application of the Kolmogorov-Smirnov test. The Boferrone treatment with repeated measures with correction was used to verify the possible differences between the BEE obtained by indirect calorimetry and by the studied estimation equations. Subsequently, analysis of the Bland and Altman residual correction was used to verify the possible differences between the BEE obtained by the IOM/2005, FAO/85 and Harris-Benedict equations for men residents of the city of Goiânia. These results are in agreement with the ones found by other authors10,11,12,20-22 who also observed statistically significant differences of BEE obtained by indirect calorimetry and the one estimated by the referred equations. An interesting piece of information which should be mentioned is that the individuals estimated by Cruz et al13 and Clark and Hoffer22, as well as the ones in the present study, lived in tropical regions. These sites present high temperatures, which can represent reduction of 2 to 5% in the total energy expenditure of sedentary individuals when compared with the ones who live in tropical climate (IOM, 2005)9.

Once the tendency to BEE overestimation was verified by the equations, the difference between the measured and estimated values was evaluated. It was observed that the difference between the measured and estimated BEE found in the present study was lower than the values obtained by Währlich and Anjos10 (Harris-Benedict: 17%; FAO/85: 13.5%) and by Cruz et al.13 (Harris-Benedict: 19%; FAO/85 12.5%), who researched the BEE in Brazilian women, indicating higher inadequation for the female population.

It was observed that the FAO/85 and Harris-Benedict equations presented the same behavior for the male group evaluated. However, Valencia et al.21 found lower values for the BEE in a study conducted with 32 Mexican men aged between 18 and 40 years, evidencing BEE overestimation of 8.2% by the FAO/85 equation6. Other studies

<table>
<thead>
<tr>
<th>Equation</th>
<th>Mean ± standard deviation (kcal)</th>
<th>Minimum (kcal)</th>
<th>Maximum (kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct calorimetry</td>
<td>1.710 ± 330</td>
<td>1.067</td>
<td>2.416</td>
</tr>
<tr>
<td>IOM, 2005</td>
<td>1.791 ± 111</td>
<td>1.583</td>
<td>2.039</td>
</tr>
<tr>
<td>FAO, 85</td>
<td>1.822 ± 115</td>
<td>1.631</td>
<td>2.083</td>
</tr>
<tr>
<td>Harris-Benedict</td>
<td>1.825 ± 138</td>
<td>1.557</td>
<td>2.168</td>
</tr>
</tbody>
</table>

DISCUSSION

It is possible to observe through the comparison of the anthropometric results of the present study and other studies that results similar to the ones reported by Piers et al.12 and Währlich et al.11 for Australian and Brazilian men, respectively were evidenced.

The values concerning the BEE measurement by indirect calorimetry indicate that the Harris-Benedict and FAO/85 equations overestimated the basal energy expenditure in men residents of the city of Goiânia. These results are in agreement with the ones found by other authors5,10,11,12,20-22. It is possible to establish a relationship between indirect calorimetry and the studied estimation equations. An interesting piece of information which should be mentioned is that the individuals evaluated by Cruz et al.13 and Clark and Hoffer22, as well as the ones in the present study, lived in tropical regions. These sites present high temperatures, which can represent reduction of 2 to 5% in the total energy expenditure of sedentary individuals when compared with the ones who live in tropical climate (IOM, 2005)9.

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reported similar results for healthy adult men (9%) and for men and women (11%) confirming the tendency of overestimation of the BEE values when using the available equations.

The IOM proposes two formula equations: one for healthy individuals and another for overweighted or obese individuals. Regarding the studied population, the IOM/2005 equation was adequate to the BEE estimation for being close to the values measured by indirect calorimetry. A different result was found by Wahrlich et al. who observed values estimated by the IOM equation, overestimating the BEE in 11.3% for Brazilian women and in 15.1% for Brazilian men who lived in the United States, when compared with the values obtained by indirect calorimetry.

**CONCLUSION**

Thus, it is concluded that the Harris-Benedict and FAO/85 equations tend to overestimate the BEE value for young and healthy men, similarly to the characteristics presented in the study here. The IOM/2005 equation on its turn, results in BEE values close to the measured ones, when considering the same public.

Further studies are suggested, especially having the Brazilian population as target.

All authors have declared there is not any potential conflict of interests concerning this article.

**REFERENCES**