ORIGINAL ARTICLE

Comparison of total energy expenditure assessed by two devices in controlled and free-living conditions

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Abstract

The objective of this study was to evaluate the validity of total energy expenditure (TEE) provided by Actiheart® and Armband®. Normal-weight adult volunteers wore both devices either for 17 hours in a calorimetric chamber (CC, $n = 49$) or for 10 days in free-living conditions (FLC) outside the laboratory ($n = 41$). The two devices and indirect calorimetry or doubly labelled water, respectively, were used to estimate TEE in the CC group and FLC group. In the CC, the relative value of TEE error was not significant ($p > 0.05$) for Actiheart® but significantly different from zero for Armband®, showing TEE underestimation (-4.9%, $p < 0.0001$). However, the mean absolute values of errors were significantly different between Actiheart® and Armband®: 8.6% and 6.7%, respectively ($p = 0.05$). Armband® was more accurate for estimating TEE during sleeping, rest, recovery periods and sitting–standing. Actiheart® provided better estimation during step and walking. In FLC, no significant error in relative value was detected. Nevertheless, Armband® produced smaller errors in absolute value than Actiheart® (8.6% vs. 12.8%). The distributions of differences were more scattered around the means, suggesting a higher inter-individual variability in TEE estimated by Actiheart® than by Armband®. Our results show that both monitors are appropriate for estimating TEE. Armband® is more effective than Actiheart® at the individual level for daily light-intensity activities.

Keywords: *Calorimetric chamber, doubly labelled water, total energy expenditure estimation, Actiheart®, Armband®, free-living*

Introduction

Today, epidemics of overweight and obesity are dramatically increasing worldwide. Such chronic diseases generally result from an energy imbalance, i.e., an excess of energy intake and physical inactivity. In preventive nutrition, the evaluation of energy expenditure and consumption is therefore of utmost importance, especially in epidemiological studies. Evaluating variations in free-living energy expenditure during the day and on a day-to-day basis is also of major interest in clinical trials as well as for individual use.

Total energy expenditure (TEE) may be calculated from physical activity questionnaires that generally lack precision because of misestimation by volunteers, or via specific monitors. Several devices are available today for research purposes. Their principle is based on either accelerometry (Actigraph®, RT3®, ActiReg®; Arvidsson, Slinde, & Hulthen, 2009; Lyden, Kozey, Staudenmeyer, & Freedson, 2011; Rothney, Brychta, Meade, Chen, & Buchowski, 2010), heart rate (HR) and accelerometry (Actiheart®; Brage et al., 2004), or accelerometry, temperature, heat flux and impedance (Armband®; St-Onge, Mignault, Allison, & Rabasa-Lhoret, 2007). It is important to validate existing devices against criterion methods and against each other so that researchers can make informed decisions about their choice of monitor.

The present study therefore aimed to investigate the validity of two portable monitoring devices – Actiheart® and Armband® – in normal-weight subjects and in both controlled (calorimetric chamber, CC) and free-living conditions (FLC). To the best of our knowledge, such a comparison between

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