Validation of Heart Rate Monitor-Based Predictions of Oxygen Uptake and Energy Expenditure

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Abstract

Montgomery, PG, Green, DJ, Etxebarria, N, Pyne, DB, Saunders, PU, and Minahan, CL. Validation of heart rate monitor-based predictions of oxygen uptake and energy expenditure. J Strength Cond Res 23(5): 1489-1495, 2009-To validate \( \dot{V}O_2 \) and energy expenditure predictions by the Suunto heart rate (HR) system against a first principle gas analysis system, well-trained male (\( n = 10, \) age 29.8 ± 4.3 years, \( \dot{V}O_2 = 65.9 \pm 9.7 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} \)) and female (\( n = 7, \) 25.6 ± 3.6 years, 57.0 ± 4.2 ml·kg\(^{-1}\)·min\(^{-1}\)) runners completed a 2-stage incremental running test to establish submaximal and maximal oxygen uptake values. Metabolic cart values were used as the criterion measure of \( \dot{V}O_2 \) and energy expenditure (kJ) and compared with the predicted values from the Suunto software. The 3 levels of software analysis for the Suunto system were basic personal information (BI), BI + measured maximal HR (BI\(_{hr}\)), and BI\(_{hr}\) + measured \( \dot{V}O_2 \) (BI\(_{hr} + v\)). Comparisons were analyzed using linear regression to determine the standard error of the estimate (SEE). Eight subjects repeated the trial within 7 days to determine reliability (typical error [TE]). The SEE for oxygen consumption via BI, BI\(_{hr}\), and BI\(_{hr} + v\) were 2.6, 2.8, and 2.6 ml·kg\(^{-1}\)·min\(^{-1}\), respectively, with corresponding percent coefficient of variation (%CV) of 6.0, 6.5, and 6.0. The bias compared with the criterion \( \dot{V}O_2 \) decreased from -6.3 for BI, -2.5 for BI\(_{hr}\), to -0.9% for BI\(_{hr} + v\). The SEE of energy expenditure improved from BI (6.74 kJ) to BI\(_{hr}\) (6.56) and BI\(_{hr} + v\) (6.14) with corresponding %CV of 13.6, 12.2, and 12.7. The TE values for \( \dot{V}O_2 \) were ~0.60 ml·kg\(^{-1}\)·min\(^{-1}\) and ~2 kJ for energy expenditure. The %CV for \( \dot{V}O_2 \) and energy expenditure was ~1 to 4%. Although reliable, basic HR-based estimations of \( \dot{V}O_2 \) and energy expenditure from the Suunto system underestimated \( \dot{V}O_2 \) and energy expenditure by ~6 and 13%, respectively. However, estimation can be improved when maximal HR and \( \dot{V}O_2 \) values are added to the software analysis.

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