

## Journal of Strength and Conditioning Research:

August 2009 - Volume 23 - Issue 5 - pp 1489-1495

doi: 10.1519/JSC.obo13e3181a39277

Original Research

# 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  $\text{Vo}_2$  and energy expenditure predictions by the Suunto heart rate (HR) system against a first principle gas analysis system, well-trained male ( $n = 10$ , age  $29.8 \pm 4.3$  years,  $\text{Vo}_2$   $65.9 \pm 9.7$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) and female ( $n = 7$ ,  $25.6 \pm 3.6$  years,  $57.0 \pm 4.2$  ml·kg<sup>-1</sup>·min<sup>-1</sup>) 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  $\text{Vo}_2$  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 ( $\text{BI}_{\text{hr}}$ ), and  $\text{BI}_{\text{hr}}$  + measured  $\text{Vo}_2$  ( $\text{BI}_{\text{hr} + \text{v}}$ ). 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 SEEs for oxygen consumption via BI,  $\text{BI}_{\text{hr}}$ , and  $\text{BI}_{\text{hr} + \text{v}}$  were 2.6, 2.8, and 2.6 ml·kg<sup>-1</sup>·min<sup>-1</sup>, respectively, with corresponding percent coefficient of variation (%CV) of 6.0, 6.5, and 6.0. The bias compared with the criterion  $\text{Vo}_2$  decreased from -6.3 for BI, -2.5 for  $\text{BI}_{\text{hr}}$ , to -0.9% for  $\text{BI}_{\text{hr} + \text{v}}$ . The SEE of energy expenditure improved from BI (6.74 kJ) to  $\text{BI}_{\text{hr}}$  (6.56) and  $\text{BI}_{\text{hr} + \text{v}}$  (6.14) with corresponding %CV of 13.6, 12.2, and 12.7. The TE values for  $\text{Vo}_2$  were  $\sim 0.60$  ml·kg<sup>-1</sup>·min<sup>-1</sup> and  $\sim 2$  kJ for energy expenditure. The %CV for  $\text{Vo}_2$  and energy expenditure was  $\sim 1$  to 4%. Although reliable, basic HR-based estimations of  $\text{Vo}_2$  and energy expenditure from the Suunto system underestimated  $\text{Vo}_2$  and energy expenditure by  $\sim 6$  and 13%, respectively. However, estimation can be improved when maximal HR and  $\text{Vo}_2$  values are added to the software analysis.

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