Estimating oxygen consumption from heart rate and heart rate variability without individual calibration

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Summary

Heart rate (HR) as an estimator of oxygen consumption (VO_2) usually requires HR to be individually calibrated in a separate test. This study examined the validity of a new HR – and HR variability-based method (Firstbeat PRO heartbeat analysis software) in the estimation of VO_2 in real-life tasks. The method takes into account the respiration rate determined from HR variability and the differences in the on/off dynamics of HR and VO_2, and no calibration tests are needed. Ten men and nine women performed 25 tasks representing different types of daily activities. Portable devices were used to measure R-to-R intervals (ECG), VO_2 and respiration rate. In pooled regression analysis, the estimated VO_2 accounted for 87% of the variability in the actual VO_2, SEE 3·5 ml min^{-1} kg^{-1} (1 MET). At group level, the method underestimated slightly the measured VO_2 (mean difference – 1·5 ml min^{-1} kg^{-1} or – 0·4 METs). Some of the values at low exercise intensities were markedly underestimated, but the agreement was better during light and heavy activities. The limits of agreement for the data were from −8·4 to 5·4 ml min^{-1} kg^{-1} or from −2·4 to 1·5 METs. At individual level, the average deviations of the predicted VO_2 ranged from −1·0 to 0·6 METs and R^2 from 0·77 to 0·94, respectively. The present data indicate that the prediction method may be considered sufficiently accurate to determine the average VO_2 in field use, but it does not allow precise estimation of VO_2.