On- and Off Dynamics and Respiration Rate Enhance the Accuracy of Heart Rate Based VO2 Estimation

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HR data was collected with rr-recorder (Polar Electro Oy, Kempele, Finland). During bicycle ergometer exercises VO2 data was collected breath-by-breath using Vmax (Sensor Medics, California, Palo Alto, USA) and during RLT’s using portable Cosmed K4 analyser (S.R.I., Italy). Specialized heart rate analysis software (Firstbeat Technologies Oy., Jyväskylä, Finland) was used to perform heart rate analysis.

### RESULTS

#### VO2 & HR kinetics

HR to VO2 relationship had different patterns during On- and Off-responses in 40%, 70% and VO2max test conditions (Figure 2). HR and VO2 drifted to higher level during 70% bicycle exercise (Table 1).

### CONCLUSIONS

1. On- and Off-dynamics of HR and VO2 are different during changes in exercise intensity and should be taken into account when estimating VO2 in field.

2. HR based VO2 estimation can be enhanced using information on On- and Off-dynamics and respiration rate during: a) dynamically changing exercise intensity, b) steady-state exercise and c) low intensity exercise simulating daily activities (RLT).

Methods presented reduce very significantly the error in VO2 estimation, and can provide a new level of accuracy for field applications, since On- and Off-dynamics and respiration rate can be estimated reliably from RR-interval data only (e.g. Saalasti, S, 2003, Neural Networks for Heart Rate Time Series Analysis. Academic Dissertation, University of Jyväskylä, Jyväskylä, Finland).

The results indicate that VO2HR+ON/OFF and VO2HR+Resp+ON/OFF were able to correct the error in VO2HR estimate due to different VO2 to HR patterns during On- and Off-responses in bicycle exercise conditions (Figure 2). Accuracy was also significantly enhanced during steady-state bicycle exercise, possibly due to the ability of On- and Off- information to correct different proportions of VO2 and HR drift (Table 1) and natural changes in power, HR and VO2 during steady state.

Information on On- and Off-dynamics and respiration rate also differentiated between dynamically changing low-intensity exercise and psycho-physiologically related HR responses, since VO2 estimation was enhanced during low intensity exercise simulating daily activities (RLT).