Are RCP and Critical Power Equivalent? The Issue of Mean Response Time

Dear Editor-in-Chief,

In the past years, several research groups have tried to identify whether there exists a single "critical intensity" that is equivalently demarcated by the commonly determined thresholds from several whole-body (maximal lactate steady state, critical power, respiratory compensation point) and peripheral responses (muscle and cerebral oxygenation), which could therefore be used interchangeably (e.g., Refs. [3,4,6,7]). One important problem is that these thresholds are determined from different exercise protocols, not all of which induce a steady-state physiological response at a given work load. Therefore, if those thresholds are determined from incremental ramp exercise, an adjustment (i.e., leftward shift) has to be made in the oxygen uptake ($\dot{V}O_2$)/work rate (W) relationship to allow for comparison of the metabolic rate and/or work rate at the respective thresholds. This adjustment should account for the time constant and time delay characterizing the pulmonary $\dot{V}O_2$ response. During ramp exercise, these two temporal delays in the pulmonary $\dot{V}O_2$ response are represented in the mean response time (MRT). The MRT has been used in the past to quantify the $\dot{V}O_2$ kinetics during incremental ramp exercise, although it has been shown to have a high level of variability with intrasubject coefficients of variation up to 20% (5). To account for rather low reproducibility, Leo et al. (7) average the MRT (~40–50 s) obtained from three ramp exercises with different ramp slopes (15, 30, 45 W·min^{-1}), starting from a baseline of unloaded cycling. However, it has been shown (1,8) that the MRT is longer in exercises with a slower ramp compared with a faster ramp, especially when the ramp exercise is initiated from a very low work rate (unloaded cycling or 10 W) (1). If the MRT values from the study of Boone et al. (1) (10 W·min^{-1}, 126 s; 25 W·min^{-1}, 76 s; 40 W·min^{-1}, 50 s) are applied to the study of Leo et al. (7), the adjusted RCP would be 212, 231, and 254 W for the 15, 30, and 45 W·min^{-1}, respectively. This MRT adjustment would be more appropriate and would even strengthen the results of Leo et al. (7). However, using the MRT to left-shift the $\dot{V}O_2$ is still quite problematic, given its low reproducibility and other interfering factors (i.e., baseline work rate, training status, pedal rate). In addition, given that the linear first-order dynamics of the $\dot{V}O_2$ response have been questioned, it is uncertain whether the temporal delay in $\dot{V}O_2$ steady state is similar at high compared with low work rates. In general, this MRT adjustment might be at the origin of the high level of intraindividual variability between the thresholds (e.g., RCP and CP in the study of Leo et al. [7]). This latter argument is often used by researchers to question the interchangeability of the thresholds (2,3). In our opinion, the issue of equivalence between the thresholds can only be resolved by means of a longitudinal training study in which the adaptations in the different thresholds to a training intervention are studied.

Jan Boone
Jan G. Bourgois
Department of Movement and Sports Sciences
Ghent University
Ghent, BELGIUM

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