Relationship between %HRmax, %HRR, %VO2max and %VO2R in elite cyclists

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Introduction
During exercise Heart Rate (HR) is often used as a surrogate to VO2 in order to estimate exercise intensity. However, the equivalence between HR and VO2 intensity levels remains to be established for various populations. Therefore, we studied the HR-VO2 relationship in elite road cyclists while testing the ACSM guidelines (1990, 1998) and evaluating the relation between %HRR (HRR = HRmax - HRrest), %VO2max and %VO2R (VO2R = VO2max - VO2rest) throughout the range of exercise intensities.

Methods
26 male cyclists (25.1±0.7 yr, 70.9±1.2 mL.kg⁻¹.min⁻¹): 11 amateurs (AMAT) and 15 professionals (PRO) performed an incremental test (50w / 3 min) until exhaustion on a bike ergometer. Physiological parameters were measured continuously and recorded every 30s until test termination. For each subject, linear regressions of %HRmax vs %VO2max, %HRmax vs %VO2R, %HRR vs %VO2max and %HRR vs %VO2R were performed and used to calculate the respective slopes and intercepts, and to predict %HRmax, %VO2max and %VO2R values for a given exercise intensity. Slopes and intercepts were then averaged to calculate the representative baseline equations.

Results
Below the intensity of 85% VO2max or VO2R, values of %HRmax were significantly higher (p < 0.0001) than those suggested by ACSM (58, 65, 73, 87% vs 55, 62, 70, 85% of HRmax at 40, 50, 60, 80% of VO2max, and 48, 61, 74% vs 35, 55, 70% of HRmax at 20, 40, 60% of VO2R). Therefore we propose two specific regression equations (means ± SEM): %HRmax = 0.706 (± 0.008) * %VO2max + 30.14 (± 0.88) with R² = 0.993 (± 0.001) and %HRmax = 0.663 (± 0.007) * %VO2R + 34.43 (± 0.84) with R² = 0.993 (± 0.001).

Discussion/Conclusion
According to the current controversy surrounding the HR-VO2 relationship, our results confirm that HR-VO2 should be determined specifically for a given population. It appears that the ACSM guidelines concerning the relationship between %HRmax and %VO2max or %VO2R are unsuited for elite cyclists. Compared to %VO2max, %VO2R is a better predictor of %HRR and this is in agreement with Swain et al. (1997). Therefore, for training guidance, elite cyclists should use %HRR in relation to %VO2R.

References