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# Laboratory predictors of uphill cycling time trial performance

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## Abstract

Background: A field test which can be easily integrated into the training routine of cyclists to monitor performance changes is valuable. It has been demonstrated that when performing a 20-min outdoor time trial (TT), cyclists produce approximately 5.4% higher mean power output during uphill than flat routes (Nimmerichter et al., 2012: European Journal of Applied Physiology, 112(1), 69-78). Therefore, this discrepancy raises questions the relationship between uphill TT performance and physiological parameters obtained during laboratory graded exercise tests (GXT), as previously demonstrated on flat courses.

Methods: Separated by at least 48 hours, eleven male and one female moderately trained cyclists (30±5 years; 78.7±16.2 kg; 175±8 cm; mean±s) undertook a 30-s Wingate test on a mechanically braked cycle ergometer (Biotec2100, Cefise, Nova Odessa, Brazil) fitted with a power-measuring crank (SRM, Jülich, Germany), a GXT to exhaustion (Computrainer ProLab, RacerMate, Seattle, USA) and a 20-min outdoor uphill TT (2.8% mean gradient). GXT pulmonary gas exchanges were measured using breath-by-breath analyses (K4b$^2$, Cosmed, Rome, Italy). During the TT, power output was measured using a mobile power-meter (PowerTap, Saris, Madison, USA).

Results: Multiple linear regressions demonstrated that 95% of the variation in TT mean power output ($P_{TT}$) was predicted by GXT $VO_{2max}$ and the respiratory compensation point (RCP), with standardized beta coefficients of 0.68 and 0.37 respectively. Moderate intraclass correlation coefficients were demonstrated for 94.6% $P_{TT}$ and RCP power (r = 0.87; 95%CI: 0.47-0.96). Bland Altman plot showed a bias ± random error of 4.4±51.6 W or 1.2±21.1 %. Mean values for Wingate 5-s peak power, Wingate 30-s mean power, $P_{TT}$ and 94.6% $P_{TT}$ were 899±163 W; 668±108 W; 295±53 W and 279±50 W, respectively. Mean values for GXT peak power output ($P_{max}$), $VO_{2max}$, RCP power and VT power were 341±46 W; 4.44±0.73 L.min$^{-1}$; 274±45 W and 173±31 W, respectively.

Discussion: The results of this study demonstrate that 95% uphill $P_{TT}$ can be explained by physiological laboratory parameters of $VO_{2max}$ and RCP. Moreover, when $P_{TT}$ is adjusted according to the findings of Nimmerichter et al. (2012), RCP power output agrees better with it. Consequently, this finding adds more experimental evidence for the predictive validity of the 20-min outdoor TT to estimate power output at RCP during GXT, provided that the uphill course is taken to account and a 5.4% subtraction is made to $P_{TT}$.

Conclusion: A 20-min outdoor TT performed on an uphill course can be utilized to predict with reasonable accuracy, power output at the respiratory compensation point and to monitor performance changes on moderately trained cyclists.

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