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Effects of flat and uphill cycling on the power duration relationship

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Background: The power duration relationship is a powerful tool for performance diagnosis in endurance sports. It is currently unknown whether the slope of the terrain effects the estimation of critical power (CP) and the work available above CP (W´). If so, the information obtained (e.g. intensity domains) cannot be generalized for different conditions. Therefore, the aim of the current study was to investigate the effects of flat and uphill cycling on the power duration relationship. **Methods**: Thirteen endurance trained subjects participated in this study (mean ± SD age: 32.2 ± 7.1 years; stature: 181.8 ± 4.7 cm; body mass: 74.6 ± 7.4 kg; maximum oxygen uptake: 67.9 ± 3.0 mL/kg/min; maximum power output: 406 ± 39 W). The participants performed three time-trials (TT) of 10, 4 and 1 minutes in that order, interspersed by 30 minutes of rest in both, flat (1.0 %) and uphill (10.0 %) conditions. TTs were conducted within 10 days with a rest period of at least one day between the tests. Participants were encouraged to produce the highest possible power output (PO) and maintain a cadence between 80 and 100 revs/min during the TT. PO and cadence during each trial were recorded with a mobile power crank (SRM), which was mounted on a 26-inch mountain bike. Mean PO from the TTs were modelled using the linear 1/time model (P = W´(1/t) + CP) for each condition. With standard errors of 1.4 ± 1.0 % and 3.9 ± 2.8 % for CP and W´, respectively, and nearly perfect coefficients of determination (R2 = 0.987 – 1.000) the 1/time model showed the best fit. Paired t-tests were applied to compare the estimates of CP and W´ from flat and uphill cycling. **Results**: PO during the TT was significantly affected by test conditions during the 1-minute trial (526 ± 74 vs. 559 ± 70 W during flat and uphill cycling, respectively; P = 0.001). No significant differences were observed during the 10 and 4-minute trials (353 ± 45 vs. 361 ± 36 W; P = 0.071 and 386 ± 49 vs. 393 ± 42 W; P = 0.289 during flat and uphill cycling, respectively). CP was not significantly different between flat (336 ± 43 W) and uphill (338 ± 35 W) cycling (T12 = -0.677; P = 0.489), whereas W´ shows a significant difference between flat (11.4 ± 2.7 kJ) and uphill (13.2 ± 3.1 kJ) cycling (T12 = -3.626; P = 0.003). **Discussion**: The results of the present study suggests that the estimated CP is not sensitive to changes in gradient. However, W´ was affected by the gradient, which might be related to the significantly higher PO in uphill conditions during the 1-minute TT. Therefore, the results of the present investigation indicate that information obtained from the estimated CP (e.g. intensity domains, race targets) is unaffected by the slope of the terrain and can be generalized for different conditions. Nevertheless, individual differences for the estimates of CP and W´ between test conditions should be considered as well.