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Real-world Cycling Cadences: Effect on Energy Cost, Joint Mechanics, and Fatigue

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INTRODUCTION:

Within an individual pursuit event (IP; 3- to 4-km time trial) in track cycling, bicycles operate with a single, fixed gear, and riders are required to sustain high power outputs resulting in significant fatigue. Gearing selection will influence the muscles' shortening speeds, activation rates, and force production, impacting the energy cost and thus performance fatigue. Gear selection is therefore critical for IP performance and may be adjusted by a rider to achieve a small, 2-4 rpm (cadence) manipulation for a given power output. Over a large range (40-180 rpm), higher cadences are associated with a higher energy cost and fatigue, yet the effect of small changes in cadence in experienced cyclists during an IP is unknown. Our purpose was to test whether small changes in cadence (as a proxy for gearing) meaningfully impact a cyclist's oxygen uptake kinetics, joint-specific torque- and- power distributions, and performance fatigability.

METHODS:

Thirteen highly trained male (10) and female (3) cyclists performed three 2-min cycling trials at their best IP power output on a stationary ergometer. Cadence was manipulated between the cycling trials, from the average cadence of their best IP (termed "preferred") to cadences 5 rpm above and below their preferred (PREF+5rpm and PREF-5rpm). Physiological stress (VO2 kinetics and blood lactate concentration) was monitored; joint-specific angular velocity, torque, and power were calculated through inverse dynamics; and performance fatigability was estimated as the mean power loss in a maximal 10-s sprint performed without pause after the 2-min cycling trials.

RESULTS:

Greater performance fatigue was evoked by PREF+5rpm than both PREF and PREF-5rpm (8.8 vs 8.8 and 8.4 W·kg-1, respectively, p=0.01), and a trend towards an increase in peak VO2 and rate of VO2 rise were observed. PREF+5rpm was associated with an increase (p<0.01) in peak knee and hip angular velocities (extension and flexion). Changes in the average joint-specific torques and powers occurred mainly during the pedal upstroke where ankle dorsiflexion torque (p=0.01), hip flexion torque (p=0.003) and knee flexion power (p=0.01) increased in PREF+5rpm, possibly suggesting a concerted effort by the cyclists to increase leg flexion during the pedal upstroke phase. No significant relationship was found between level of performance fatigue and joint-specific mechanics.

CONCLUSION:

This study demonstrated that a small increase in cadence (i.e., gear) may induce small but significant increases in performance fatigue and alter joint-specific mechanics in highly trained cyclists during the first 2 min of a simulated IP. Importantly, high inter-individual variations were observed, as particularly torque- and- power distributions varied across the joints for different individuals in response to cadence changes. This emphasises that practitioners should take an individualised approach to understand the effects of small (but practically relevant) changes in cadence on IP performance.

Topic:	**Biomechanics**
Presentation	**Oral**