Effect of environmental temperature on pacing during a simulated 16 km cycling time trial

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Abstract

Background: In cycling time trials (TT) the aim is to produce greatest average power possible for the duration of the effort; to do this an athlete must distribute their effort efficiently to ensure that they do not fatigue early but finish the event having exhausted their energy stores (Atkinson et al, 2007: Sports Medicine, 37, 647-667). This distribution of effort is initially determined by conscious control (selection of a pacing strategy), but is influenced by afferent feedback from both internal sensations and environmental factors (St. Clair Gibson & Noakes, 2004: British Journal of Sports Medicine, 38, 797-806). Performance in prolonged endurance exercise is inversely related to environmental temperature; this is thought to be due to central nervous system regulation of effort in response to increased core temperature. While this negative effect of hot conditions on TT performance is well established, less is known about the effect of environmental temperature on pacing during TT efforts, in particular in short time trials which are common in amateur cycling as well as in professional stage races such as the Grand Tours.

Purpose: The aim of this study was to examine the effect of environmental temperature on performance and pacing during a simulated 16 km cycling time trial.

Methods: After familiarisation, six moderately trained male cyclists (age (mean ± s) 20 ± 1 year; VO2max 45.3 ± 7.3 ml.kg-1.min-1, power at VO2max 312 ± 28 W) completed self-paced 22-minute trials on an electromagnetically-braked cycle ergometer in hot (30ºC, HOT) and temperate (15ºC, COOL) conditions. Participants were instructed to complete as much work as possible during the trial and the only feedback provided was cadence and time with 5 and 1 minute remaining. Heart rate, core temperature and rate of perceived exertion were recorded at two minute intervals.

Results: Mean power was slightly lower in HOT than COOL (201 ± 38 W vs. 209 ± 43 W); the difference was not significant. Core temperature and heart rate were both significantly higher in HOT than COOL (temperature: 37.3 ± 0.5 ºC vs. 36.4 ± 0.9 ºC; heart rate: 173 ± 7 bpm vs. 166 ± 11 bpm); rating of perceived exertion did not differ between the two conditions. Pacing appeared to differ slightly: when power output was compared across four quarters of the time trial the athletes adopted a positive split with end-spurt in HOT (Q1: 103% overall mean power, Q2: 100%, Q3: 97%, Q4: 100%) and a negative split with end-spurt in COOL (Q1: 97% overall mean power, Q2: 98%, Q3: 99%, Q4: 107%); the difference was significant in the last quarter.

Discussion: The main outcome of this study was that pacing strategy differed slightly with environmental conditions, despite relatively similar overall performances in both trials. The effect of environmental conditions on pacing and the mechanisms involved warrant further investigation, given the important of pacing in successful time trial performance for athletes who train and compete under a range of environmental conditions.

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