

Effect of Carbohydrate Ingestion on the Power-Duration Relationship Following Prolonged Endurance Exercise in the Moderate Exercise Intensity Domain

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1 Introduction

Physiological assessments of endurance athletes have typically occurred in a well-rested state, which albeit important do not account for the magnitude of deterioration in physiological profiling variables (e.g., lactate threshold, VO₂max, critical power, functional threshold power) over time during prolonged endurance exercise (also known as ‘durability’). We tested the hypotheses that the parameters of the power-duration relationship, estimated as the end-test power (EP) and work done above EP (WEP) during the 3-min all-out critical power test (3MT),

would be reduced following prolonged exercise in the moderate exercise intensity domain and that carbohydrate (CHO) ingestion would (at least) attenuate the reduction in power output at the heavy-to-severe intensity transition in direct proportion to the rate of CHO supplementation during exercise.

2 Material and Methods

In a repeated measure, randomised study design, eight endurance-trained cyclists and triathletes (one female) performed two characterisation trials to establish baseline physiological parameters (VO₂max: 55.41 ±



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7.21 mL·kg⁻¹·min⁻¹; gas exchange threshold, GET: 164 ± 29 W), including a 3MT performed in a well-rested state to determine EP ('Fresh'-EP) and WEP ('Fresh'-WEP). Subsequently, on three separate occasions, participants completed a fatigued-3MT (Fatigued-EP and Fatigued-WEP) immediately following 180-min of moderate intensity exercise at 95% of GET while consuming a CHO supplement containing either 0 g·h⁻¹, 60 g·h⁻¹ or 120 g·h⁻¹ of CHO at a glucose-to-fructose ratio of 1:0.8. Each trial was commenced following the provision of a standardised high CHO diet in the 24 h prior to each lab visit (8 g·kg⁻¹ CHO) and 2 h after a high CHO breakfast (2 g·kg⁻¹) on the morning of the trial. Venous blood, gas exchange, whole-body CHO and lipid oxidation, exercise energy expenditure, subjective gastrointestinal symptoms, capillary blood lactate and rating of perceived exertion were measured throughout exercise.

3 Results

Power output at the heavy-to-severe transition was significantly lower in Fatigued-EPWater (251 ± 30 W, $P = 0.016$) and Fatigued-EPCHO60 (269 ± 27 W, $P = 0.022$) than 'Fresh'-EP (285 ± 31 W). There were no differences between 'Fresh'-EP and Fatigued-EPCHO120 (276 ± 33 W, $P = 0.220$), nor between Fatigued-EPCHO60 and Fatigued-EPCHO120 ($P = 0.587$). There was no difference between 'Fresh'-WEP (14.67 ± 4.02 kJ) and Fatigued-WEP for all three conditions. Mean whole-body CHO utilisation rates were significantly higher in CHO120 (2.12 ± 0.21 g·min⁻¹, $P = 0.010$) compared to Water only trial (1.49 ± 0.49 g·min⁻¹), with no differences between CHO120 and CHO60 trials (1.86 ± 0.37 g·min⁻¹, $P = 0.119$). Total exercise energy expenditure did not differ between conditions ($P = 0.731$).

4 Conclusions

These data suggest that CHO ingestion during prolonged exercise in the moderate exercise intensity domain at a rate of 120 g·h⁻¹, but not 60 g·h⁻¹, negates the reduction in power output at the heavy-to-severe boundary measured in a well-rested versus semi-fatigued state.

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