

The physical, mental and hormonal responses to short-term intensified training in well-trained cyclists with a high carbohydrate nutritional intervention

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Abstract

Background: Short periods of intensified training (IT) are a regular feature in a cyclist's training programme. The aim of this study was to monitor changes in performance, mood state and plasma hormones during short term IT in well-trained cyclists and the effects of a carbohydrate nutritional intervention.

Methods: Thirteen highly trained male cyclists (age: 25±6 y, V̇O₂max: 72±5 ml/kg/min) participated in two 9-day periods of intensified training while ingesting either high (HCHO) or low (LCHO) carbohydrate (CHO) beverages before (24 g vs 2 g CHO), during (60 g/h vs 20 g/h CHO) and after (44 g vs 10 g CHO) every training session. All training sessions were monitored with SRM power meters and heart rate (HR) monitors. Performance was assessed throughout IT with maximal oxygen uptake (V̇O₂max) and 1 h time trial (TT). Mood state questionnaires (POMS and DALDA) were completed daily to monitor total mood disturbance (TMD). Venous blood samples were collected before and immediately after each TT and analysed for brain-derived neurotrophic factor (BDNF), cortisol (CORT), testosterone (TEST), CORT/TEST ratio, adrenocorticotrophic hormone (ACTH) and prolactin (PRL).

Results: Weekly training volume and intensity (time spent in the three highest HR zones) increased significantly during IT (9.3±2.4 h to 23.5±3.4 h/week for volume and 2.6±2.5 to 6.5±4.0 h/week for intensity). Total energy intake and dietary CHO were significantly higher in HCHO than LCHO (4148±766 vs 3501±616 kcal/d and 679±105 vs 505±107 g/d CHO). TMD was elevated during IT (p<0.05). Overall, POMS TMD was significantly higher in LCHO than HCHO (p=0.04). Performance in the V̇O₂max exercise protocol fell significantly with IT in both conditions (p<0.05): peak power (391±37 to 375±38 W), maximum HR (190±10 to 179±8 bpm) and completion time (31:15±03:12 to 30:00±03:30 min:s). No significant changes in TT performance were observed over IT, or between conditions. However, absolute mean power during TT decreased non-significantly in both conditions (-1.2 W (-1%) and -7.2 W (-3%) for HCHO and LCHO, respectively). Mean HR tended to decrease from TT1-TT3 in LCHO (p=0.06). Pre-exercise CORT and BDNF tended to be lower after IT in both conditions (p=0.07) and pre-exercise ACTH tended to be lower in LCHO than HCHO (p=0.06). Post-exercise CORT, ACTH, BDNF, CORT/TEST ratio and PRL concentrations decreased with IT (p<0.05), with no difference between conditions. The post-exercise increase in PRL seen at TT1 did not occur at TT3; instead PRL concentrations fell from 373 to 348 mIU/L. Post-exercise TEST was lower in LCHO than HCHO (13.2±3.6 vs 14.6±3.8 nmol/L; p=0.03).

Discussion: A relatively short period of IT resulted in significant disturbances in mood state and minor performance decrements. LCHO resulted in significantly greater TMD than HCHO. Previous studies have reported significant declines in performance with similar exercise protocols; yet this group of well-trained athletes showed a level of resistance to the substantial increase in training load. However, hormonal changes present signs of chronic stress, including decreased post-exercise PRO, BDNF, CORT, ACTH and CORT/TEST suggesting these cyclists may have exhibited early signs of overreaching.

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