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Effects of different training protocols on the heart rate variability of trained cyclists

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Abstract

Background: Studies have shown that measures of HRV can be useful for monitoring the training load in cycling. However, most of these studies are observational and have not assessed the impact of cumulative days of training on the autonomic system.

Purpose: To evaluate the impact of three training protocols (one continuous and two interval training) performed on three consecutive days on HRV measures of trained cyclists.

Methods: 12 trained cyclists participated in this experimental study with a cross over design. Initially an incremental test was performed on a cycle ergometer. The test began with an intensity of ~50w and increased 25w/minute until exhaustion. During the test and subsequent training sessions, heart rate was measured with a Polar RS800CX. The anaerobic threshold (equivalent to the respiration compensation point) was identified from the HRV following a procedure described elsewhere (Cottin et al., 2006: International Journal of Sports Medicine, 27(12), 959-967). Three days after the incremental test, cyclists returned to the laboratory to perform – in random order - one of the three protocols: P1 - 30min at 70% of power at anaerobic threshold; P2 – six sets of 4min at 90-95% of power at anaerobic threshold separated by 1min at 50w and P3 – eight sets of 1min at 120% of power at anaerobic threshold with 3min of recovery at 50w. All protocols were performed consecutively on three days and there was a four-day washout period between protocols. During 30minutes after the training sessions, participants remained seated for measuring HRV. The averages of minute 10 to 20 (post 15) and 20 to 30 (post 25) were analyzed. The parameters of HRV studied were mean of RR intervals (Mean RR), standard deviation of Mean RR (SDNN), square root of SDNN2 (RMSSD), low frequency (LF; 0 – 0.15 Hz) and high frequency (HF; >0.15 – 0.40 Hz) and its ratio (LF/HF) and the total power (TP). Rating of perceived effort (RPE) was obtained 30minutes after each training session. The training impulse (TRIMP) for each training session was also calculated following the Bannister approach.

Results: Cyclists had a mean age of 28±7 years and 72.6±9.1kg of body weight. The mean peak power output and power at anaerobic threshold were 333.2±37.7 and 267.4±37.0 watts, respectively. In general, there were no differences across the days regardless the HRV indices evaluated. However, Mean RR, RMSSD and LF/HF were lower for P2 compared to the other two protocols at post 15 and post 25. Accordingly, RPE was higher for P2 compared to the other protocols. The TRIMP was similar between P1 and P2 and both were higher than P3 ($p<0.001$). None of the HRV parameters showed differences at the moment prior the training sessions.

Discussion: The main findings of the present study are that: a) the training sessions proposed did not show any cumulative effect over the days on the HRV parameters of trained cyclists and b) P2 had a higher impact on HRV indices than the other protocols. The later finding is in accordance with a higher RPE for P2.

Conclusion: These results support the notion that not only the intensity but also other parameters such as duration of effort and recovery impact on the internal load and thus must be taken into consideration when prescribing training in order to maximize performance and avoid overtraining. Intensities around the anaerobic threshold might have a greater impact on the HRV than intensities above or below it.

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