Stress hormones and perceived recovery-stress state in elite male rowers during prolonged training

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Introduction
It has been suggested that basal cortisol levels may be used as a marker of training stress in athletes as basal cortisol levels represent the endpoint of the hypothalamus-pituitary-adrenocortical axis. Increased levels of basal cortisol have been linked to normal stress response to heavy training, while a decrease in basal cortisol has been used as a late sign of overtraining (Urhausen and Kindermann, 2002). In addition to the hormonal values, the amount of psychologically related stress seems to reflect well the clinical state of athletes (Jüriämäe et al., 2002). Furthermore, variation in cortisol has been linked to changes in mood, sleep quality, and recovery activities (Jüriämäe et al., 2002). These findings suggest that training monitoring in elite athletes should involve a multi-level approach using valid hormonal as well as psychological indices to assess adaptation to certain training load.

The aim of the present investigation was to integrate hormonal and psychological approaches of training monitoring during the course of preparation period in elite rowers; and to investigate possible relationships between training volume, basal hormone levels and perceived recovery-stress state. These hormone and perceived recovery-stress state markers should reflect the variations in the training volume that take place during the 24-week training season in elite male rowers.

Methods
Eleven elite male rowers were tested on seven occasions over the six month training season. Fasting testosterone, growth hormone, cortisol and creatine kinase activity, and perceived recovery-stress state (RESTQ-Sport questionnaire) were evaluated after a resting day. Maximal oxygen consumption (VO2max) was determined before and after the training period. Training was mainly organized as low-intensity prolonged training sessions.

Results
Significant increases in VO2max (from 6.2 ± 0.5 to 6.4 ± 0.6 l.min⁻¹), VO2max/kg (from 67.6 ± 3.0 to 69.2 ± 3.1 ml.min⁻¹kg⁻¹) and Pa max (from 442.8 ± 40.5 to 465.9 ± 26.2 W) were observed as a result of 24-week training period. At the beginning of the preparation period, the mean value of training volume was about 128 min per day. With regard to this initial value, there was a significant increase (P < 0.05) after Week 8 to Week 20 (Week 8: ≈129 min.day⁻¹; Week 12: ≈135 min.day⁻¹; Week 16: ≈146 min.day⁻¹; Week 20: 167 min.day⁻¹). At the end of the study (Week 24), the mean training volume was about 116 min.day⁻¹. The Standardized RESTQ-Index did not change significantly over the 24-week preparation period in elite rowers. Standardized Stress score significantly changed after Week 12 compared to the pretraining score, while Standardized Recovery score was also significantly higher from Week 20 in comparison with the pretraining value. When comparing the fasting cortisol concentrations with the first measurement, Weeks 12 and 20 show significant increases, while fasting testosterone concentration demonstrated a significant increase after Weeks 4, 8 and 20 compared to the initial measurement (Week 0). Fasting growth hormone concentration did not change throughout the 24-week training period. Creatine kinase activity was significantly increased after the first four week training period and remained elevated until the end of the 20th week of training. After 24 weeks, all measured blood biochemical parameters were not different (P > 0.05) from the values of the first measurement session.

Significant relationships were observed between mean weekly training volume, and fasting cortisol (r = 0.416; p = 0.010) and testosterone (r = 0.527; p = 0.001) values. Standardized Stress score was significantly related to fasting cortisol (r = 0.381; p = 0.002) and growth hormone (r = 0.284; p = 0.021) values. While Standardized Recovery was significantly related to fasting creatine kinase activity only (r = -0.248; p = 0.045). In addition, RESTQ-Index was significantly related to fasting creatine kinase activity (r = -0.299; p = 0.015), cortisol (r = 0.321; p = 0.009), growth hormone (r = 0.417; p = 0.001) and testosterone (r = 0.349; p = 0.004) values.

Discussion/Conclusion
Testosterone and cortisol appear to be more sensitive to changes in training volume in typical elite rowing training during preparation period. Increases in these stress hormone concentrations represent positive adaptation to current training load. Significant relationships between hormonal and perceived recovery-stress state suggest that metabolic and psychological changes should be carefully monitored to avoid unfavourable outcome on the training status in elite rowers.

References