Effects of supramaximal training on physical performance and parasympathetic function: repeated sprint vs. high-intensity intermittent running

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Introduction

Repeated supramaximal exercise training is an efficient means of improving both aerobic and anaerobic energy system capacities (1, 2). However, the influence of different levels of supramaximal training on parasympathetic function is unknown. The aim of the present study was to compare the effects of repeated sprint (RS) versus high-intensity intermittent training (HIT) on performance and parasympathetic function in trained adolescents.

Methods

• Participants: 17 trained male adolescent handball players (15.6 ± 0.8 y, 178.0 ± 9.1 cm and 75.8 ± 6.5 kg) who trained 10 ± 2.1 h·wk^{-1} in a regional centre.
• 9-week training program: in addition to usual training contents (similar for both groups), 2 supramaximal sessions/week, RS and HIT matched by exercise duration.
- RS: 2-3 sets of 5-6 x 15-20 m shuttle sprints (≈100 to 120%V_{IFT}) interspersed with 14-23 s of rest.
- HIT: 6-12 min of intermittent running for 15-20 s (90-95 %V_{IFT}) interspersed with 15-20 s of active (45 %V_{IFT}) recovery.
- Physical performance and parasympathetic function assessment tests were performed one week before and after the training period.
• Physical performance assessment:
- Maximal speed reached at the end of the 30-15 Intermittent Fitness test (V_{IFT})(3)
- Counter movement jump height (CMJ, Microgate, Italy).
- 10-m sprint time (10 m).
- Repeated sprint ability test (6 x shuttle 15-m runs interspersed with 14 s of passive recovery, RSA).
• Parasympathetic reactivation assessment: 10-min beat-to-beat heart rate (HR) collection (Polar Electro, Kempele, Finland) following a 6-min submaximal exercise test (60% V_{IFT}).
- HR recovery time constant (first-order exponential decay curve, HRRτ) (4, 6)
- Root mean square of successive R-R interval differences, calculated on the last stationary 5-min segment ($RMSSD_{5\text{-}10min}$) and on consecutive 30-s moving windows ($RMSSD_{30s}$) (5, 6)

Results

Parasympathetic function, V_{IFT} and RSA_{mean} were significantly improved with HIT but not RS training. In contrast, changes in CMJ were similar in both groups, and there was no significant improvement of 10 m (Fig 1). When considering each group separately, no significant time effect was observed for $RMSSD_{30s}$ before the training period (P = 0.35 and P = 0.29 for RS and HIT, respectively), whereas there was a significant time effect after training for the HIT group (P = 0.04) but not for the RS group (P = 0.09) (Fig. 2). A significant relationship was shown between the decrease in HRRτ and RSA_{mean} (Fig. 3).

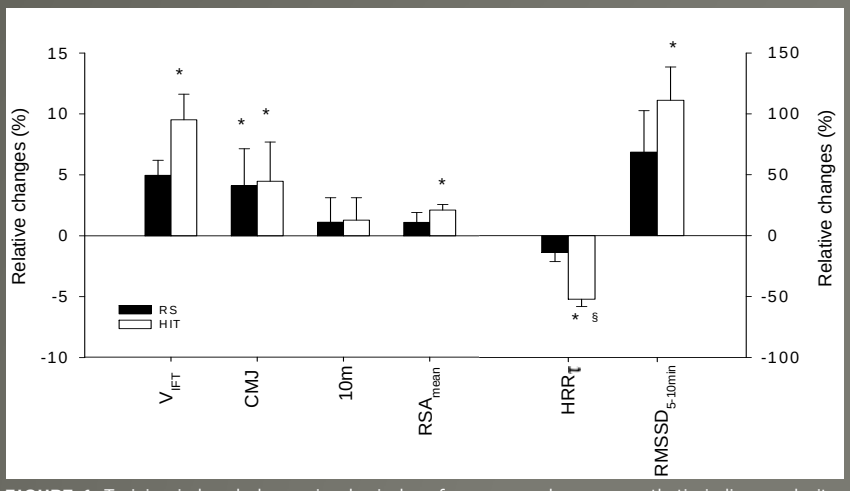

FIGURE 1—Training-induced change in physical performance and parasympathetic indices, velocity reached at the end of the 30-15$_{IFT}$ (V_{IFT}), counter movement jump (CMJ), 10 m sprint time (10m), mean sprint time during the RSA test (RSA_{mean}), time constant of the HR decay (HRRτ), and root-mean-square difference of successive normal R-R intervals ($RMSSD_{5\text{-}10min}$) calculated for the last 5-min period. *: significant difference between Pre and Post measurements (P< 0.05); §: significant difference between RS and HIT training (P <0.05).

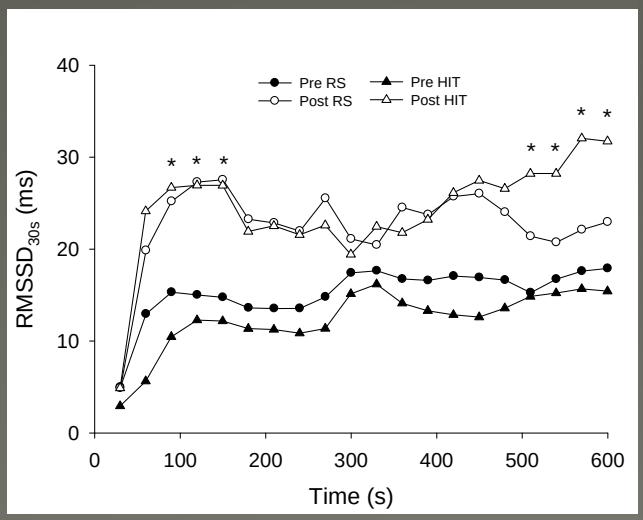

FIGURE 2—Average root mean square of successive differences in the R-R intervals measured on successive 30-s segments ($RMSSD_{30s}$) during the 10-min recovery period after the 6-min submaximal exercise bout (60%V_{IFT}), as calculated for participants of repeated sprint (RS) and high-intensity intermittent training (HIT) groups, before (Pre) and after (Post) the training period *: significant difference vs. $RMSSD_{30s}$ at 30s after the end of exercise during the same test session (P < 0.05). For the sake figure clarity, error bars have been removed.

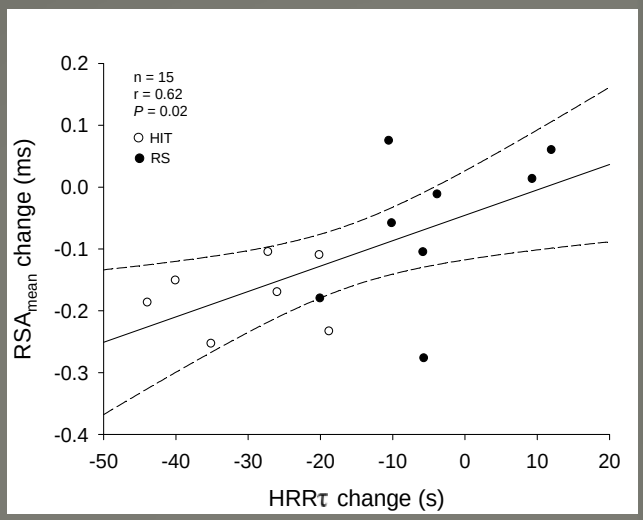

FIGURE 3—Relationsip between changes in HR recovery (HRRτ) and changes in mean repeated sprint ability (RSA_{mean}) after the training period in the repeated sprint (RS) and high-intensity intermittent training (HIT) groups. Shaded lines represent 95% confidence intervals.

References

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Conclusions

HIT was more effective than RS training at improving post-exercise parasympathetic function and RSA_{mean}. The relationship shown between changes in HHRτ and RSA_{mean} suggests that post-exercise HR and HRV recovery may be useful performance-related measurements.