The Effects of Heat Acclimatization, Heat Acclimation, and Intermittent Heat Training on Maximal Oxygen Uptake

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Category: Doctoral

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ABSTRACT

Maximal oxygen uptake (VO_{2max}) is an important determinant of endurance performance. Heat acclimation/acclimatization (HA/HAz) strategies elicit improvements in endurance performance. When heat exposure is reduced, intermittent heat training (IHT) is potentially beneficial to alleviate HA/HAz adaptation decay, however corresponding VO_{2max} responses are unknown. **PURPOSE:** To determine the effects of HA/HAz and IHT on VO_{2max} in endurance runners and identify how long VO_{2max} adaptations remain following removal of repeated heat exposure. **METHODS:** Twenty-seven male endurance runners (mean ± SD; age, 36 ± 12 years; body mass, 73.03 ± 8.97 kg; height, 178.81 ± 6.39 cm; VO_{2max}, 57.48 ± 7.03 ml.kg^{-1}.min^{-1}) completed VO_{2max} and exercise testing at five time points; baseline, pre-HA, post-HA, week 4 of IHT (IHT_4), and week 8 of IHT (IHT_8). Exercise testing and HA environmental conditions were the same (ambient temperature, 35.42 ± 1.06°C; relative humidity, 46.35 ± 2.48%). Following baseline testing, participants completed HAz, proceeded by 5 days of HA involving exercise to induce hyperthermia (38.50 - 39.50°C) for 60 minutes. Participants were then randomly assigned to one of three IHT groups: once weekly ($n = 9$), twice weekly ($n = 10$), or no IHT ($n = 8$). Differences in VO_{2max} and maximal heart rate at VO_{2max} (HR_{max}) for baseline, pre-HA, post-HA, IHT_4, and IHT_8 were analyzed using repeated-measures ANOVAs with Bonferroni corrections post-hoc. **RESULTS:** No significant VO_{2max} differences were observed between baseline (57.92 ± 6.82 ml.kg^{-1}.min^{-1}), pre-HA (59.65 ± 8.24 ml.kg^{-1}.min^{-1}), and post-HA (59.49 ± 7.18 ml.kg^{-1}.min^{-1}, $p = 0.36$). No significant group or time effects were identified for VO_{2max} at post-HA, IHT_4, and IHT_8 ($p = 0.67$). However, significant HR_{max} differences were observed between baseline (180 ± 11 beats.min^{-1}), pre-HA (177 ± 10 beats.min^{-1}), and post-HA tests (175 ± 10 beats.min^{-1}, $p = 0.01$). No significant group or time HR_{max} differences were shown for post-HA, IHT_4, and IHT_8 ($p = 0.59$). **CONCLUSION:** No changes in VO2max were identified among endurance runners following HA/HAz, potentially due to participants' high aerobic fitness levels. As IHT maintained VO_{2max} following 8 weeks without repeated heat exposure, it is potentially a beneficial strategy to minimize VO_{2max} adaptation decay in endurance athletes.