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Conference Abstract

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Effects of Heat Training on Nocturnal Core Body Temperature in Professional Endurance Athletes: A Pilot Study

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1 Abstract

Heat training is commonly implemented in professional endurance athletes (PEA) to promote thermoregulatory adaptation and improve performance efficiency. Although the acute physiological responses to exercise in the heat are well described, the immediate effects of a single heat training session on nocturnal core body temperature and sleep-related temperature rhythms remain poorly characterized. This pilot study investigated the impact of an acute heat training session on overnight core body temperature and associated sleep parameters in PEA.

Nocturnal core body temperature (Tc) was measured in PEA (N = 7; 3 male, 4 female) using an ingestible telemetric temperature pill (e-Celsius, BodyCAP, France) across two consecutive nights: one night before (N1) and one night after (N2) a standardized heat training session (Duration: 65.7 ± 2.6 min; maximum exercise Tc: 39.0 ± 0.3 °C). Continuous Tc was recorded throughout the sleep period on both nights. From these recordings, key circadian and sleep-related metrics were derived, including time to nadir, nadir time, nadir temperature, average nocturnal core temperature, total sleep time, and the amplitude of the nocturnal temperature rhythm.

Compared with N1, the post-training night (N2) showed a later time to nadir (mean difference: +78 min, p = 0.03), delayed nadir timing (mean difference: +80 min, p = 0.04),

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reduced total sleep time (mean difference: −53 min, $p < 0.001$), and a greater amplitude of the nocturnal core temperature rhythm (mean difference: +0.35 °C, $p = 0.01$). In contrast, there were no significant differences in mean nocturnal core temperature ($p = 0.46$) or nadir temperature ($p = 0.45$) between nights, suggesting that heat training primarily alters the timing and variability of nocturnal thermoregulation rather than the absolute overnight temperature level.

Increased nocturnal temperature variability, accompanied by blunted nighttime cooling and a delayed onset of core temperature decline, indicates a sustained thermophysiological load extending into the recovery period. A single heat training session modified the temporal profile and amplitude of nocturnal core body temperature and reduced total sleep time, without altering mean or nadir core temperature. These findings suggest that intensive heat training disrupts normal nocturnal thermoregulation in PEA, manifesting as delayed and more variable core temperatures during sleep.

This pattern points to a potential trade-off between pursuing heat adaptation and preserving overnight recovery, underscoring the importance of optimizing training timing and post-session recovery strategies. Moreover, the results indicate that acute heat exposure can shift the timing and stability of nocturnal thermoregulation in athletes, with consequences for sleep quality, quantity, and subsequent recovery. This may be particularly relevant during intensive training blocks and stage races.