Sex differences in adaptation to short and long term Isothermic heat acclimation

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Aim: The current study assessed the sex differences in thermoregulatory and physiological adaptation to short term heat acclimation (STHA) and long term heat acclimation (LTHA).

Method: Eight males (22 ± 6 years; 74.2 ± 6.9 kg; 178 ± 6 cm and 3.63 ± 0.69 L.min^{-1}) and eight females (20 ± 1 years; 58.9 ± 7.7 kg; 164 ± 7 cm and 2.69 ± 0.30 L.min^{-1}) performed ten, cycling isothermic (rectal temperature ~38.5°C) heat acclimation (HA) sessions (90 minute) separated by three heat stress tests (HST). HST were performed 48 hours before commencing HA (HST1), 48 hours following 5 days HA (HST2) and 48 hours following 10 days HA (HST3). The HST consisted of 30 minutes running at 9km·hr^{-1} and 2% gradient in a hot environment (40°C and 25% relative humidity).

Results: ANOVA revealed an effect of HST on peak rectal temperature (Tr_{peak}) ($F_{(2, 28)}$ = 15.583, p < 0.001, np^2 = 0.565), peak heart rate (HR_{peak}) ($F_{(2, 28)}$ = 4.287, p = 0.026, np^2 = 0.263) and sweat rate ($F_{(2, 28)}$ = 12.191, p < 0.001, np^2 = 0.465). Bonferroni corrected pairwise comparisons revealed a reduction from HST1 to HST2 for males Tr_{peak} (-0.32 ± 0.42°C, p = 0.030) and HR_{peak} (-14 ± 14 beats.min^{-1}, p = 0.016), independently from females. There were no changes in male's sweat rate from HST1 to HST2 (23 ± 533, p = 0.896) however, females had an increased sweat rate (689 ± 412 g.hr^{-1}, p = 0.001). There were no differences from HST2 to HST3 in males and females Tr_{peak} and HR_{peak} ($p \geq 0.05$). However, there was a reduction in Tr_{peak} from HST1 to HST3 in males (-0.42 ± 0.47°C, p = 0.002) and females (-0.48 ± 0.27°C, p = 0.003). Furthermore, sweat rate increased from HST2 to HST3 in males (583 ± 638 g.hr^{-1}, p = 0.016) independently from females.

Conclusion: These findings suggest males and females have different temporal patterning in their adaptation to STHA. Females require LTHA to establish thermoregulatory and cardiovascular stability. HA protocols should be designed to target sex differences in thermoregulation for optimal adaptation.