Isothermic heat acclimation requires lower exercise durations to elicit superior adaptation to heat stress compared to a fixed intensity protocol.

Gibson, O.R.[1] Mee, J.A.[1] Tuttle, J.A.[2] Taylor, L.[2] Maxwell, N.S.[1] Watt, P.W. [1]

[1] Environmental Extremes Laboratory, Centre for Sport and Exercise Science and Medicine, University of Brighton, Welkin Laboratories, Denton Road, Eastbourne, UK.

[2] Muscle Cellular and Molecular Physiology (MCMP) and Applied Sport and Exercise Science (ASEP) Research Groups, Department of Sport and Exercise Sciences, Institute of Sport and Physical Activity Research (ISPAR), University of Bedfordshire, Bedford Campus, Polhill Avenue, Bedfordshire, UK

Aim

We investigated whether equal cardiovascular (Heart rate; HR), thermoregulatory (Rectal temperature; Trec), sudomotor (Sweat-rate; SR), and cellular (Leukocyte Heat shock protein-72 mRNA; Hsp72) adaptation followed fixed-intensity (FIXED; workload=50%$\dot{V}O_{2peak}$) or isothermic (ISO; Trec=38.5°C) heat acclimation (HA).

Method

Following heat stress tests (HST; 30 min, 9 km.h^{-1}/2%, 40°C/25%RH), twenty-seven males performed five 90 min sessions (STHA;40°C/25%) utilising FIXED (age 19.8 ± 0.9 years, mass 77.7 ± 16.5 kg, $\dot{V}O_{2peak}$ 3.61 ± 0.80 L.min^{-1}), or ISO (24.4 ± 5.4 years, 74.6 ± 7.7 kg, 3.71 ± 0.61 L.min^{-1}) followed by repeat HST.

LTHA comprised five additional sessions, ISO dividing into continuous (ISOCONT; Trec=38.5°C) and progressive (ISOPROG; Trec=39.0°C) groups, and a final HST. Hsp72 was measured via quantitative PCR (RT-QPCR).

Results

STHA improved HR_{rest} (-6 ± 1 b.min^{-1}), $Trec_{rest}$ (-0.22 ± 0.01 °C), HR_{peak} (-8 ± 1 b.min^{-1}), $Trec_{peak}$ (-0.31 ± 0.02 °C) and SR (+0.38 ± 0.20 L.hr^{-1}) overall (p<0.05). Post-hoc analysis observed adaption for HR_{peak}, $Trec_{rest}$ $Trec_{peak,}$ and SR in ISO, and HR_{rest} in FIXED.

LTHA improved HR_{rest} (-7 ± 0 b.min^{-1}), $Trec_{rest}$ (-0.21 ± 0.05 °C), HR_{peak} (-8 ± 1 b.min^{-1}), $Trec_{peak}$ (-0.33 ± 0.05 °C), and SR (+0.57 ± 0.16 L.hr^{-1}) overall (p<0.05). Post-hoc analysis observed adaption in HR_{rest} in ISOCONT, $HR_{peak,}$ in ISOCONT and ISOPROG, $Trec_{rest}$ in FIXED and $Trec_{peak}$ in FIXED and ISOCONT.

ISO achieved STHA for less (p<0.05) exercising duration (ISO 303.5 ± 59.8 min; FIXED = 446.5 ± 7.5 min), and work (ISO 2,730 ± 481 kJ; FIXED = 3,353 ± 749 kJ). ISOCONT (706.9 ± 102.5 min) and ISOPROG (597.5 ± 87.2 min) achieved LTHA for less exercising duration (p<0.05) than FIXED (891.9 ± 17.7 min).

Hsp72 increased in ISO and FIXED (p<0.05) pre-post session one and five, FIXED Hsp72 reduced (p<0.05) between post one and five. ISOCONT, ISOPROG and FIXED elicited increases (p<0.05) pre to post session one and ten, FIXED Hsp72 reduced (p<0.05) between post one and ten.

Conclusion

Short and long term Isothermic HA elicits superior adaptation more efficiently than fixed-intensity. Hsp72 increased post-exercise following HA, however increases were attenuated post-exercise following sessions five and ten, compared to one in FIXED.

Main text word count (excluding title and affiliations) = 350