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THE EFFECTS OF AMBIENT TEMPERATURE AND WHOLE-BODY COOLING ON SKELETAL MUSCLE OXYGENATION DURING AEROBIC EXERCISE

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Objectives

Dynamic exercise increases skeletal muscle tissue deoxygenation while peripheral cooling decreases blood volume1,2. Whether tissue oxygenation is further decreased during aerobic exercise in the cold or following a whole-body pre-exercise cooling period is unknown.

Methods

Eleven male subjects, dressed in shorts and t-shirt, exercised 6 times for 60 min on a treadmill in a climatic chamber set at 22°C (Neutral, NT), 0°C (Cold, CO), or at 0°C following a pre-exercise cooling period (Cold with pre-exercise cooling, CD) at 50% and 70% of peak VO2. Near-infrared spectroscopy determined blood volume (tHb) and tissue oxygenation (diffHb) (ΔμM) of the vastus lateralis (VL) and the gastrocnemius (GAS) muscles. Core and skin temperatures were also measured. Early and later responses at 10 and 60 min of exercise were analyzed by ANOVA (Mean ± SE).

Results

Skin temperature was lower in CD and CO *vs.* NT throughout exercise ($p < 0.001$). Core temperature was lower in CD at 10 min *vs.* NT and CO ($p < 0.05$). At 50% VO2peak, diffHb was lower in the VL at 10 min in CD (-15.9 ± 3.0μM) *vs.* CO (-4.2 ± 3.1μM) and NT (-0.4 ± 1.3 μM) with tHb also lower at 60 min in CD (-10.4 ± 2.1 μM) *vs.* CO (-1.4 ± 3.4 μM) and NT (-3.3 ± 1.1 μM) ($p < 0.05$). At 70% VO2peak, tHb was lower at 10 min in the VL in CD (-8.0 ± 1.7 μM) vs. CO (-1.9 ± 2.1 μM) and NT (-1.8 ± 1.5 μM) ($p < 0.05$). No changes were seen in GAS.

Conclusions

Pre-exercise whole-body cooling induced a greater skeletal muscle tissue deoxygenation during early submaximal exercise in VL but not in GAS. Ambient temperature alone did not modulate the tissue oxygenation response. Individuals with dysfunctional vascular capability may be at greater risk of tissue deoxygenation if unprepared for cold environments.

1. Peltonen J.E., et al. (2013) Resp Physiol Neurobi 188, 102-112
2. Yanagisawa O, et al. (2007) Eur J Appl Physiol 100, 737-745