Sudomotor responses during isometric exercise appear to be intensity- and muscle mass-dependent

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Cardiac frequency, mean arterial pressure and skin sympathetic nerve activity during isometric exercise, increase in proportion to exercise intensity (Vissing *et al.*, 1991), while pressor responses also appear to be modulated by the size of the active muscle mass (Ray and Wilson, 2004). Sweating also responds to exercise intensity (Kondo *et al.*, 2000), however, there is no information relating to the affect of muscle mass recruitment on sudomotor function. The hypothesis was tested that non-thermal sudomotor drive in the heat would be influenced by both exercise-intensity and the size of the recruited muscle mass.

Seven, resting (upright) males were heated (60 min) using a water-perfusion suit (37.2°C) and a climate-controlled chamber (36.7°C, 58% relative humidity) to induce steady-state sweating. Body temperature was clamped thereafter. Isometric handgrip and knee extension activations (60 s with 10 min rest) were performed at 30% and 50% maximal voluntary contraction (MVC) in a balanced order. Sweat rate ($\dot{m}_{sw}$) was measured (1 Hz: 3.16 cm^2 capsules) at four sites (forehead, chest, and inactive forearm and thigh), and averaged. Cardiac frequency was monitored continuously (0.2 Hz), and mean arterial pressure was measured beat-by-beat.

Oesophageal and mean skin temperatures did not change during either rest or isometric exercise, verifying the veracity of the thermal clamp. Cardiac frequency displayed both an intensity- and a mass-dependence, resulting in the following pre- to post-activation changes (1 min): handgrip (5.9±1.4, 22.4±2.0 $b.min^{-1}$, 30 and 50% MVC; P<0.05); knee extension (14.5±1.4, 26.6±2.5 $b.min^{-1}$, 30 and 50% MVC; P<0.05). Similar to cardiac frequency, mean arterial pressure increased significantly during handgrip (10.1±1.9, 23.7±4.1 mmHg, 30 and 50% MVC; P<0.05), and knee extension (20.1±1.6, 32.1±2.8 mmHg, 30 and 50% MVC; P<0.05). Whilst pre-activation $\dot{m}_{sw}$ baselines were similar, normalised increases in $\dot{m}_{sw}$ from baseline, were intensity-dependent, but not mass-dependent: handgrip (0.093±0.027 and 0.212±0.035 $mg.cm^{-2}.min^{-1}$, 30 and 50% MVC; P<0.05); knee extension (0.140±0.017 and 0.198±0.026 $mg.cm^{-2}.min^{-1}$; P>0.05). However, the integrated sudomotor responses during isometric exercise appeared to reveal an intensity- and muscle mass-dependency: handgrip (3.15±0.70 $mg.cm^{-2}$ and 4.61±0.87 $mg.cm^{-2}$, 30 and 50% MVC); knee extension (4.17±0.48 and 5.53±0.89 $mg.cm^{-2}$). Whilst differences between handgrip and knee extension were non-significant (30% MVC P=0.09; 50% MVC P=0.08), *post hoc* analyses reveal our design to be under-powered; further testing is underway. In addition, following knee extension, $\dot{m}_{sw}$ remained elevated compared to handgrip exercise. The possibility exists that the delayed $\dot{m}_{sw}$ recovery, was mediated by intramuscular changes, which may be mass-dependent.

This study provides evidence that sudomotor responses to isometric exercise, during heat stress, may be exercise-intensity and muscle mass-dependent. If real, this latter observation is both novel and significant. Non-thermal factors have been suggested to modulate sweating during isometric exercise (Kondo *et al.*, 2000). We now propose that motor unit recruitment may also influence sweating. In addition, the continued elevation of $\dot{m}_{sw}$, but not body temperature, after isometric exercise, in particular knee extension exercise, may indicate that metaboreceptor stimulation, or an unidentified thermal factor, has augmented post-exercise sweating. This appears to also be mass-dedendent.

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