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MUSCLE temperature, exercise perception and central fatigue

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Central fatigue during thermal stress has been widely attributed to changes in core temperature as well as the central integration of perceptual feedback from the periphery. In this experiment, we examined the effect of localised changes in muscle temperature ($T_m$) on sensory feedback and muscle activation during maximal intensity exercise. Sixteen subjects were assessed for neuromuscular responses to a range of $T_m$ (22°C, 28°C, 34.9°C, 37°C & 38.5°C), before, during and after, 120-s maximal isometric (n = 8) or dynamic (n = 8) knee extension exercise. Single leg water immersion was used to set $T_m$ to the required level for each condition. Mean muscle activation (ACT%) and resting potentiated twitch force (RPTF) were used to examine the relationship between $T_m$, sensory feedback and central fatigue. Mean isometric force output (MIFO) and dynamic power output (DPO) was used to compare differences between the two exercise modalities. MIFO and ACT% were significant for the effect of $T_m$ ($p <0.005$) showing a negative relationship ($r = -0.74$ & -0.66; $p <0.001$, respectively) across the muscle temperature continuum (-7N & -0.7% per-degree-centigade increase). Both isometric and dynamic RPTF at the start of the exercise was significantly augmented as $T_{muscle}$ increased ($p <0.001$), however RPTF post-exercise was similar across conditions. Peak DPO was markedly reduced ($P<0.001$) in cold $T_{muscle}$, however after 60-s of maximal dynamic exercise, DPO plateaued at a similar level across all conditions. The rate of decline in PO was therefore higher ($p < 0.001$) in hot $T_m$ (-85.3 W.min$^{-1}$) and thermoneutral $T_m$ (-82.1 W.min$^{-1}$) compared to cold $T_m$ (-51.2W.min$^{-1}$). The negative relationship between ACT% and $T_{muscle}$ indicates that $T_{muscle}$ can affect central fatigue onset, contributing in part to a reduction in mean force output during sustained isometric contractions. While this may not be significant to override the optimised force-velocity relationship in hot muscle, the contributory effects of the increases in muscle sensory feedback may still contribute significantly to early exercise cessation.

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