

Impact of Head-and-Neck Heating on Fatigue and Stress Responses in Healthy Men and Individuals With Multiple Sclerosis

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Purpose: Individuals with multiple sclerosis (MS) often experience heat sensitivity, with elevated temperatures increasing the risk of injury, healthcare costs, and decreased productivity. While the effects of whole-body or ambient heat exposure have been widely studied, the impact of localised thermal stress – particularly on central and peripheral neuromuscular function – remains unclear. This study aimed to determine whether applying localised heat to the head and neck during prolonged submaximal exercise in a thermoneutral environment would affect neuromuscular fatigue in healthy men and individuals with MS.

Methods: We examined the effects of head-and-neck heating ($44 \pm 0.5^\circ\text{C}$ at the skin surface) in men with relapsing-remitting MS ($n = 16$; age: 31.8 ± 7.6 years) and healthy controls ($n = 18$; age: 27.6 ± 4.3 years). Each participant completed two trials – one with local heating and one control trial – separated by one week. The protocol involved 100 intermittent isometric knee extensions (5 seconds contraction, 20 seconds rest). Measurements included electrically induced torque, maximal voluntary contraction, central activation ratio, muscle temperature (T_{mu}), perceived effort, and blood stress markers. Data were collected at baseline, after 50 and 100 contractions, and following a 1-hour recovery period.

Results: Local heating during submaximal exercise significantly reduced central activation and attenuated peripheral fatigue in men with MS compared to the control condition ($p < 0.05$). Head-and-neck heating also increased T_{mu} and perceived effort in both groups ($p < 0.05$). Notably, the effects of local heating on central and peripheral fatigability were more pronounced in the MS group than in healthy controls ($p < 0.05$).

Conclusion: Head-and-neck heating during exercise resulted in greater suppression of central muscle activation and a more substantial reduction in peripheral fatigue in men with MS compared to non-heated conditions. These effects were significantly more pronounced in individuals with MS than in healthy controls, suggesting a heightened neuromuscular sensitivity to localised thermal stress in this population.

