Neuromuscular alterations may not be the trigger for the early cessation of exercise in a hot environment

Author  Sebastien Racinais
Institution  Aspetar, Qatar Orthopaedic and Sports Medicine Hospital, Doha, Qatar

**Background:** It has widely been described that elevated environmental temperatures and humidity reduce exercise capacity and that elevated body temperatures alter the maximum voluntary activation of skeletal muscle and peripheral transmission of neural drive.

**Purpose:** This study aimed to determine if such neuromuscular alterations trigger early exercise cessation when exercising in a hot environment i.e. if exercise cessation occurs because, in a hot environment participants become unable or unwilling to adequately activate the musculature.

**Method:** Twelve participants sequentially performed neuromuscular test sessions (cortical excitability, spinal modulation, neuromuscular junction, muscle contractility) after 1 hour of rest, after a 20 minute sub-maximal cycling task (100 W), and after reaching exhaustion during an incremental cycling test. Tests were carried out in both a control (CON, 24°C-24% rH) and hot (HOT, 40°C-40% rH) environment.

**Results:** Exercise duration before voluntary exhaustion (incremental test) was shorter (HOT, 13min 50s; CON, 17min 09s) and final peak power output was lower (HOT, 220W; CON, 255W) in HOT than CON. Rectal, muscle and skin temperature were higher at exhaustion in HOT than CON (e.g. rectal temperature: HOT, 38.7°C; CON, 38.2°C). Heart rate was also higher in HOT (184bpm) than CON (179bpm) but not the subjective rate of perceived exertion (RPE), which was higher than 19/20 in both conditions. The amplitude of the motor evoked potential (MEP) by transcranial magnetic stimulation (TMS) was not altered (HOT, 4.5mV; CON, 5.6mV) by environmental temperature. In addition, peripheral fatigue (peak twitch decrement) was less in HOT (-19%) than CON (-33%).

**Conclusion:** Our data shows that participants withdrew earlier from the incremental cycling test with lower power output and EMG activity in HOT than CON environments. Given that: (i) MEP amplitude during cycling was not affected by fatigue nor heat exposure; and (ii) the extent of peripheral fatigue was smaller in the HOT environment, we conclude that there is no evidence that neuromuscular failures represent the limiting factor for cycling in the heat. Instead, higher core temperature and heart rate in the HOT environment might have triggered a voluntary exercise cessation with participants withdrawing from exercise in hot environment before being limited by the modifications in the neuromuscular system.