The role of thermal and touch sense in the perception of skin wetness at rest and during exercise in different environments

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**THERMOREGULATORY RESPONSES OF ATHLETES WITH A SPINAL CORD INJURY DURING INTERMITTENT WHEELCHAIR EXERCISE IN COOL CONDITIONS**

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Introduction: Individuals with a spinal cord injury (SCI) have impaired thermoregulatory control, resulting in a loss or reduction in sweating capacity and an inability to make effective vasomotor adjustments. Individuals with high level cervical lesions (tetraplegia, TP) possess a greater impairment in thermoregulatory control than individuals with lower level lesions (paraplegia, PA). Although the thermoregulatory responses of athletes with SCI have been reported, no data has compared the responses of athletes with TP and PA during an intermittent sprint protocol (ISP). The purpose of this study was to investigate the thermoregulatory responses of athletes with TP and PA during intermittent wheelchair exercise and recovery. Methods: Eight wheelchair rugby players with TP (lesion level C4/5-C6/7, body mass 65.2 ± 4.4 kg, VO2peak 1.55 ± 0.37 L·min⁻¹) and eight wheelchair basketball players with PA (lesion level T4-S1, body mass 68.1 ± 12.3 kg, VO2 peak 1.92 ± 0.47 L·min⁻¹) completed a 60 min ISP at maximal effort on a wheelchair ergometer, followed by 15 min of passive recovery in cool ambient conditions (20.6 ± 0.1°C and 39.6 ± 0.8% relative humidity). Core temperature (Tcore, telemetry pill), mean (Tsk) and individual muscle temperatures were measured throughout. Heat storage (HS) was calculated every 15 mins. Results: Sprint speed (3.16 ± 0.59 m/s) and 3.51 ± 0.44 m/s for athletes with TP and PA, respectively) was similar between groups. There were larger increases in Tcore and Tsk for athletes with TP compared to athletes with PA during exercise and recovery (p<0.05). Back, chest, lower arm and forehead skin temperatures all increased during recovery in athletes with TP compared to a decrease in athletes with PA (p<0.05). Heat storage was higher in athletes in TP (p<0.05), with end of recovery values of 3.42 ± 1.42 J·g⁻¹ and -0.51 ± 1.30 J·g⁻¹ for athletes with TP and PA, respectively. Discussion: The results of this study show that athletes with TP experienced a greater increase in Tcore and Tsk in comparison to athletes with PA. Although only exercising in cool conditions, this suggests athletes with TP have a greater inability to dissipate heat than athletes with PA during intermittent sprint exercise and recovery, possibly due to the greater loss of sweating capacity. This is also reflected by the gain in HS for athletes with TP and the net loss for athletes with PA by the end of the recovery period.

**THE ROLE OF THERMAL AND TOUCH SENSE IN THE PERCEPTION OF SKIN WETNESS AT REST AND DURING EXERCISE IN DIFFERENT ENVIRONMENTS**

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Introduction: The type and amount of physical activity an individual performs is influenced by the level of comfort achievable with the surrounding environment (Yanos et al., 2012). Skin wetness has been shown to be a critical determinant of thermal and clothing comfort (Fukazawa et al., 2009). Clarifying the neurophysiological bases of wetness perception (WP) is critical to improve sporting garments’ design and thus comfort. WP seems to result from the integration of temperature (cold and mechanical pressure) inputs. The aim of this study was to investigate the role of thermal and touch sense in the WP. Methods: Six cold-dry stimuli (3 temperatures, 4, 8, 15°C lower than local skin temperature) X 2 pressures (7 and 10 kPa) were applied (10 sec) on the bare, upper and lower back of 11 (8F/3M) participants. Differences in muscle Vol (+8 CON vs. +6% ECC) and maximal voluntary contraction (MVC) (+9 CON vs. +11 % ECC) were similar in both groups. If increased significantly after ECC but not CON (+12 vs. +5%) and PA increased markedly after CON (+30 vs. +5%). Hypertrophy in the distal and mid part of the VL was different between the groups (CON +2 vs. ECC +8%; ECC +7 vs. CON +11%, respectively). Discussion: In terms of whole-muscle hypertrophy, despite the ~12 fold greater training load of the ECC group, similar increases in VOL and MVC in were found after training. However, distinct architectural changes were found between the two loading regimes: increases in U were greater after FCC than CON while in contrast, PA increased more in CON vs. ECC. These adaptations (in accordance with (3)) reflected differences in fascicle behaviour in the two contraction modes, i.e., lengthening in ECC vs. shortening CON. When examining regional hypertrophy, the changes in architecture induced by the two regimes induced preferential growth in the distal region of VL for ECC while for CON, VL growth occurred mainly at mid-belly. In terms of signaling, while MAPK activation (i.e., p38MAPK, ERK1,2, p90Rsk1) was exclusive to ECC, neither mode affected AKT-mTOR or inflammatory signaling. To conclude, hypertrophy in response to CON vs. ECC yields distinct architectural and regional adaptations, rather than in whole-muscle growth despite the greater loading intensity of ECC protocol. These morphologic and architectural changes to ECC vs. CON were associated with discrete acute fascicle behaviour, which we speculate to underlie the preferential activation of MAPK signaling, and perhaps the ensuing distinct muscle adaptations. References: 1- Kehat et al. Circ Res, 2011 2- Wretman et al. J Physiol, 2001 3- Reeves et al. Exp Physiol, 2009.
Different studies have found compromised adaptation of strength, especially muscle power, when both strength and endurance were trained at the same time. Several strategies or mechanisms have proven effective in reducing the interference phenomenon of concurrent strength and endurance training as follows [1,4]: • Short training phases (5 weeks) using highly concentrated training loads (>50% of the total training volume) and which focus on the development of only two target fitness components in each training phase (i.e. on one for strength and another for endurance), result in a more effective training stimulus for the improvement of performance in highly trained athletes when compared with a more traditional training periodization approach [2]. • Avoidance of the simultaneous development of muscle hypertrophy (~8-10 RM) and aerobic power can reduce the interference phenomenon due to both training intensities inducing opposite adaptations on the same peripheral components. In contrast, due to the compatible training-induced adaptations associated with strength and power and aerobic power, as well as the compatible effects of development of maximal aerobic power, muscle hypertrophy and strength and power stimulus, no interference effects should be expected during the concurrent development of these fitness components [4]. • The residual fatigue caused by a previous endurance session could reduce and/or impair the quantity and quality of subsequent strength training sessions. For highly trained athletes, the strength training sessions should be placed before the endurance sessions, or at least separating both types of training sessions by more than 8 hours. Performing extra endurance training sessions at submaximal intensities that involve mainly non-specific muscle groups, may allow high-level athletes to achieve muscle peripheral adaptations, while the specific muscle groups recover for subsequent sessions of greater intensity [1,3]. • The training to repetition failure approach should be avoided in athletes at any performance level. A concurrent strength and endurance training program using a moderate number of repetitions for not to repetition failure training provides a favorable environment for achieving greater enhancements in strength, muscle power and specific performance when compared with higher training volumes of repetition to failure. The training for the not to repetition failure approach speeds up recovery from strength training, allowing rowers and paddlers to perform subsequent endurance training sessions of higher quality [3]. References 1. García-Pallarés J and Izquierdo M (2011). Sports Medicine. 1;41(4):329-343. 2. García-Pallarés J et al. Eur J Appl Physiol. 110(1):99-107. 3. Izquierdo-Gabarrón M, et al. Med Sci Sports Exerc (2011) 42(6):1191-9. 4. García-Pallarés J et al. (2010). Med Sci Sports Exerc 42(6):1209-14.