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Dosage effects of pre-cooling volume for intermittent-sprint performance in the heat.

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Purpose: The aim of this study was to determine the effects of pre-cooling volume on neuromuscular function and performance in self-paced intermittent-sprint exercise in the heat.
Methods: Ten male, team-sport athletes (20.9 ± 2.6 yrs; 182.1 ± 8.8 cm; 77.8 ± 6.7 kg) completed two 35-min spells of self-paced intermittent-sprint exercise separated by a 15-min recovery on four separate occasions (33.0 ± 0.7°C, 33.3 ± 3.9% relative humidity).Each session was preceded by a pre-cooling intervention designed to be incrementally greater in surface area coverage but still remain practically manageable in the field. Interventions included a control (CONT; no cooling), head (H; pre-cooling with an iced towel), head and hand (HH; pre-cooling with an iced towel and containers of cold water) and mixed-method whole-body (WB; pre-cooling with iced towel, container of cold water, ice vest and ice packs applied to the quadriceps). Cooling was applied for 20-min pre-exercise and reapplied for 5-min mid-exercise. Performance outcomes were determined according to 15-m sprint times, % decline and self-paced distances covered throughout the protocol. Maximal voluntary contractions (MVC) and voluntary activation were recorded pre- and post-intervention and mid- and post-exercise. Core temperature and skin temperature, heart rate, perceptual exertion and thermal stress were recorded throughout.
Results: While no significant differences were observed between conditions for mean and peak sprint times during the exercise protocol (P= 0.08-0.91; Figure 1), the maintenance of sprint speed is reflected following WB pre-cooling with a reduced % decline (P= 0.04). Overall self-paced distances covered were significantly higher with WB (4833 ± 380 m) and HH pre-cooling (4644 ± 360 m) compared to H (4602 ± 448 m) and CONT conditions (4413 ± 545 m), respectively (P= 0.001-0.04). Mean and total hard running distances increased with WB pre-cooling 8.4 ± 4.5% compared to CONT (P= 0.001), further, WB was 5.3 ± 5.8 and 6.7 ± 3.2% greater than HH (P= 0.02) and H (P= 0.001) pre-cooling, respectively (Figure 1). Despite this increased workload, no significant reductions in pre- to post-exercise MVC were detected following WB and HH pre-cooling (P= 0.43-0.93; Figure 1). Core temperature was reduced by 0.1-0.3°C with WB and HH pre-cooling at the completion of the intervention period compared to remaining conditions (P= 0.003-0.04). Moreover, skin temperature was significantly lowered in WB pre-cooling trials (P= 0.001) and overall heart rate responses were significantly suppressed in comparison with CONT (P<0.001).
Conclusion: These data highlight a dose-response relationship between the pre-cooling volume and ensuing exercise performance gains to correspond with a reduced physiological and thermoregulatory response. While part-body pre-cooling may provide some thermal benefit, cooling a larger surface area prior to self-paced intermittent-sprint exercise in the heat may aid in the preservation of higher exercise intensities. Accordingly, a reduced heat stress following pre-cooling may assist in the maintenance of MVC, increasing work output and alleviating centrally-mediated down-regulation of exercise intensity in hot conditions.

Figure 1. Mean ± SD A) individual15 m sprint times, B) individual hard running distances covered (m) and C) mean peak torque (Nm) pre-intervention, post-intervention, mid-exercise and post-exercise for all pre-cooling conditions. * Significant difference compared to pre-intervention values for Head and Head and Hand trials.