The effects of practical torso cooling during soccer-specific exercise in the heat

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Methods summary

Participants

Eight physically active male soccer players (24 ± 2 years, height 1.77 ± 0.07 m, body mass 70.80 ± 7.13 kg) participated in the study. All participants trained at least twice a week, played a full 90-minute match once a week and had not been exposed to high temperatures for 10 days prior to the study.

Experimental design

Participants completed one familiarisation session (maximal sprints on the non-motorised treadmill until habituated, and one 15-min block of the soccer-specific protocol) before completing the two experimental trials in a randomised cross-over design. Each session was separated by at least 6 days and completed at the same time of day to control for the effect of circadian rhythm on body temperature (Reilly & Brooks 1986). In one of the experimental trials participants wore an ice vest for the duration of the exercise (IV) and for the other visit, no ice vest was worn (CON). Both experimental trials took place in a climatic chamber controlled at a temperature of 35 ± 0.2°C and 50 ± 0.5% RH.

Cooling garment

During the IV condition, participants wore an ice vest (Kewl Fit, Techniche International, California, USA) which had four pockets covering both the anterior and posterior section of

the torso. Four sealed packets (378 g) of frozen PC25 were fitted into these pockets, and then applied to participants. At room temperature, the ice vest weighed 1752 g and the dimensions were 56 cm x 32 cm. The ice vest was worn by participants after completing their warm up stretches inside the climatic chamber throughout the first 45 minutes of exercise in the IV trial. The ice vest was replaced with a new vest at the end of the half time break before participants re-entered the climatic chamber and worn for the second 45 minutes of the IV trial.

Experimental procedure

During the two experimental trials, participants were asked to self-insert a rectal probe 10 cm beyond the anal sphincter. Skin thermistors were attached to four body sites (sternum, right forearm, right anterior thigh and right posterior calf) using Transpore^{TM} surgical tape (3M, St. Paul, Minnesota). A chest strap and the corresponding heart rate monitor were secured to measure heart rate (Polar Electro Oy, Kempele, Finland). All participants wore a soccer shirt, shorts, socks and trainers. Capillary blood samples were obtained from participant fingertips before entering the climatic chamber for the warm up. Participants then entered the climatic chamber to perform a 5-min warm up jogging at 8 km·h^{-1} on the motorised treadmill. This was followed by 5-min static stretching inside the climatic chamber. Depending on the experimental trial, participants then either put on the ice vest on top of their soccer shirt or continued to wear their soccer shirt for the duration of the experimental trial. Participants then completed the first 45-min of the exercise protocol, followed by a 15-min rest period outside the heat chamber (~ 23°C, 50% RH). At the beginning of this rest period, another capillary blood sample was obtained. At the end of this 15-min period, during the IV condition, the ice vest was replaced with a new vest to reinitiate the cooling process before participants re-entered the climatic chamber, and was worn for the last 45-min of the exercise protocol. During exercise, water was provided *ad*

libitum. Upon completion of the 90-min exercise protocol, the last capillary blood sample was obtained.

Soccer-specific intermittent-sprint treadmill exercise

Participants completed a laboratory based intermittent-sprint treadmill protocol designed to replicate the demands of soccer (Bradley et al. 2010). The exercise protocol consisted of two 45-min halves separated by a 15-min rest to replicate half time. Each 45-min half consisted of three 15-min blocks repeated six times to form the 90-min protocol. Within the 15-min blocks, there were three 5-min sub cycles which consisted of 11 discrete bouts of activity. The 11 bouts were 3 static pauses, 3 walking bouts, 3 jogging bouts, 1 cruise performed on a motorised treadmill (Pulsar, h/p/cosmos, Germany) and 1 maximal sprint performed on a non-motorised treadmill (Woodway, Vor DEM, Auf Schrauben, Germany). The order of these activities were randomised within each 5-min sub cycle. Treadmill speeds were set on the motorised treadmill for three of the movement activities. These speeds were adapted from data from Van Gool et al. (1988) as used by previous studies (Drust et al. 2000a; Drust et al. 2000b; Price et al. 2009; Clarke et al. 2011). The speeds for each activity for all participants were: walking 4 $km \cdot h^{-1}$, jogging 8 $km \cdot h^{-1}$, cruising 10 $km \cdot h^{-1}$. No speed limitations were assigned to the sprint category as participants were required to sprint at their maximal ability.

Measurements

Core body temperature was monitored by recording rectal temperature (T_{re}). T_{re} and skin temperatures were recorded every three seconds and are reported as five minute averages. Mean weighted mean skin temperature (T_{sk}) was calculated using the calculation of Ramanathan (1964). Capillary blood samples obtained before the warm up, at the beginning of the half time break and after the 90-min exercise protocol were analysed for lactate using a EKF Biosen C-Line (EKF). Heart rate was recorded at the 3rd and 5th minute within each

5-min sub cycle during the exercise session and then averaged, as well as at the beginning and end of the half time break. When performing a sprint, participants were instructed to perform each sprint maximally for 8s once within each 5-min sub cycle. Mean sprint speed and peak sprint speed of every sprint were recorded. TS was rated using a 9-point thermal sensation scale before exercise, during exercise at the end of each 5-min sub cycle, at the beginning and end of the half time break. Participants' ratings of perceived exertion was assessed using Borg's (1982) scale at the end of each 5-min sub cycle during the exercise session.

Results summary

Exercise performance

- Mean and peak sprint speeds were unaffected by the vest overall
- Mean sprint speed was higher during the vest condition compared to CON between 40 and 45 minutes
- Peak sprint speed was higher at the 45th minute in the vest condition compared to CON condition

Physiological responses

- Core and skin temperatures were unaffected by the vest in the first half
- Core and skin temperatures were ~0.2°C cooler with the vest throughout the 2nd half
- Heart rate was unaffected by the vest
- Lactate concentrations were unaffected by the vest

Perceptual responses

- Ratings of perceived exertion were unaffected by the vest in the 1st half and non-significantly lower in the 2nd half
- Perceived thermal sensation was unaffected by the vest in the first half but were improved with the vest throughout the 2nd half