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Limiting the Rise in Core Temperature During a Rugby Sevens Warm-Up With an Ice Vest

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Purpose: To determine how a cooling vest worn during a warm-up could influence selected performance (countermovement jump [CMJ]), physical (global positioning system [GPS] metrics), and psychophysiological (body temperature and perceptual) variables. ***Methods:*** In a randomized, crossover design, 12 elite male World Rugby Sevens Series athletes completed an outdoor (wet bulb globe temperature 23–27°C) match-specific externally valid 30-min warm-up wearing a phase-change cooling vest (VEST) and without (CONTROL), on separate occasions 7 d apart. CMJ was assessed before and after the warm-up, with GPS indices and heart rate monitored during the warm-ups, while core temperature (T_c; ingestible telemetric pill; n = 6) was recorded throughout the experimental period. Measures of thermal sensation (TS) and thermal comfort (TC) was obtained pre-warm-up and post-warm-up, with rating of perceived exertion (RPE) taken post-warm-ups. ***Results:*** Athletes in VEST had a lower ΔT_c (mean [SD]: VEST = 1.3°C [0.1°C]; CONTROL = 2.0°C [0.2°C]) from pre-warm-up to post-warm-up (effect size; ±90% confidence limit: −1.54; ±0.62) and T_c peak (mean [SD]: VEST = 37.8°C [0.3°C]; CONTROL =38.5°C [0.3°C]) at the end of the warm-up (−1.59; ±0.64) compared with CONTROL. Athletes in VEST demonstrated a decrease in ΔTS (−1.59; ±0.72) and ΔTC (−1.63; ±0.73) pre-warm-up to post-warm-up, with a lower RPE post-warm-up (−1.01; ±0.46) than CONTROL. Changes in CMJ and GPS indices were trivial between conditions (effect size < 0.2). ***Conclusions:*** Wearing the vest prior to and during a warm-up can elicit favorable alterations in physiological (T_c) and perceptual (TS, TC, and RPE) warm-up responses, without compromising the utilized warm-up characteristics or physical-performance measures.

Keywords: cooling, heat, elite, telemetric, hyperthermia

During World Rugby Sevens Series (WRSS) match play in temperate (wet bulb globe temperature range: 14–19.2°C) and warm (wet bulb globe temperature range: 25–27°C) conditions, peak player core temperatures (T_c) of 39.6°C and 39.9°C, respectively, have been observed.[1] When T_c is >39°C, intermittent sprint performance can be decreased.[2,3] Given WRSS game demands are predominately glycolytic (eg, passing, tackling, competing at the ruck contest, breakdown, lineout, or scrum as well as running, sprinting, etc) and their execution is a key determinate of WRSS match outcome and game actions,[4–7] large increases in T_c during WRSS match play (eg, $T_c > 39$°C) may limit physical performance.[1]

A WRSS tournament day is typically characterized by 3 matches in close proximity (~3 h between matches) and ~20 to 30 minutes allocated for a team to warm-up prior to each match.[1] The warm-up is implemented to raise skeletal muscle temperature and activate relevant metabolic and neural pathways to prepare players with specificity for the upcoming, predominantly glycolytic, game demands.[4–7] However, it appears on occasions that WRSS match-day warm-ups may increase T_c in excess of what is desirable (eg, ≥39°C).[1] Precooling and midcooling can reduce perceptual and peak body temperature responses to an endurance or intermittent sprint-based exercise bout, eliciting favorable physical performance outcomes (eg, increased distances covered).[2,8–13] Therefore, WRSS practitioners may benefit from body cooling techniques that are compatible within the constraints of WRSS match-day preparations.

Minimal use of precooling techniques was observed during WRSS competition in temperate and warm environments,[1] whereas such interventions are absent from recent WRSS-specific physical preparation recommendations[7], perhaps due to practitioner concerns regarding the potential of precooling to reduce explosive maximal physical performance early within a match.[14,15] A light-weight phase-change cooling garment (eg, an "ice" vest) can moderate T_c increase during a warm-up and positively influence subsequent high-intensity exercise.[16] Although in practice, this vest must not interfere with the desired physical and technical outcomes from an effective warm-up. Given Rugby Sevens is an Olympic sport (2016 and 2020) and that Tokyo 2020 is predicted to be the hottest modern Olympics to date (temperatures: ~30°C and relative humidity: ~75%),[16,17] practically valid empirical data supporting cooling strategy use (eg, as described previously) would be well received by practitioners, although such data are currently lacking from elite Rugby Sevens athletes within an ecologically valid setting.

The experimental aims were therefore to use a phase-change cooling vest within elite WRSS players during an externally valid match-day warm-up. Specifically, the performance (countermovement jump [CMJ]), physical (global positioning system [GPS] metrics), and psychophysiological (body temperature and perceptual variables) responses to wearing the vest relative to the warm-up were examined. It was hypothesized that body temperatures and perceptions of heat/exertion would be favorably influenced, while performance (CMJ) and warm-up characteristics (GPS) would not be negatively influenced, when wearing the vest compared with CONTROL (eg, not wearing the vest).

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Methods

Subjects

Data were collected from 12 elite male squad members (25.0 [4.5] y; 87.5 [8.5] kg; 180.5 [7.6] cm) of a single 2017–2018 WRSS international team (several athletes competed at the 2016 Olympic Games and/or 2018 Commonwealth Games and/or 2018 World Rugby Sevens World Cup) after written informed consent was provided. Ethical approval from the Southern Cross University Human Research Ethics Committee (ECN-17-007) in the spirit of the Declaration of Helsinki was granted.

Design

A standardized, 30-minute, externally valid match-day warm-up (referred to from here on as "warm-up") was performed outdoors on 2 occasions, separated by 7 days, within near identical environmental conditions (wet bulb globe temperatures range on both days: 23–27°C). The warm-ups were performed prior to scheduled training sessions and not during a WRSS tournament, and thus, match-performance metrics (eg, physical performance) are not available. The warm-up involved a specific combination and sequence of drills (including passing, dynamic stretching, defensive structures, and accelerations) leading into contested and contact-specific work, followed by progressive sprints over 30 to 40 m and finishing with team structure drills. With a randomized, cross-over design, squad members completed one experimental trial wearing a phase-change cooling vest (VEST) and another trial without (CONTROL). Specific kinematic and kinetic variables of a CMJ were assessed before and after the warm-ups, with GPS and heart rate (HR) data collected during the warm-ups, whereas T_c was recorded throughout the experimental period (see Figure 1). Six athletes volunteered to have their T_c monitored, 3 in each arm of the cross-over design. Food and fluid intake replicated the teams' typical match-day practice. The same practitioner obtained each measure outlined below, using standardized language and procedures.

Methodology

Core Temperature. Volunteered athletes ingested an e-Celsius telemetric capsule (BodyCap, Caen, France) at 9 PM on the evening prior to the experimental trials, ensuring that a minimum of 8 hours (to allow transit into the gastrointestinal tract[17,18]) was observed prior to establishment of baseline values (from 05:00 on each day) for use within subsequent statistical modeling. T_c was sampled at 30-second intervals, with data downloaded at the end of the warm-up via a wireless data receiver (e-Viewer; BodyCap). Capsules underwent an individual 3-point calibration, as described previously.[1,18] The e-Celsius system has been shown valid and reliable for running exercise when adopting the previously approach[18] while excellent validity (intraclass correlation coefficient [ICC]: 1.00), test–retest reliability (ICC: 1.00), and inertia were found in water bath experiments between 36°C and 44°C,[19] and it has been used previously within elite WRSS athletes during match play.[1]

Specific predefined time periods relative to T_c were employed within analyses (see Figure 1):

- Baseline: 05:00 to 07:00
- Pre-warm-up: 07:00 to 08:10
- Warm-up: 08:10 to 08:40

VEST. The vest (TechNiche Hybrid Cooling Vest Product 4531; TechNiche International, Vista, CA) can be used to augment evaporative heat loss (eg, the vest is immersed in water prior to use) and through phase-change heat lost whereby the frozen inserts (Cool Pax Product 7065V; TechNiche International) are melted by body heat. In this study, the vest was used only in a phase-change capacity. Athletes wore the vest from 7 AM (commencement of team meeting), during travel to the training pitch, and throughout the warm-up (8:10–8:40 AM), which was a total duration of 100 minutes, as per Figure 1. Four frozen (freezer temperature: −20°C for at least 48 h) Cool Pax inserts (surface temperature: −15.4°C [2.1°C]) were inserted into the vest (itself stored as per Cool Pax inserts) at ~06:55. The cooling inserts were not replaced during the 100 minutes of wearing the vest and were not fully melted by the end of use. (Surface temperature was not taken.) The vest was worn under the team's official 2017–18 WRSS warm-up jersey next to the skin, but on top of a player's GPS vest.

Global Positioning System. External load during the warm-up was measured using 5-Hz GPS devices (SPI HPU; GPSports, Canberra, Australia) that were interpolated to 15 Hz by the manufacturer's software (Team AMS 2016.6; GPSports). These devices have acceptable accuracy for distance (coefficient of variation [CV, in percentage]: 0.14–3.73%) and speed (CV: 4.22–9.52%), and reliability for distance (CV: 0.34–3.81%) and speed (CV: 3.19–6.95%).[20] Each unit was assigned to an individual athlete and worn in their GPS vest, positioning the unit between their scapula blades. Following the warm-up, devices were removed, and the data were exported using the manufacturer's software. Metrics exported from the GPS data included measures of total distance (m), relative distance (m/min) high-speed running distance (>5 m/s), very high-speed running distance (>6.7 m/s), number of accelerations per minute (>2.5 m/s^2), and number of decelerations per minute (<2.5 m/s^2). HR was collected using a fitted chest strap (Polar T34, Kempele, Finland) worn beneath the athlete's GPS vest. This chest strap recorded HR data to the GPS device at 1 Hz. HR data were extracted using the GPS manufacturer software, where average HR (in beats/min) and maximum HR (beats/min) were included in the present study.

Countermovement Jump. Countermovement jump were performed using dual portable force platforms (Pasco Pasport Force Platform PS-2141; Pasco, Roseville, CA) sampling at 1000 Hz. Prior to each set of CMJ (see Figure 1), athletes completed 3 full range lunges each side, 10 "footsies" (small jumps with straight knees and stiff ankle, emphasizing dorsiflexion and plantar flexion), and 3 submaximal CMJ (with wooden dowel) as per the athlete's normal routine before a CMJ. A wooden dowel was provided to athletes, placed across the back and held in a typical back-squat position. Athletes were instructed to limit the dowel movement before, during, and after CMJ execution. After placing one foot on each force platform, athletes stood motionless for 3 seconds to determine body mass. They were then instructed to drop into a squat position and then immediately jump as high as possible with triple extension at the ankle, knee, and hip in an explosive concentric action while avoiding bending the knees when airborne. Upon landing, they were instructed to stick the landing and hold for 5 seconds. Three CMJs were performed pre-warm-up and post-warm-up. The athletes completed this specific CMJ protocol for monitoring on all training days and while away for WRSS tournaments; thus, they are well familiarized to this specific CMJ protocol. Data were recorded and extracted using the manufacturer's proprietary software (Pasco capstone; Pasco) and commercially

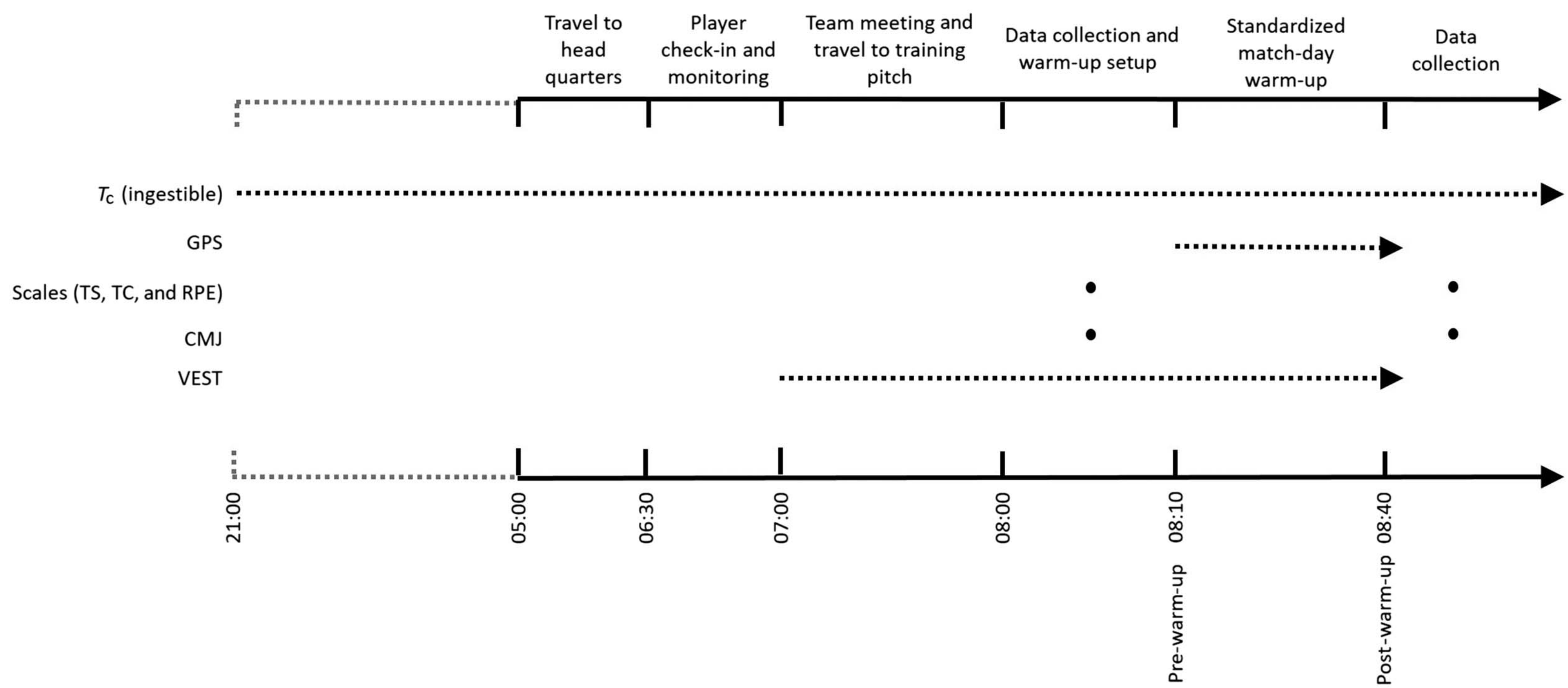

Figure 1 — Experimental schematic. T_c indicates core temperature (ingestible telemetric pill); GPS, global positioning system; TS, thermal sensation; TC, thermal comfort; RPE, rating of perceived exertion; CMJ, countermovement jump; VEST, phase-change cooling vest.

available software (Forcedecks 3.1, Forcedecks, London, UK). Utilized metrics exported/calculated from the CMJ data include (with intraday reliability CV, and ICC lower and upper confidence limits provided) peak velocity (in m/s; CV: 2.77–6.76%; ICC: .17–.89), peak power (in W; CV: 4.67–11.56%; ICC: .06–.86 and in W/kg; CV: 4.64–11.48%; ICC .32–.92), jump height (in cm; CV: 6.31–15.80%; ICC: .13–.88), flight time (in s; CV: 2.41–5.88%; ICC: .52–.95), eccentric duration (in ms; CV: 2.72–6.65%; ICC: .40–.93), eccentric/concentric duration (in %; CV: 2.72–6.64%; ICC: .24–.90), and rate of concentric power development (in W/s; CV: 5.77–14.38%; ICC: .23–.77 and in W/s per 100 ms; CV: 8.54–21.72%; ICC: .21–.90).

Perceptual Measures. Thermal sensation (TS) was measured using a 17-point category ratio scale (where 0 = "unbearably cold" and 8 = "unbearably hot").[21] Thermal comfort (TC) was measured using a 10-point category ratio scale (where 1 = "comfortable" and 10 = +1 above "extremely uncomfortable"). Rating of perceived exertion (RPE) was measured using an 11-point category ratio scale (where 0 = rest and 10 = maximal).[22] These measures were collected as per Figure 1.

Statistical Analysis

Statistical analyses were performed using the SPSS version 24 (IBM, SPSS Inc, Chicago, IL) and magnitude-based inferences customizable spreadsheets, using the raw data.[23] Initially, descriptive statistics were generated, and normality checked using quantile–quantile plots.[24] Descriptive statistics are reported as mean (SD) and range (from minimum to maximum). GraphPad Prism 4 (GraphPad Software, San Diego, CA) was used to create Figure 2. Individual player T_c was determined and averaged for each predefined time period. At each time period, the individual player change (Δ) relative to baseline and other time periods was calculated. In addition, peak T_c values from the warm-up period were also extracted and compared with other time periods. Linear mixed models were used to determine if there were any differences between condition (CONTROL and VEST) and across time (relevant predefined time periods) for T_c, GPS, TS, TC, RPE, and CMJ. GPS data were analyzed for between-condition (CONTROL and VEST) differences. Fixed and random effects for the linear mixed model were fit for each dependent variable.[25] The most appropriate model was chosen using the smallest Hurvich and Tsai criterion.[26] The least squares mean test provided pairwise comparisons between the fixed effects. Step-down Hommel *P* value adjustments were used for post hoc analysis in the event of a significant main and/or interaction effect.[27] Normality and homogeneity of variance of the residuals were checked using quantile–quantile plots and scatter plots, respectively, and deemed plausible in each instance. Cohen *d* effect sizes, and 90% confidence limits were obtained using the magnitude-based inference spreadsheets and categorized using standardized thresholds of <0.2, trivial; 0.21 to 0.60, small; 0.61 to 1.20, moderate; 1.21 to 2.0, large; and >2.0, very large.[23] Differences were considered real if there was a >75% likelihood of the observed effect exceeding the smallest worthwhile effect (0.20),[1] using the following qualitative descriptions: 75% to 95%, likely; 95% to 99.5%, very likely; and >99.5%, most likely.[23] Data are reported as effect size; ±90% confidence limit.

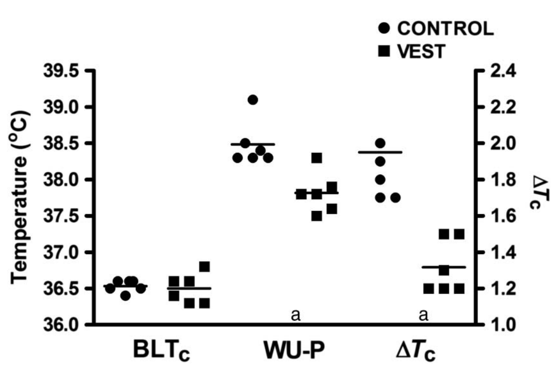

Figure 2 — T_c responses to warm-up. BLT_c indicates baseline; T_c, core temperature; WU-P, peak T_c during warm-up; ΔT_c, change in T_c from BLT_c compared with WU-P; VEST, phase-change cooling vest; CONTROL, without phase-change cooling vest. Filled circles represent individual CONTROL data. Filled squares represent individual VEST data. Black horizontal line represents the mean. [a] Differences between CONTROL and VEST (most likely). Note: Only 3 players from each arm of the crossover ingested the telemetric T_c pill.

Results

The between-group (CONTROL vs VEST) and across-time (pre-warm-up and post-warm-up) comparisons of the perceptual and performance data are presented in Table 1. The between-group (CONTROL vs VEST) comparisons of the GPS measurements are presented in Table 2.

Core Temperature

Players in VEST had a most likely lower ΔT_c (mean [SD]: VEST = 1.3°C [0.1°C]; CONTROL = 2.0°C [0.2°C]) pre-warm-up versus post-warm-up (effect size; ±90% confidence limit = −1.54; ±0.62) and T_c peak (VEST = 37.8°C [0.3°C]; CONTROL = 38.5°C [0.3°C]) during warm-up (−1.59; ±0.64) compared with CONTROL (see Figure 2). This was seen with a trivial difference (−0.18; ±1.2) between VEST and CONTROL during the pre-warm-up period (07:00–08:10).

Perceptual Measures

There was a most likely decrease in ΔTS (−1.59; ±.72) and ΔTC (−1.63; ±0.73) in VEST compared with CONTROL, pre-warm-up to post-warm-up. Furthermore, players in VEST had a most likely lower post-warm-up RPE compared with CONTROL (−1.01; ±0.46).

Performance and GPS Measures

There was a trivial effect of VEST on the CMJ performance measures (Table 1). All players demonstrated a *likely* increase in jump height (4.4 [3.5] cm) from pre-warm-up to post-warm-up (0.29; ±0.11) irrelevant of condition. There were only trivial differences regarding the effect of VEST on all GPS measures (Table 2).

Discussion

Wearing a phase-change cooling vest prior to and during a match-specific Rugby Sevens warm-up can elicit favorable alterations in physiological (peak and ΔT_c; Figure 2) and perceptual (TS, TC and RPE; Table 1) warm-up responses, without compromising warm-up characteristics (GPS metrics; Table 2) or physical performance (CMJ metrics; Table 1), in acceptance of the experimental

Table 1 Perceptual and Performance Measurements for CONTROL and VEST for Pre-Match-Day and Post-Match-Day Warm-Ups

	CONTROL		VEST	
	Pre-warm-up	Post-warm-up	Pre-warm-up	Post-warm-up
TS	4.5 (0.4)[a] 1.0 (4.0–5.0)	5.9 (0.5)[a] 2.0 (5.0–7.0)	3.4 (0.5)[a] 1.5 (2.5–4.0)	4.6 (0.6)[a] 2.0 (3.0–5.0)
TC	2.5 (0.5)[a] 1.0 (2.0–3.0)	4.7 (0.8)[a] 2.0 (4.0–6.0)	1.2 (0.4)[a] 1.0 (1.0–2.0)	3.1 (0.5)[a] 2.0 (2.0–4.0)
RPE	—	5.8 (1.2)[a] 3.0 (4.0–7.0)	—	4.3 (1.4)[a] 4.0 (3.0–7.0)
Peak velocity, m/s	2.72 (0.11) 0.33 (2.54–2.87)	2.89 (0.08) 0.34 (2.67–3.01)	2.77 (0.12) 0.41 (2.55–2.96)	2.91 (0.17) 0.58 (2.72–3.30)
Peak power, W	4434 (467) 1427 (3745–5172)	4893 (530) 1835 (4228–6063)	4450 (499) 1413 (3663–5076)	4911 (537) 1438 (4213–5651)
Peak power, W/kg	50 (4) 15 (43–58)	55 (3) 12 (48–62)	52 (4) 16 (45–61)	57 (7) 23 (48–71)
Jump height, cm	34.3 (3.2)[b] 9.3 (29.6–38.9)	39.1 (2.7)[b] 10.5 (32.2–42.7)	35.9 (3.0)[b] 9.6 (30.5–40.1)	39.8 (5.3)[b] 18.4 (34.1–52.5)
Flight time, s	0.66 (0.07) 0.24 (0.54–0.78)	0.73 (0.08) 0.26 (0.58–0.84)	0.71 (0.11) 0.35 (0.58–0.93)	0.77 (0.10) 0.33 (0.66–0.99)
ECC, ms	557 (61) 205 (453–658)	538 (52) 138 (458–596)	530 (79) 270 (391–661)	510 (61) 217 (363–580)
ECC/CON, %	178 (15) 51 (160–211)	180 (14) 43 (159–202)	181 (15) 51 (156–207)	183 (13) 39 (163–202)
RPD, W/s	17,975 (2399) 8321 (14,523–22,844)	20,904 (3630) 13,268 (17,568–30,837)	19,730 (4459) 14,382 (15,194–29,575)	23,076 (4713) 13,900 (18,314–32,213)
RPD 100, W/100 ms	16,043 (3582) 10,422 (11,534–21,976)	19,398 (4410) 14,651 (12,284–26,935)	19,415 (7764) 24,042 (11,983–36,025)	23,113 (8204) 23,245 (15,137–38,382)

Abbreviations: CONTROL, without phase-change cooling vest; ECC, eccentric; ECC/CON, eccentric/concentric duration; RPD, rate of power development; RPE, rating of perceived exertion; TC, thermal comfort; TS, thermal sensation; VEST, phase-change cooling vest. Note: Pre-warm-up and post-warm-up measures were at approximately 8:10 and 8:40 AM, respectively, as per Figure 1. Data are expressed as mean (SD) and range (minimum to maximum value). Between-conditions (CONTROL and VEST) and across-time (pre-warm-up and post-warm-up) substantial differences are also shown. [a] Differences between CONTROL and VEST (most likely). [b] Differences between time points (pre-match-day and post-match-day warm-ups) (likely).

Table 2 Global Positioning System Measurements for CONTROL and VEST

	CONTROL	VEST
Total distance (m)	1707 (150) 472 (1536–2008)	1635 (90) 281 (1486–1766)
Relative distance (m.min^{-1})	69.8 (6.7) 18.3 (59.7–78.0)	67.2 (8.3) 25.2 (53.4–79.0)
HSR distance, m	195.4 (38.1) 138.0 (155.8–293.8)	182.7 (38.3) 131.8 (100.0–231.9)
VHSR distance, m	66.7 (36.4) 99.6 (19.3–119.0)	53.9 (35.1) 105.5 (2.7–108.1)
Avg HR, beats/min	135 (15) 52 (99–151)	134 (19) 71 (99–170)
Max HR, beats/min	175 (12) 40 (145–185)	165 (18) 54 (130–184)
Acc/min, n	2.1 (0.3) 0.9 (1.6–2.5)	1.9 (0.4) 1.0 (1.4–2.5)
Dec/min, n	1.1 (0.3) 0.8 (0.6–1.4)	0.9 (0.4) 1.1 (0.5–1.6)

Abbreviations: Acc, acceleration; Avg HR, average heart rate; Dec, deceleration; HSR, high-speed running (>5 m/s); Max HR, maximum heart rate; VHSR, very high-speed running (>6.7 m/s); Acc/min, >2.5 m/s^2; Dec/min, <2.5 m/s^2. Note: Changes in all measurements were trivial (effect size <0.2). Data are expressed as mean (SD) and range (minimum to maximum value).

hypothesis. Importantly, independent of condition, there was a substantial increase in CMJ height by ~5 cm (0.29; ±0.11) from pre-warm-up to post-warm-up, indicating that the warm-ups were effective in augmenting CMJ physical performance. This is likely via increased muscle temperature and activation of various metabolic and neural pathways (although not specifically measured within this design). The data suggest practitioners could use this intervention with their athletes to limit the rise in T_c during a warm-up.

Through wearing the vest, T_c was ~0.7°C lower on average in VEST compared with CONTROL (VEST: 37.8°C [0.3°C]; CONTROL: 38.5°C [0.3°C]) post-warm-up (Figure 2). This attenuated increase in T_c post-warm-up between conditions could extend time taken to reach a T_c (eg, ≥39°C; subject to individual variation) that may restrict repeated sprint performance during a match,[2] without compromising initial lower body power (Table 1). On a WRSS match day, the employed warm-up (which was replicated within the present experimental design) can elicit a T_c response of 39°C; a magnitude of change that has been associated with reductions in repeated sprint-based performance and capacity.[2] However, wearing the vest during the experimental warm-up ensured T_c did not exceed this proposed performance-impairing threshold (eg, ≥39°C), yet such a response was seen in one player in CONTROL (Figure 2). Importantly, athletes reported that wearing the vest was not uncomfortable nor did it impede their ability to fully engage with or execute any aspect of the warm-up. Indeed, athletes were willing when directly asked to wear the vest in future WRSS tournament warm-ups without concern.

Wearing the vest between 7:00 and 8:10 AM did not elicit a favorable body temperature response between conditions (eg, a precooling effect was not seen) prior to warm-up commencement (08:10). Practically, this data suggest that the vest may not need to be worn for a period prior to the warm-up (in this case, 70 min prior to warm-up commencing) if the major goal is to physically reduce body temperature postwarm-up. However, as outlined in Table 1, TS and TC are reduced in VEST compared with CONTROL, immediately before the warm-up at 08:10. Reductions in TS without accompanying physical body temperature decreases can within some scenarios prove ergogenic to exercise performance in the heat.[10,11,28–30] Therefore, practitioners must consider carefully their rationale for cooling vest use relative to their desired performance outcomes and the complex interaction between peripheral and central thermoregulatory factors.[10,13]

This approach could be trialed across a simulated WRSS match day to determine any performance changes in response to the observed cooling vest mediated alterations in peripheral and central thermoregulatory factors. These experimental effects are from a single commercially available vest. The phase-change material used, the quantity and location of phase change material within a vest, and the vest design (fit, materials used, etc) itself vary across commercially available garments. Further research that optimizes the combination of these factors with specificity to the unique somatotypes seen within the present and other elite athletes is required, given the variety of body compositions/shapes across the elite sport continuum. Finally, a greater array of externally valid physical and technical performance measures could be employed, to more robustly determine any unwanted effects from wearing the cooling vest during the warm-up.

Practical Applications

The commercially available vest can be comfortably worn within WRSS warm-up contexts to favorably influence perceptual and body temperature responses, without compromising the identified warm-up characteristics or physical performance (lower body power) at the end of the warm-up.

Conclusions

Wearing the vest prior to and during a warm-up can elicit favorable alterations in physiological and perceptual warm-up responses, without compromising the identified warm-up characteristics or physical performance (lower body power) at the end of the warm-up.

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