

Effect of Heat Acclimation among International Women Rugby Sevens Players

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Heat Acclimation | Elite | Rugby Sevens

Headline

Elite Rugby Sevens match play is characterized by high intensity running, accelerations, decelerations and collisions (11), and repeated high-intensity efforts (4, 5). Due to the popularity of Rugby Sevens, tournaments are played worldwide, including in hot and humid environments (e.g. 45°C in Sydney during Sevens 2020). When training or competing in the heat, physiological strain can lead to impairments in endurance exercise capacity (9). Elevated whole-body temperature can also impair repeated sprint performance through a reduction in arterial oxygen delivery, greater reliance on anaerobic energy provision and accelerated accumulation of atomic hydrogen (6). Such heat related physiological impairments could impact performance in Rugby Sevens.

Training strategies to mitigate the effects of heat stress on physical performance should be explored in the context of Rugby Sevens. If such strategies are effective, they could help staff and players to adequately prepare for the next Olympic Games in Tokyo, where similar conditions will be encountered (10). Recently, equipped with an environmental chamber (hypoxia, heat and relative humidity), the French Rugby Union investigated the potential effect of high-intensity interval training (HIIT) performed in the heat before the 2019 Dubai Sevens tournament.

Aim

The purpose of this study was to introduce a heat acclimation protocol with the French elite female Rugby Sevens players and to assess its effectiveness on reducing thermal sensation and discomfort before the Dubai Sevens tournament.

Methods

Athletes. Twenty-three female Rugby Sevens players (25 ± 5 y; 169.2 ± 4.9 cm, 65.6 ± 4.9 kg) provided written informed consent to participate in this study. The players were from the two teams that participated in the Dubai Sevens tournament (December 2019).

Design. Players were randomly assigned into one of two groups: Acclimation Group (AG, n=10) which carried out five sessions of heat acclimation; Control Group (CG, n=13) which did not perform any heat acclimation training. Upon arrival in Dubai, the two groups completed identical training programs on the first three days: one training session per day, at the same time and on the same pitch.

External load monitoring. During each training session, players wore a 16-Hz global positioning system (GPS) unit (SensorEverywhere; Digital Simulation, France) capturing the data for further analysis into Sensor-Everywhere software (Digital Simulation, France). The GPS unit fitted into a bespoke pocket in their playing jersey positioned on the upper thoracic spine between the scapulae. High-speed was defined as the speed above individual maximal aerobic speed and very-high-speed as the speed above 85% of maximal sprint speed.

Heat acclimation. During the ten days preceding travel to Dubai, five heat acclimation sessions of one-hour were performed. For all sessions, players undertook a fifteen min warm-up consisting of dynamic stretching, sub-maximal running, cycling and technical collision drills. After that, three working sets (four min between-set recovery) consisting of 12 x 6-s all-out efforts interspaced by 24 s of recovery. All-out efforts were as follow (Figure 1):

1. Contacts were done within a tactical situation played in a small area (4 x 4m) from various open starts. The situation was played as a 1 + 1 vs. 2. The first attacking player was playing a 1 vs. 2 situation with the defenders. The first attacking support of the ball carrier was then allowed to play, thus creating a ruck. The situation stopped when the ruck was completed.
2. Cycling consisted on 1 all-out sprint on Wattbike Pro.
3. Sprinting consisted on 1 all-out sprint on a non-motorized curved treadmill.

Heat stress was gradually increased from 25 to 35°C with 50% to 60% relative humidity.

Thermal sensation and comfort. During the first three days after arrival in Dubai, thermal sensation (TS) and thermal comfort (TC) were measured. Immediately after each training sessions, the two groups answered a thermal sensation rating (TS; 1-7 scale) (1) and thermal comfort rating representing the entire session (TC; 1-7 scale) (3) as presented in Table 1. The average temperature and relative humidity were recorded over the three days.

Statistical Analysis

A magnitude-based inferential approach to statistics was adopted based on recent recommendations (2,13). Effect sizes (ES) were quantified to indicate the practical meaningfulness of the differences in mean values. The ES was classified as trivial (<0.2), small (0.2 to ,0.6), moderate (0.6 to ,1.2), large (1.2 to ,2.0), and very large (2.0–4.0) based on the guidelines of Batterham and Hopkins (7). If the 90% confidence intervals overlapped small positive and negative values, the magnitude was deemed unclear; otherwise, that magnitude

Table 1. Thermal sensation rating (TS; 1-7 scale) and thermal comfort rating (TC; 1-7 scale)

Thermal Sensation Rating		Thermal Comfort rating	
Hot	7	Much too warm	7
Warm	6	Too warm	6
Slightly warm	5	Comfortable warm	5
Neutral	4	Comfortable	4
Slightly cool	3	Comfortable cool	3
Cool	2	Cool	2
Cold	1	Too cool	1



Fig. 1. Figure 1 - Different efforts during the heat acclimation sessions at the National French Rugby Center

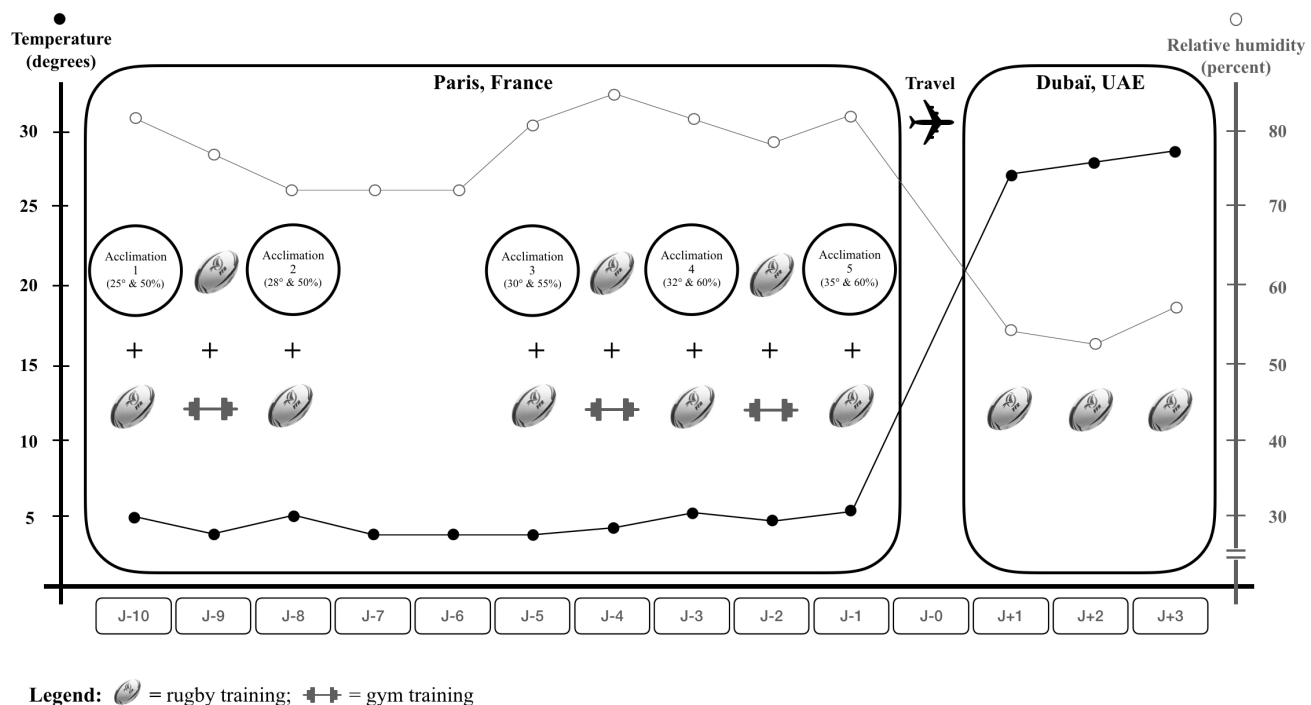


Fig. 2. Experimental design and variation in relative humidity and temperature

was deemed to be the observed magnitude (7). The chances that the changes in performance were greater than the smallest worthwhile change (0.2 multiplied by the between-subject SD, based on Cohen's d principle), similar, or smaller than the other contextual variables were calculated. Quantitative chances of greater or smaller changes in performance variables were assessed qualitatively as follows: 0 to ,1%, almost certainly not; 1 to ,5%, very unlikely; 5 to ,25%, unlikely; 25 to 75%, possibly; ,75 to 97.5%, likely; ,97.5 to 99%, very likely; and ,99%, most likely (7).

Results

Temperature and relative humidity. During the ten days preceding the departure, in France, the average temperature was $5 \pm 1^\circ\text{C}$ and relative humidity was $80 \pm 10\%$. In Dubai, the average temperature and relative humidity during trainings were: Day 1, 26°C and 55% of relative humidity; Day 2, 27°C

and 52% of relative humidity; Day 3, 28°C and 57% of relative humidity. Figure 2 shows the variation in relative humidity and temperature.

External load. External load for all training sessions is presented in Figure 3. The average total distance (6625 ± 618 vs. 5743 ± 618 m; $ES = 1.54 \pm 0.46$) and high-speed running distance (1366 ± 346 vs. 867 ± 218 m; $ES = 1.71 \pm 0.36$) covered during the first three sessions in Dubai were most likely higher in AG compared with CG.

Thermal sensation and thermal comfort. Average thermal sensation and thermal comfort post-training are reported in Figure 4. The AG reported most likely lower thermal sensation ($ES = -1.3 \pm 0.2$) and better thermal comfort than CG ($ES = -1.0 \pm 0.1$).

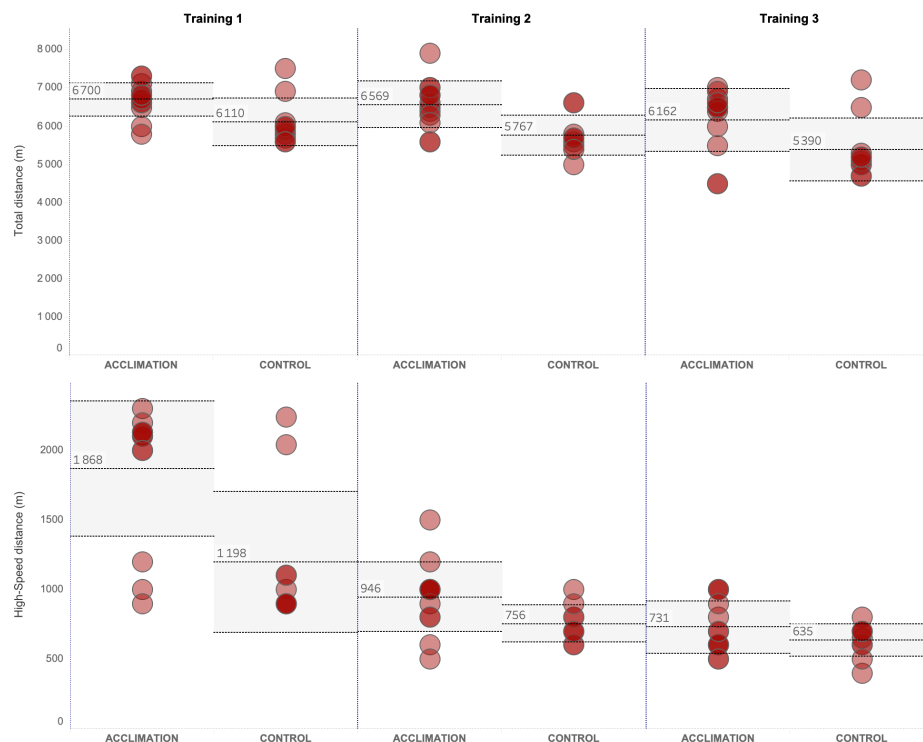


Fig. 3. External load for the three first training sessions in Dubai for the Acclimation and Control groups

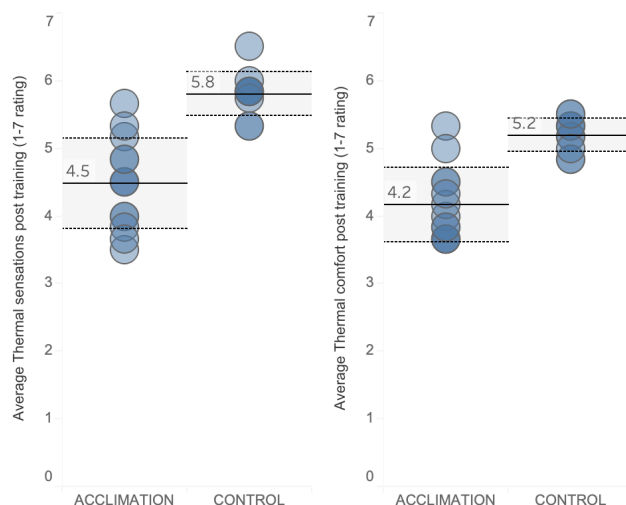


Fig. 4. Average thermal sensation and thermal comfort post-training in Dubai for the Acclimation and Control groups

Discussion

This case study demonstrated that undertaking five heat acclimation sessions in the ten days preceding a competition in the heat can moderately-to-largely improve thermal sensation and comfort among elite women Rugby Sevens players.

During the ten days preceding travel, the acclimation group performed five heat training sessions consisting of 3 sets of 12 x 6-s all-out contact, cycling and sprinting efforts. While many studies used low-intensity long-duration training in the heat to favor different performances, some studies have found that high-intensity intermittent training in the heat – even of short

duration (30-45 min) can achieve similar adaptations (8) and result in increased intermittent running exercise capacity in women athletes (12). Also, we thought that training designed around repeated high intensity efforts would more closely replicate the training and game demands of Rugby Sevens, which predominantly involves accelerations and contact efforts (5).

The group that performed heat acclimation reported better thermal sensation and thermal comfort when training in the heat of Dubai compared with the control. These data suggest that the protocol was effective at lowering thermal perception, despite no extreme environmental stress on the competition site (26-28°C, ~ 50% relative humidity). Moreover, this better thermal perception in Dubai was reported despite the acclimation group trained harder (more total distance and high-speed distance covered) than the control group. This case study adds to the literature currently available and may be of particular interest to coaches and staff preparing competitions to be held in hot environments such as the Tokyo 2021 Olympics.

Practical Applications

- Before training in a hot outdoor environment, five sessions of HIIT-oriented heat training can moderately-to-largely reduce thermal perception.

Limitations

- A main limitation of this study is the absence of physical and physiological performance measurement. Due to the ecological setup and elite level population of this study, it was unfortunately not possible.
- The heat stress when training on competition site was lower than expected (~ 26-28° vs. >35° usually at the same period), potentially limiting the between-group differences.

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