Core temperature parameters in elite sailors during the Tokyo 2020 Olympic Test Event.

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ABSTRACT

Objective On the eve of the summer Olympic Games in Tokyo research focus has shifted on the core temperature responses of elite athletes competing in the heat. In the absence of the field data of core temperature during Olympic sailing competition aim of the present study was to identify core temperature response during the Tokyo 2020 Olympic Test Event.

Methods Four elite athletes from Olympic sailing (177.5±5.2 cm, 71.1±7.4 kg, body mass index 22.5±1.4 kg/m2, 24.8±3.7 yrs, VO2max 50.6±7.2 mL/min/kg)): 2 males and 2 females participated in the study. Core temperature was recorded using e-Celsius ingestible capsules, heart rate using a heart rate monitor. Ambient conditions in direct sunlight were measured using portable meteo station.

Results Core temperature was recorded at water environment via an ingestible capsule in 4 sailors during the training (T), and competition (C), respectively. Ambient conditions in direct sunlight were hot and humid: during training temperature were 30.9°C±1.7°C and relative humidity 81.4%±2.8%, corresponding to a wet-bulb globe temperature of 41°C±4°C and during competition temperature was 31.2°C±2.3°C and relative humidity 87.2%±4.4%, corresponding to a wet-bulb globe temperature of 45.2°C±8.9°C. Core temperature increased during training reaching higher peak values (38.6°C±0.4°C) and during competition (38.9°C±0.4°C). The highest temperature recorded was 39.4°C (C).

Conclusion The current study provides unique information into the core temperature parameters under heat stress in elite Olympic sailors during training and race event.

KEYWORDS: elite athletes, olympic sailors,body temperature, heat adaptation

What are the findings?

► The highest temperature recorded during the study was 39.4°C.

► Core temperature increased during training reaching higher peak values 38.6±0.4 °C and during competition 38.9±0.4 °C.

How might it impact on clinical practice in the future?

► Current data provide the insights of the level of the heat stress in Olympic sailors and can help to elaborate recommendations, guidelines and policies for the athlete health protection.

INTRODUCTION

Sailing is one of the oldest sports presented in the summer Olympic Games program. Currently Olympic program counts ten different sailing classes During training and competition in the summertime athletes are exposed to hot and humid environment during long periods of time and are under the risk of hyperthermia. In the literature there are limited information related to environmental studies, heat adaptation and hydration requirements compared with endurance sports [1-4].

Additional complications in sailing are created due to neoprene wetsuits and lifeguard jackets which use is mandatory by rules https://www.sailing.org/40174.php. Olympic Games in Tokyo 2020 is supposed to be the hottest in the history of the modern Olympic games with the average temperature around 30 °C with the highest value 36-37 °C according to the august 2018 with the 73% of average humidity. In such extreme environmental and competition conditions (exercise, wetsuits, lifeguard jackets) risk of heat stress increases. Latest research in thermoregulation and heat stress are based on non-invasive core temperature dynamic measurements [5-7]. Innovative technologies allowed to perform measurements during training and competition and provide the insights of the level of the heat stress under certain environment and load and help to elaborate recommendations, guidelines and policies for the athlete health protection. For the moment in the literature we found limited information of the core temperature response during sailing trainings and competitions events. [4]

METHODS

Participants

Four elite athletes from Olympic sailing (177.5±5.2 cm, 71.1±7.4 kg, body mass index 22.5±1.4 kg/m2, 24.8±3.7 yrs, VO2max 50.6±7.2 mL/min/kg)): 2 males and 2 females participated in the study. One male and female from RSX and one male and one female from Laser. Detailed characteristics of the athletes are listed in Table 1. Written informed concern were obtained before the study from each participant. All procedures complied with the Declaration of Helsinki regarding human experimentation.

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Table 1. Athlete physical characteristics.

Group description	
Age, years	24,8 ± 3,7
Height, cm	177,5 ± 5,2
Weight, kg	71,1 ± 7,4
VO2 max	50,6 ± 7,2
BMI, h/m2	22,5 ± 1,4
Fat mass, %	13,3± 4,2

Project design

This observational study was designed to evaluate physiological response of Olympic sailors during training period before Tokyo 2020 Olympic Test Event and during the competitions that took place from 9 to 22 of august in Enoshima, Japan. Ambient conditions in direct sunlight were hot (31±2 °C) and relative humidity (84±5 %), corresponding to a wet-bulb globe temperature of 43±7 °C. Detailed characteristics of the environment are listed in Table 2. Additional difficulties are related with dependence from the wind conditions of training and competition. They can be canceled or continue during more than 4 hours.

Table 2. Environmental characteristics during training and competition.

	Training	Competitions
Air temperature, °C	30,9 ± 1,17	31,2 ± 2,27
Humidity, %	81,4 ± 2,74	87,2 ± 4,37
Heat Index, °C	41 ± 4,03	45,2 ± 8,86
Wing strength, m/s	10,7 ± 6,82	6,7 ± 3,35
Wave height, m	2,69 ± 0,40	1,07 ± 0,30

Data collection

Core temperature was recorded using e-Celsius ingestible capsules and e-Viewer receivers (BodyCap, Caen, France) with disctness one recording every 30 - 60 s. Every morning during morning check up before breakfast every athlete were receiving the capsule and was taking it together with a small amount of room temperature water. The temperature capsules were ingested at least 3 h before sailing but sometimes it wasn't enough for the capsule to progress sufficiently along the gastrointestinal tract, in this case we used sensor from the previous day that already achieved intestine [8]. Data were stored in the capsule and synchronized twice a day: after lunch and before sleep. Heart rate and GPS data were recorded using heart rate monitors (Garmin, USA) using heart rate strap. Environmental data were recorded using (Esa Coach, Italy).

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Data analyses

Means and standard deviation analysis was used to rate sample characteristics. Statistical analysis was performed using GraphPad Prism version 5.01 for MacOs (GraphPad Software, Inc., La Jolla, CA, USA).

RESULTS

Core temperature increased during training reaching higher peak values 38.6°C±0.4°C and during competition 38.9°C±0.4°C. The highest temperature recorded at competition was 39.4°C. After the discussion of recorded temperatures at the training with medical commission of the world sailing the decision to cancel life west were taken and it helped to decrease the core temperature in athletes in the competition even with worse meteorological condition (heat, humidity). Summary of the results are listed in Table 3. Additionally athletes are divided by class and by gender. Example of native records of heart rate and core temperature presented in Figure 1.

Table 3. Summary of the physiological data during training and competition in all athletes. (In the brackets are listed number of observations).

	Preparation period		Gender		Sailing class	
Internal	**Training (4)**	**Competitions (4)**	**F (2)**	**M (2)**	**RSX (2)**	**Laser (2)**
Temperature mean, °C	37,6 ± 0,5	37,6 ± 0,3	37,3 ± 0,1	37,9 ± 0,3	37,5 ± 0,4	37,7 ± 0,5
Temperature max, °C	38,2 ± 0,6	38,6 ± 0,4	38,3 ± 0,5	38,5 ± 0,5	38,4 ± 0,5	38,3 ± 05
Temperature min, °C	36,7 ± 1	35,0 ± 3	35,1 ± 2,7	36,6 ± 1,7	36,0 ± 2,2	35,4 ± 2,7
HR mean, bpm	129,6 ± 10,2	124,5 ± 8,1	135,8 ± 6,3	122,4 ± 8,0	127,1 ± 10,2	134,5 ± 3,5
HR max, bpm	189,0 ± 6,6	184,0 ± 3,8	135,8 ± 4,8	122,4 ± 3,8	127,1 ± 6,7	134,5 ± 3,0
HR min, bpm	70,5 ± 6,6	64,3 ± 7,8	70,3 ± 6,7	67,5 ± 7,8	67,7 ± 7,6	75,0 ± 2,0
Covered distance, km	10,64 ± 2,65	-	10,54 ± 2,75	10,81 ± 2,44	10,69 ± 2,92	10,40 ± 0,10
Time, min	1:38:17 ± 0:24	3:28:45 ± 0:44	2:33:44 ± 1:00	2:40:40 ± 1:10	2:16:00 ± 0:54	3:04:55 ± 1:09

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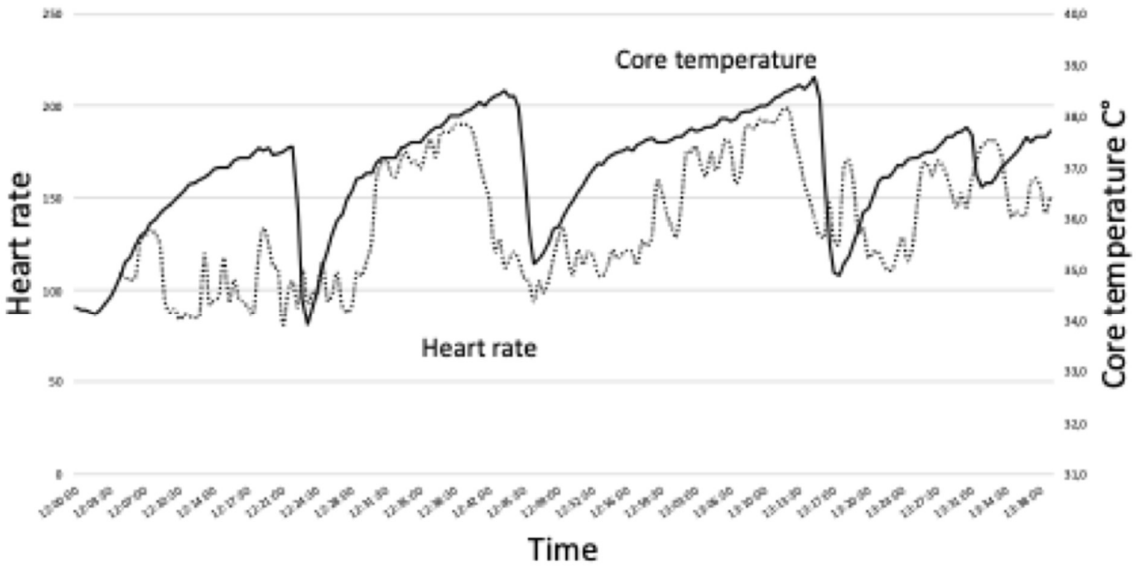

Figure 1. Individual example of core temperature (line) and heart rate (dots) in elite RSX female athlete (A) during training.

DISCUSSION

Current data provide unique piece of information about the core temperature variation in elite sailors from different genders and sailing classes. Our data showed that in both classes and in both genders peak core temperatures were recorded in competition > 38,3 °C. The highest value of the core temperature 38,5 °C were recorded during Tokyo 2020 Test Event in laser class male with an ambient temperature of 34 °C and relative humidity 90%. In female laser class athlete highest value of core temperature reached 38,3 °C with an ambient temperature of 31°C and relative humidity 79%. In RSX class in female athletes the highest value of the core temperature of 39,0 °C were recorded during Tokyo 2020 Test Event with an ambient temperature of 34°C and relative humidity 85% and in male core temperature of 38,5 °C were recorded during Tokyo 2020 Test Event with an ambient temperature of 29 °C and the relative humidity was 88%. Our data go in line with the study of Naville et al. who measured core temperature in elite professional America's Yacht Racing [4]. In our study athletes sustained described core temperatures and didn't undergo any type of heat illness. Unfortunately our sample size do not allow us to study the influence of the increased core temperature on the performance [9]. Additional factor that probably influenced in the heat tolerance can be an acclimatisation that athletes underwent before the start of the 2020 Tokyo test event. Athletes arrived 8 days before the start of the competition and also were carefully monitored by sport science specialist for their fluid loss and fluid intake.

Limitations

The limitation of the current study is related to the size sample. Despite the numerous data that was collected related to the acclimatisation process sample size doesn't aloud to perform any statistical analysis.

Conclusion and applicability of our results

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Contributors. AG,SZ and IZ conceived the experiments. AG, SZ, IZ and MO designed the experiments. MO, YL and IZ collected data. MO and IZ analysed data and drafted the manuscript and all authors contributed to the final manuscript.

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Competing interests None declared. Patient consent Not required.

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