



Participant Information Sheet (Running option)

Study Title: Short vs. Long Term Heat Acclimation for Male and Female athletes

An invitation to take part:

Thank you for taking the time to read this leaflet. We would like to invite you to take part in this study. Before you decide if you want to participate or not, it is important that you understand why the research is being done and what it will involve. Please take the time to read the following information carefully and discuss it with friends or relatives, if you wish. Please ask us if there is anything that is not clear or if you would like more information.

1. What is the purpose of the study?

Repeated heat exposure (i.e., heat acclimation) is an increasingly common and effective training and conditioning technique for high-level athletes. Males and females have been reported to adapt differently during short (5 day) and long-term (10 day) heat acclimation protocols, however key differences in physical characteristics between the sexes require careful consideration and standardisation of the heat stimulus used during heat acclimation protocols to improve our understanding of the physiological responses causing these potential differences. Therefore, this study aims to determine the effect of 5-day and 10-day heat acclimation on physiological function and aerobic exercise capacity in hot and cool conditions in male and female runners.

2. Why have I been chosen?

You have been chosen because you are:

- Male or female aged between 18-45 years old
- Healthy
- Have no history of heat stroke, cardiovascular or respiratory disease
- Are considered a “trained” athlete in endurance exercise

3. Do I have to take part?

No. Taking part in this study is entirely voluntary. If you would like to participate, you will be given this information sheet to keep and asked to sign a consent form, but you are still free to withdraw at any time without giving a reason. You should feel under no pressure to participate and if at any time you are asked questions that you are not comfortable with answering (eg. those asked in the General Health Questionnaire) you are free to not disclose this information. Though, please note that not answering some questions may mean you cannot participate. Please also bear in mind that all information collected will be kept strictly confidential. However if you do decide to withdrawal, any data collected relating to you will only be retained following your consent at the time of withdrawal.

4. What will happen to me if I agree to take part?

You will be invited to the School of Sport, Exercise and Rehabilitation Sciences at the University of Birmingham for an initial screening. An investigator will explain the nature of the procedures to you in detail and you will then be asked to sign a consent form before being asked to fill out a general health questionnaire. If you are female, you will be instructed on how to use an oral thermometer and to use a home contraception monitor so you can monitor your menstrual cycle while you are enrolled in the study. During the preliminary meeting you will be asked to run on a treadmill at 9km/h so that you become familiar with this exercise pace. Subsequent exercise tests will be conducted at this speed.

Following this, you will have your height plus bodyweight measured and you will be taken to view the environmental heat chamber that you will acclimate in during the study. You are encouraged to ask questions at any stage if there is anything you do not understand or feel comfortable with.

If all of the above is fine, then your participation in the study starts. Below is a schematic illustrating the number of visit involved and what will occur during those visits.

Figure: Schematic of study protocol

PV=PV blood sample

US= Urine sample

STHA: Short Term Heat Acclimation

LTHA: Long Term Heat Acclimation

HST: Heat Stress Test

NPT: Normothermic Performance Test

VO₂max

Testing timeline

Firstly, you will be asked to visit the laboratory for a pre-acclimation baseline **Normothermic Performance Test (NPT)** which will be immediately followed by a **maximal oxygen consumption (VO_{2max}) test**.

Twenty-four hours before this test, you will be asked to stay hydrated, as well as refrain from the consumption

of alcohol or caffeine, and not do any exhaustive exercise. The conditions of the lab will be slightly cool and comfortable for exercise (~15°C). We will collect a urine sample, and you will have your body composition (using a bio-impedance system), nude body mass, height, heart rate, core (T_{re}) and skin temperature (T_{skin}), sweat rate, and perceived exertion measured. You will warm up by running for 10 minutes at a light pace and run for 30 min at a moderate pace, which will be followed immediately by a VO₂ max test. After this you will cool down for 10 minutes at a light pace on the treadmill. During the 30- min continuous run and VO₂max test you will be required to wear a face mask for collection of gas samples for the duration of the test. During exercise, heart rate, oxygen consumption, core temperature and skin temperature will be monitored continuously and recorded every 5- min. Ratings of perceived exertion will be obtained and recorded every 10- min during exercise. Participants will have the opportunity to warm down adequately post- exercise in cool ambient conditions.

Following your first NPT, you will have at least one rest day before heat **acclimation** will begin. Visits are to be consecutive after the first acclimation/heat stress test visit (visits 3-7 and 9-13). This first acclimation visit will include a **Heat Stress Test (HST)**, followed immediately by a VO₂ max test. You will be re-briefed on the protocol that you are completing, have resting measures taken, then be taken into the heat chamber to perform the Heat Stress Test and VO₂ max test. The heat chamber will be set to 40°C, 40% RH. We will collect blood plus urine samples and you will have your body composition, nude body mass, heart rate, body core and skin temperature, sweat rate, plus perceived exertion measured. The HST will be similar to the NPT in that you will warm up for 10 minutes, run for 30 min at a moderate pace, followed immediately by a VO₂ max test. You will be required to wear a face mask for the duration of the 30-min continuous run and VO₂max test. During exercise, heart rate, oxygen consumption, core temperature and skin temperature will be monitored continuously and recorded every 5- min. Ratings of perceived exertion will be obtained and recorded every 10- min during exercise. Participants will have the opportunity to warm down adequately post-exercise in cool ambient conditions. You can voluntarily withdraw from both the HST and VO₂ max test for any reason, and we will terminate the test if your internal temperature exceeds 39.5°C.

You will spend the next four visits acclimating by exercising for 90 minutes in the heat chamber at 40°C, 40% RH. We will measure your core temperature, heart rate, sweat rate, hydration state and perceived exertion, in all of these sessions. Following these 4 days of heat acclimation you will have one rest day. The next visit we will take a small blood and urine sample and you will complete a second HST, followed by VO₂max test; following the same protocol as described above. You will then complete another 4-day heat acclimation bout, acclimating by exercising for 90 minutes in the heat chamber at 40 °C, 40% RH. Following these 4 days acclimation you will have a rest day, followed by your third and final HST and VO₂max test. Finally, you will have another rest day, before completing a NPT and VO₂max test, as you did before the 10-day acclimation protocol.

5. What do I have to do for the measurements made during the experimental visits (VO₂max, Plasma Volume, HST, NPT)?

Before the experimental visits

You will be asked to refrain from vigorous exercise or consuming any alcoholic drinks 24 hours prior to testing.

Normothermic Performance Test (NPT)

For this test the laboratory conditions will be slightly cool and comfortable for exercise (15 °C, 40% RH). When you arrive at the laboratory we will ask for a urine sample (which will be used to contribute to measures of sweat volume, and to measure hydration) plus measure your body mass and composition. We will fit you with equipment to continuously measure your heart rate, core temperature and skin temperature, collect resting measures of these variables as well as fitting you with a face mask to measure your respiratory gases. You will then warm up by running for 10 minutes at a light intensity, followed by a 30-min continuous run. The treadmill will be at a constant speed and the pace should feel comfortable for the duration of exercise. Heart rate, core temperature, skin temperature and respiratory gases will be collected continuously plus rate of perceived exertion will be obtained every 10- min. Immediately following the test, you will continue onto the VO₂max test.

VO₂max Test

Immediately after the continuous run, you will begin the VO₂max test. You will begin running at a steady pace (9 km/h) and the running intensity will increase every minute, so that you move from light intensity exercise to maximal effort. For the first three minutes your pace will increase by 1km/h each minute. After this the pace will remain constant and the incline of the treadmill will increase by 1% per minute. The test will finish when you reach volitional exhaustion and/or the your running cadence can no longer be maintained. The VO₂max test will be followed by a 10-minute, self-paced cool down, after which your nude body mass will be measured again.

Normothermic Performance Test (NPT)

Arrival 	20 min stabilization	Warm up	30 min continuous			VO ₂ max test			Warm down
	Resting: PV, HR, Tc, Tsk	10 min	x	x	x	x	x	x	10 min
			10	20	30	5	10	15	
			HR, Tc, Tsk, Q, VO ₂ , VCO ₂ , VE						

Heat Stress Test (HST)

The HST will be similar to the NPT, with the exception of performance in hot environmental conditions (40 °C, 40% RH) and an additional venous blood sample at rest and after exercise.

Heat Stress Test (HST)

Arrival 	20 min stabilization	Warm up	30 min continuous			VO2max test			Warm down
	Resting: HR, Tc, Tsk	10 min	x	x	x	x	x	x	10 min
			10	20	30	5	10	15	
			HR, Tc, Tsk, Q, VO2, VCO2, VE						

Heat Acclimation sessions

The days that you are acclimating without a HST beforehand you will cycle or run in the environmental chamber (set to 40 °C and 40% RH) for 90-minutes at a pace/intensity that raises and maintains your body core temperature at 38.5 °C. Changes in body mass, heart rate, core temperature, skin temperature and ratings of perceived exertion will be measured during the session. You may voluntarily withdraw at any time.

Measures

The following measurements will be made:

- ***VO₂max test:*** Following the HST and NPT we will record your VO₂max performance in order to observe any change in your aerobic fitness following heat acclimation.
- ***Urine Samples:*** You will be asked to urinate into a container from which we will immediately assess the osmolality, colour and volume of your urine.
- ***Venous Blood Samples:*** Plasma volume and fluid regulatory hormones will be measured from your blood samples. Your blood sample will be spun and stored for later analysis. All samples will be labelled with key code (i.e., not directly identifiable to your name).
- ***Core Temperature:*** Rectal temperature will be measured using a medical grade, flexible, sterile, and disposable thermistor. You will be instructed on how to insert your own rectal thermistor, to a depth of 10 cm. This procedure may cause slight discomfort initially but should not be painful.
- ***Skin Temperature*** will be measured by taping temperature probes to your skin at four sites: chest, triceps, thigh, and calf.
- ***Oxygen Consumption (VO₂):*** During the HST, NPT and VO_{2max} tests, VO₂ and respiratory (*ventilation rate* and *volume*) variables will be measured using a portable, breath-by-breath indirect calorimetry system (Vyntus, Carefusion). You will wear a face mask for the duration of the continuous run in hot and cool conditions and VO₂max test. These measurements will also be used to estimate your cardiac output.
- ***Sweat Volume:*** By measuring your nude body mass before and after a session, as well as your fluid intake, we will be able to calculate the volume of sweat that you have produced during the session.
- ***Heart rate:*** will be measured continuously during exercise via a heart rate monitor.
- ***Perceived Exertion:*** Throughout the study, you will be asked to rate your level of perceived exertion on a scale of 6-20, ranging from very, very light up to maximal exertion.

6. What are the possible disadvantages and risks of taking part?

There are risks associated with exercise. The General Health Questionnaire is a screening tool to minimize these risks but exercise will be discontinued immediately if you feel distressed, unduly uncomfortable, wish to stop, or if we become concerned for your welfare. Please let us know if you have had any previous issues with exercise or heat illness.

Drawing venous blood can cause some local pain and discomfort, and sometimes bruising and discoloration.

There may be some initial discomfort associated with measurement of rectal temperature. It should however not be painful, and any initial feeling of discomfort should disappear immediately upon completion of insertion.

The conditions of the lab during the HST and the acclimation protocols will be hot, and may cause discomfort during exercise. Know that acclimation protocols in similar conditions are frequently conducted and that we will monitor your well-being closely.

There is a risk of tripping and falling when running to exhaustion on a treadmill. A crash mat will be placed at the end of the treadmill plus you will wear a safety harness during the VO₂max test to prevent you from falling.

The investigators are experienced in performing all the procedures detailed with many similar sessions completed safely in the recent past. Investigators will observe you carefully throughout the study and you are encouraged to notify an investigator immediately if you have any worrisome symptoms in addition to those symptoms described above.

7. What are the possible benefits of taking part?

If you are travelling for international competition to a warmer climate in the near future, you will reap the performance benefits of acclimation. If you are competing locally, heat acclimation has been shown to improve performance in temperate temperatures as well.

You will receive an assessment of your aerobic capacity (i.e., VO₂max) as well as receive your individual information about how you responded to short vs long term heat acclimation. This will allow you to make an informed decision about which type of heat acclimation you may chose for competitions in the future. During the cool winter/spring months, you may also find training in the heat chamber to be a nice alternative to the outdoor conditions.

8. Will my taking part in this study be kept confidential?

Yes, your participation in this study will be kept confidential.

9. What will happen to the results of the research study?

The results of this study will form part of a MSc by Research degree project and may be published anonymously in a scientific journal; however names of participants will never be published.

10. Who is organising and funding the research?

The School of Sport, Exercise & Rehabilitation Sciences is funding the research. Dr Sam Lucas, Dr Rebekah Lucas and MSc Research student, Rachel Gifford, are organising the research as part of ongoing research studies.

11. Can I obtain feedback from the study?

Yes, if you wish to know the results of the study a summary of the results can be provided once the study has concluded. On the Consent Form there is a space to indicate if you would like to receive a study summary.

12. Do you have any further questions or concerns?

If you have any further questions about the study please feel free to contact:

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