Athlete 365


# BEAT THE HEAT

## OLYMPIC GAMES TOKYO 2020

# Beat The Heat during the Olympic Games Tokyo 2020

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## 10 TOP TIPS

1. Heat acclimatisation by training in the heat for at least two weeks. [see p. 7, 9]
2. If you cannot acclimatise for two weeks, try at least one week! [see p. 8, 10]
3. Implement your hydration plan starting in the days preceding the event. [see p. 11–13]
4. Use pre-cooling strategies during your warm-up (e.g. ice vest). [see p. 14]
5. Test your cooling strategies during practice prior to the event/competition. [see p. 14]
6. Do not use clothing that limits sweat evaporation. [see p. 14]
7. Many medications can impair your ability to tolerate heat, so discuss your medications with your sports physician.
8. Diarrhoea and vomiting impair your hydration status and will require the use of Oral Rehydration Solutions (ORS).
9. Use a non-greasy sunscreen. [see p. 14]
10. Use a hat and Category 3 sunglasses. [see p. 14]

# Beat The Heat during the Olympic Games Tokyo 2020

The Games of the XXXII Olympiad Tokyo 2020 (24 Jul – 9 Aug) will take place in hot and humid environmental conditions.

Hot and humid ambient conditions limit heat dissipation capacity during exercise, thus impairing endurance performance and increasing the risk of exertional heat illness such as heat cramps, heat exhaustion and heat stroke.

The risk of heat-related illness can be reduced by adopting countermeasures such as heat acclimatisation.

This document addresses some "Frequently Asked Questions" about performing in hot and humid ambient conditions and provides recommendations to optimise performance and reduce the risk of heat illness.

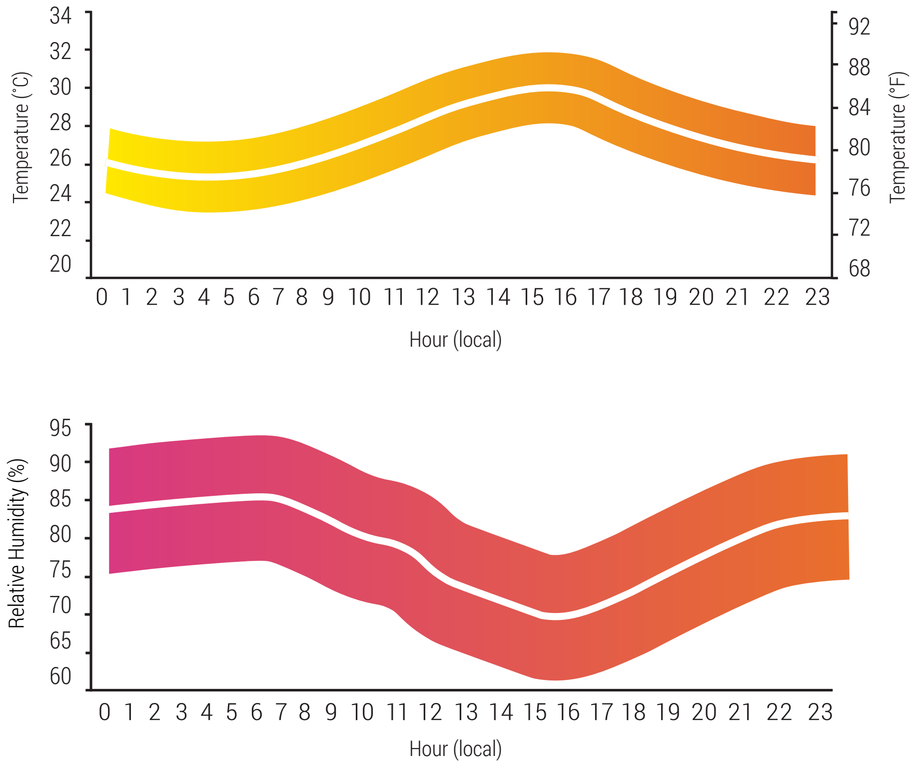
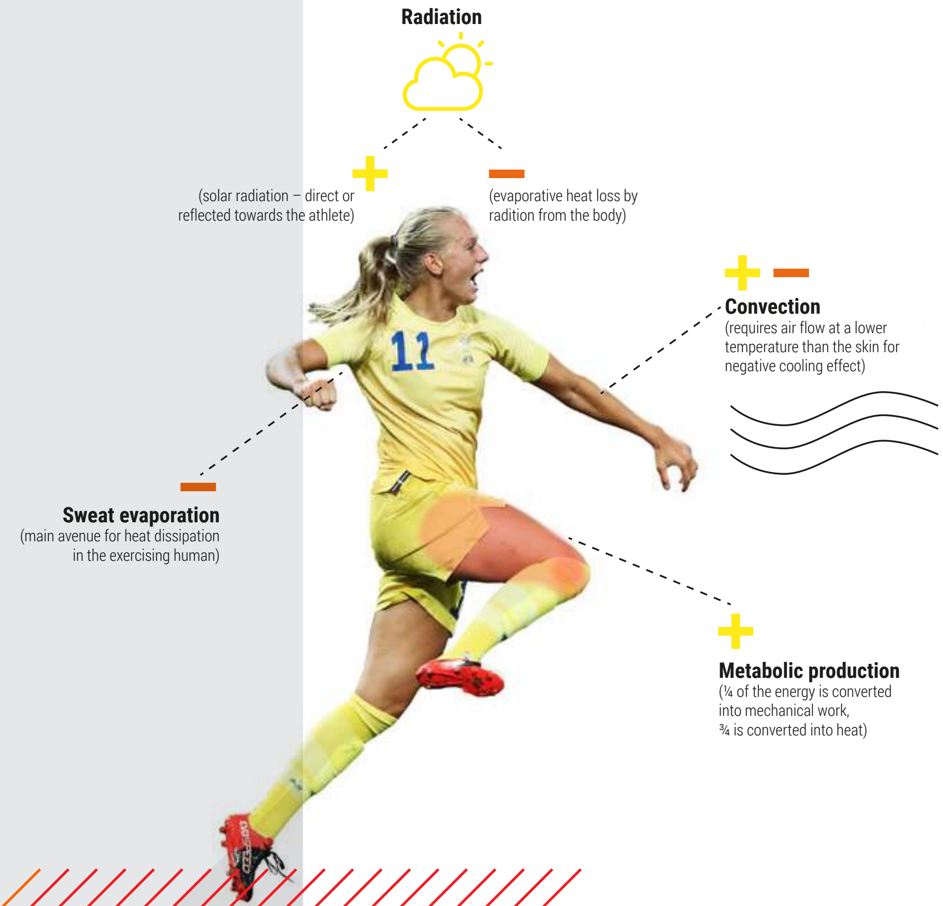



***Figure 1:*** *Typical Tokyo weather during 24 July – 9 August Olympic period (Tokyo airport average data from 1998–2018)*

# How is body temperature maintained?

**Figure 2:** *The athletes' thermal environment*

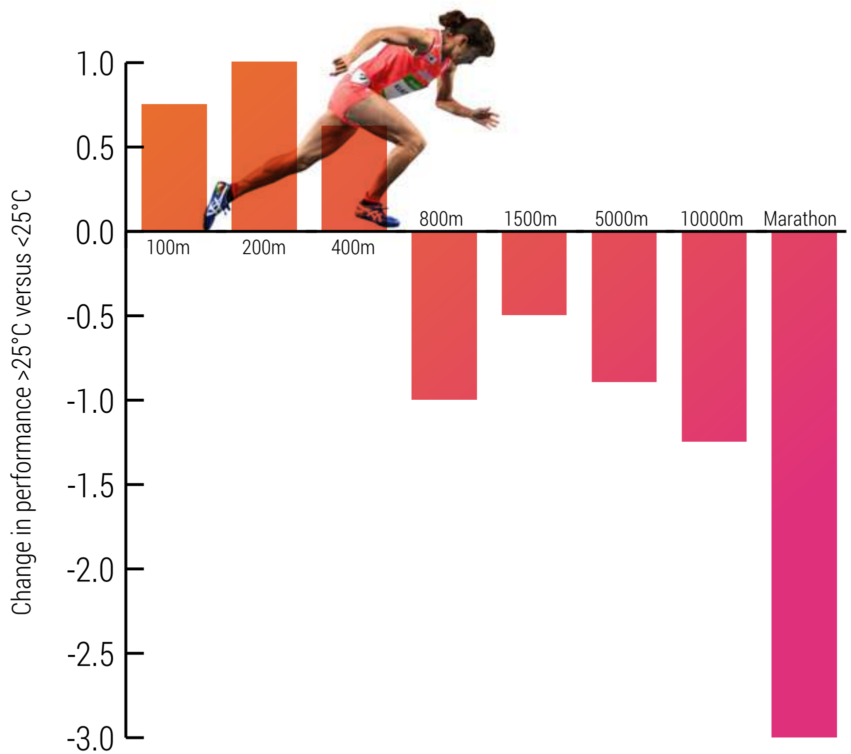



The ambient conditions during sporting events are generally determined using the Wet-Bulb-Globe-Temperature (WBGT) index. The WBGT is calculated from the dry (standard thermometer) temperature, the wet-bulb temperature (indicative of the true capacity of the air to evaporate water according to its relative humidity and air velocity) and the solar radiation (globe temperature). Thus, both a hot and dry (e.g. 37°C, 25% relative humidity as during the 2016 UCI Road World Championships in Qatar) or a warm and humid (e.g. 28°C, 75% relative humidity as during the 2014 FIFA World Cup in Brazil) environment can produce the same WBGT (27°C).

When resting in temperate environmental conditions, core body temperature in humans is around 37°C, while muscle and skin temperature is approximately 35°C and 31°C, respectively. During physical exertions, such as running or race-walking, muscle contractions produce a considerable amount of heat, inducing a large increase in muscle temperature which drives an increase in core body temperature. The heat produced is dissipated into the environment via the skin through sensible (i.e. convection and radiation) and insensible evaporation heat loss pathways, primarily in the form of sweating. In hot ambient conditions, the gradient between skin and environmental temperature is minimal, possibly even negative, such that heat dissipation occurs mainly through sweat evaporation.

# How does heat affect performance?

***Figure 3:*** *The effect of temperature on running performance*




Source: Guy, J. H., Deakin, G. B., Edwards, A. M., Miller, C. M. & Pyne, D. B. Sports Med 45, 303–311 (2015).

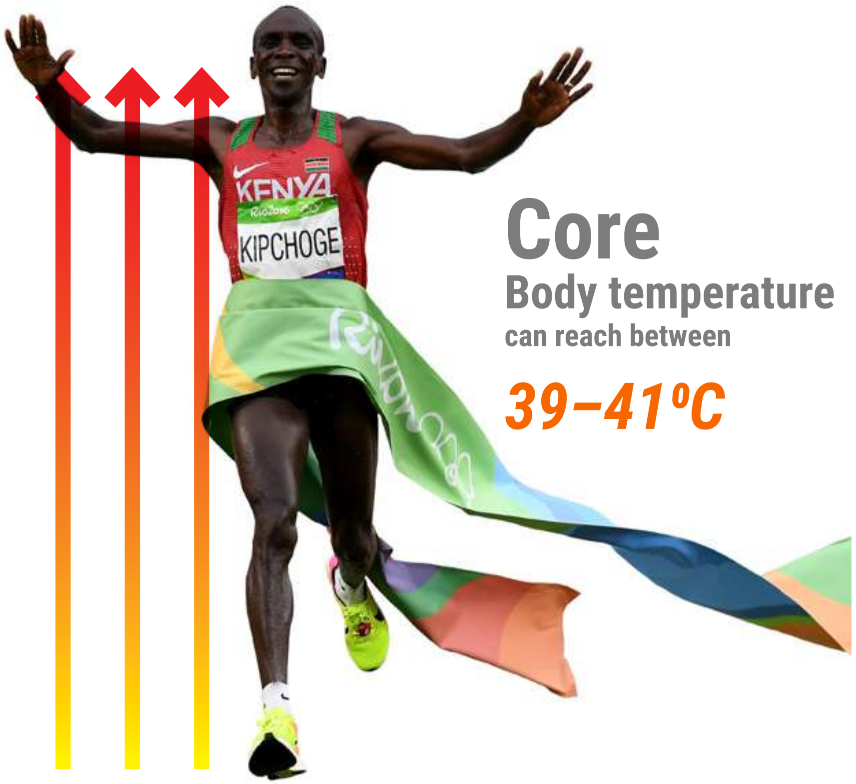
An increase in muscle temperature (e.g. through warm-up) has several benefits for explosive athletic performance such as sprints, jumps and throws. However, preventing an excessive rise in core body temperature during prolonged exercise requires transferring metabolic heat from the working muscles and core to the skin and then dissipating this heat into the environment.

The heat dissipation process requires an increase in blood flow and sweating which is more pronounced in hot and humid conditions due to the lower capacity of the skin to dissipate metabolic heat into the surrounding environment. The resultant rise in cardiovascular strain increases perception of effort and this will inevitably impact on absolute exercise capacity (e.g. reduce speed).

In summary, hot ambient conditions may benefit performance during short duration explosive events, but can progressively impair performance during longer duration events.

# What is the normal body temperature response during exercise?

***Figure 4:*** *Maximal body core temperature when competing in the heat*



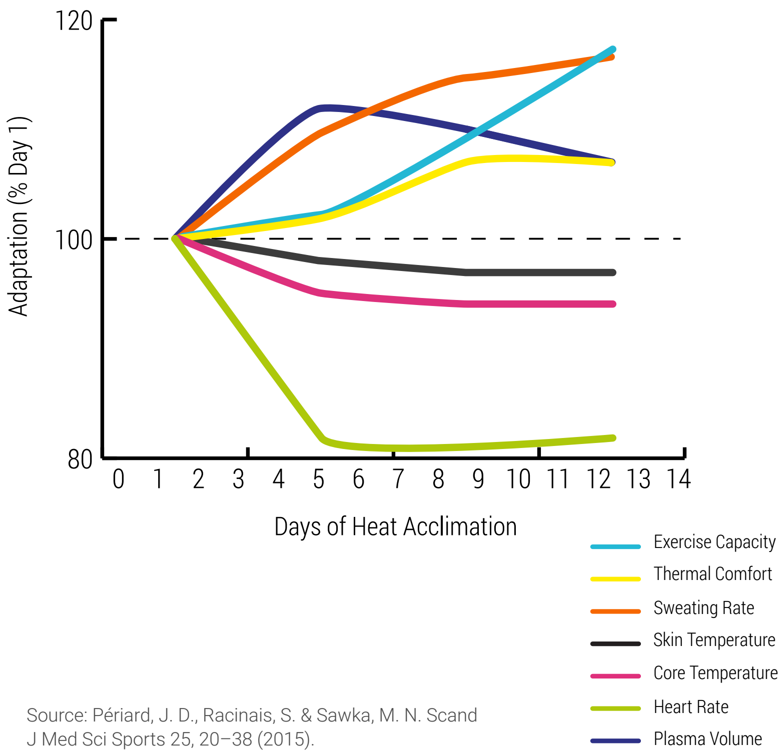

Body temperature increases after a few minutes of exercise. The heat dissipation capacity of the environment is determined by air temperature, radiant temperature, humidity and air velocity. The athlete's personal potential for heat loss is determined by their acclimatisation status, sweat rate, clothing and fitness. The environment together with the individual athlete's potential for heat loss will determine to what extent their core temperature will increase.

Core temperature will keep rising during exercise unless heat production is reduced (e.g. reduce speed). Depending on the intensity and duration of the exercise, a plateau in body temperature may occur anywhere around 38.5–40°C when exercising in temperate environments.

However, athletes can transiently achieve a core body temperature above 41°C when competing intensely in hot ambient conditions.

# How best to prepare for competition in the heat

***Figure 5:*** *Adaptations to repeated training in the heat for unacclimatised athletes*




Source: Périard, J. D., Racinais, S. & Sawka, M. N. Scand J Med Sci Sports 25, 20–38 (2015).

The best way to prepare for competition in the heat is to train in the heat (i.e. to heat acclimatise). Heat adaptation is achieved via repeated exercise/heat exposure that increases body core and skin temperature, as well as inducing significant sweating.

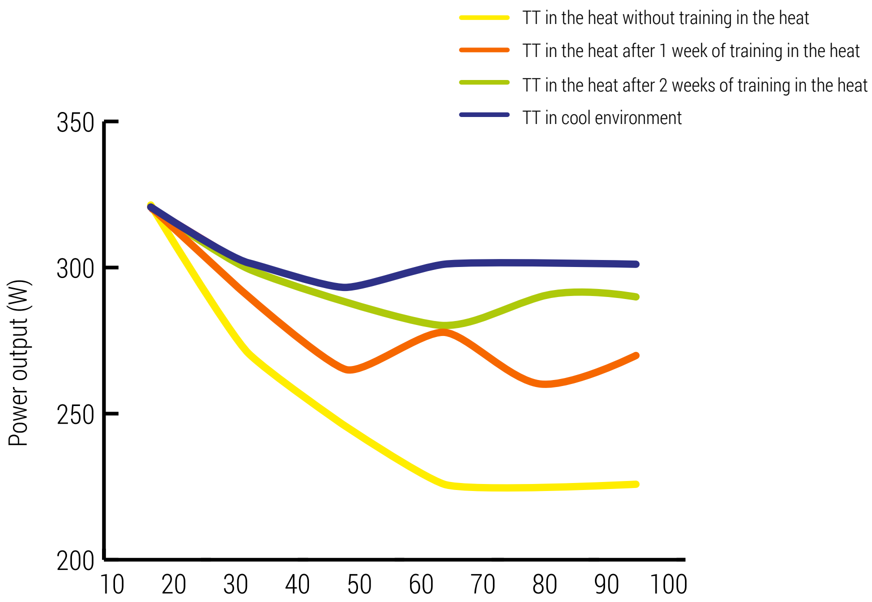
This adaptation to the heat can be achieved using hot ambient conditions (i.e. acclimatisation) or by simulating hot ambient conditions using purpose-built environmental chambers or improvised low-tech "hot rooms" (i.e. acclimation). The number of days required to achieve optimal adaptation varies between individuals, but most adaptations tend to develop within 7–10 days, with 14 days being optimal for most.

It is therefore recommended that athletes train in a similar environment to that in which competition will occur, commencing heat adaptation at least two weeks prior to competition.

Conducting an initial heat acclimatisation camp several weeks before the target event may also enhance the rate of adaptation to the heat in a follow-up pre-competition camp. The most visible body adaptations to repeated training in the heat include an increased sweat rate, a decreased heart rate at a given intensity, a better retention of electrolytes, and a decreased body core temperature.

# How much can performance be improved by heat acclimatisation?

***Figure 6:** The impact of heat acclimatisation on cycling time trial (TT) performance in the heat*




Source: Racinais, S., Périard, J. D., Karlsen, A. & Nybo, L. Med Sci Sports Exerc 47, 601–606 (2015).

Heat stress can dramatically decrease endurance performance, but this reduction in performance can be mitigated progressively with heat acclimatisation. Heat acclimatisation is an ideal adjunct to other performance-enhancing strategies (e.g. high-altitude training). Heat acclimatisation will also reduce the risk of heat-related illness.

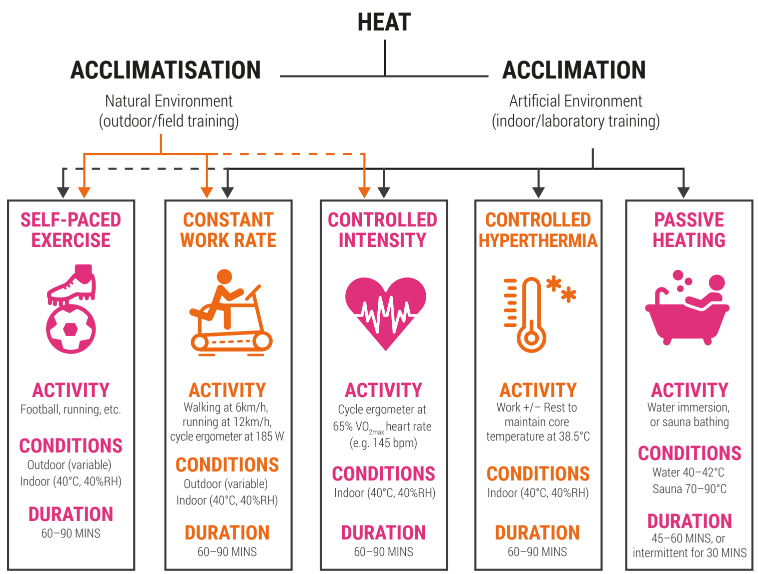
If the signs and symptoms of heat-related illness develop then:

- Call for medical assistance
- Remove the individual from the heat source (e.g. from out of the sun to shade)
- Where possible start active cooling

Therefore, heat acclimatisation should be a priority before any event where hot and/or humid conditions are likely or expected. Indeed, heat acclimatisation does not impair performance in cooler environments and may even enhance performance under certain conditions.

# How to heat acclimatise in a cold country

***Figure 7:*** *The different heat acclimatisation methods*




Source: Daanen, H. A. M., Racinais, S. & Périard, J. D. Sports Med 48, 409–430 (2018).

There are a wide variety of approaches that can increase core and skin temperature and stimulate sweating.

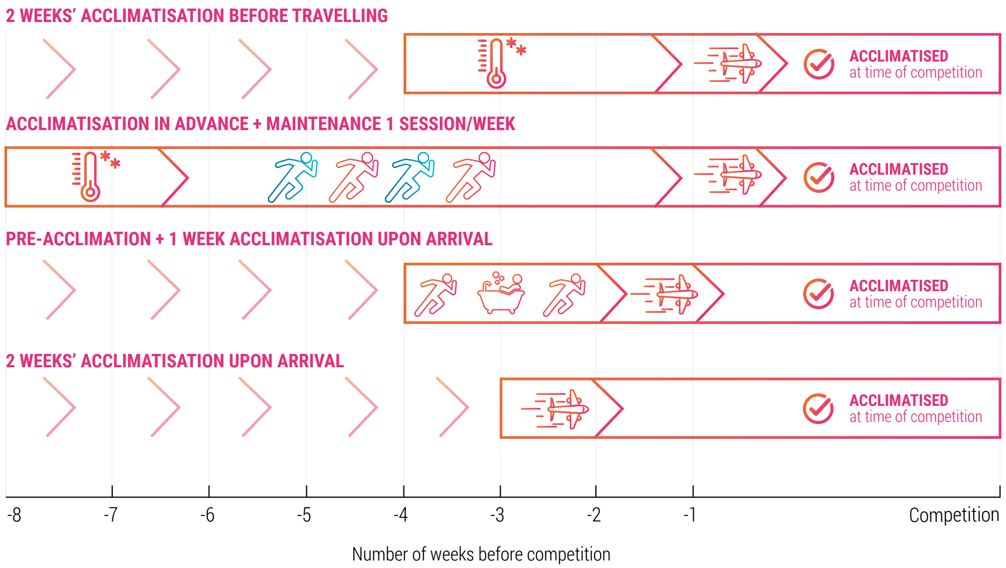
The first choice should be to train for 60–90 minutes a day in the same ambient conditions as the upcoming competition for two weeks. However, if this is not possible, most adaptations can be acquired by artificially simulating heat during indoor training (i.e. use of a purpose-built environmental chamber if available, or even using heaters and boiling water to artificially create hot and humid ambient conditions).

It is also possible to use passive heat acclimation techniques such as hot water immersion or sauna bathing for 30–40 minutes pre- or post-training, but the overall benefits of passive heat acclimation will be less than training in hot ambient conditions. Water temperature should be around 40°C in order to elicit adaptation while remaining tolerable (this can easily be measured with a floating pool thermometer).

Another approach to induce heat adaptation is to wear extra clothing during training to increase the heat stimulus. Collectively, artificial techniques aimed at inducing heat adaptation are called "heat acclimation". Although not as specific as exercise heat acclimatisation, heat acclimation can be used before travelling to a hot environment to reduce the time required for acclimatisation upon arrival.

# When to heat acclimatise

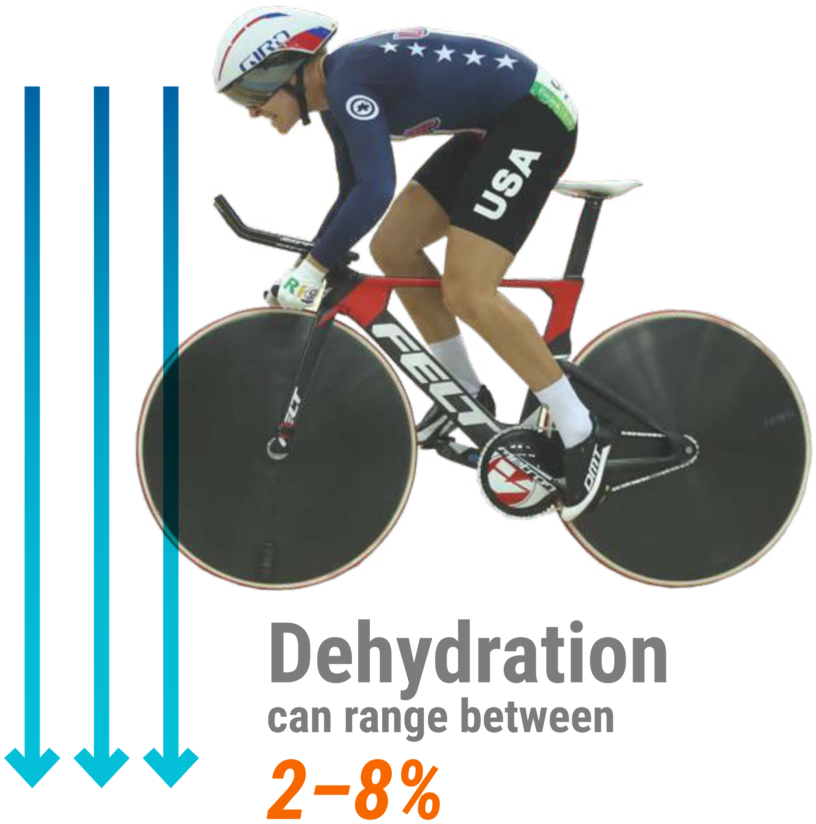
***Figure 8:*** *Examples of heat acclimatisation strategies, depending on travel requirements*




Despite the benefits of heat acclimatisation, only 15% of athletes participating in the 2015 IAAF World Championships (Beijing), which were held in a hot and humid environment, occur by regular training, even in cool conditions, the most effective method to obtain in the heat prior to the competition. While some degree of heat acclimatisation does occur by regular training even in cool conditions, the most effective method to obtain all the heat adaptation benefits is to train in conditions similar to the upcoming competition (using either real or simulated conditions). Travel to the competition should be planned to ensure optimum heat adaption and taking into account the competition schedule.

# How does hydration impact on performance?

*Figure 9:* Dehydration level when competing in the heat




Heat dissipation relies on sweat evaporation. However, profuse sweating may lead to progressive dehydration if fluids are not sufficiently replaced. Severe dehydration accelerates the rise in whole-body temperature and impairs prolonged exercise performance. This reduction in performance occurs as dehydration negatively impacts the normal functioning of the heart by making it more difficult to maintain blood pressure and blood flow to the working muscles and skin (to lose heat). Therefore, a sufficient intake of fluids before, during and after exercise is necessary for athletes to perform well and stay safe when competing in hot and humid ambient conditions.

# How much to drink

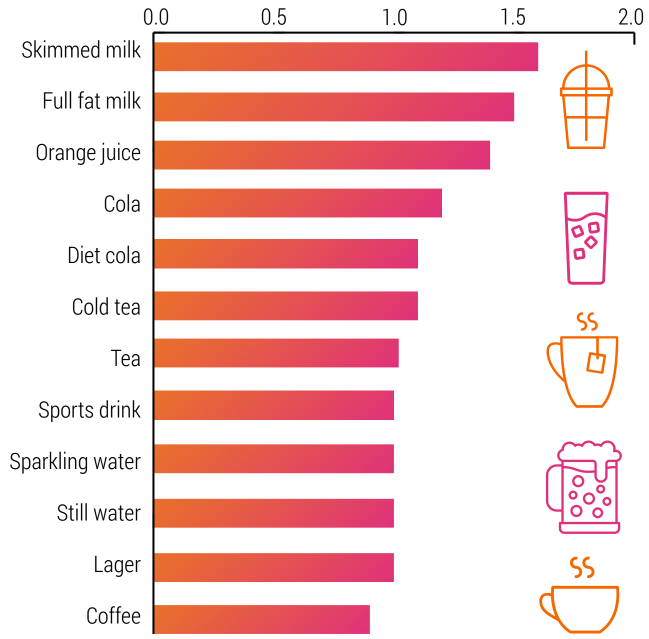
**Figure 10:** *What colour is your urine?*


Drinking to satisfy thirst is adequate for exercise lasting less than one to two hours in cool environments. Planned drinking may enhance sporting performance during activities lasting more than 90 minutes, particularly during high-intensity exercise in the heat that elicits high sweat rates (and when carbohydrate intake of 1 g/min or more is desired). Individuals with high sweat rates and/or those concerned with exercise performance should determine sweat rates under conditions (exercise intensity, speed) and ambient conditions similar to that anticipated when competing, and tailor drinking to prevent body mass losses exceeding 2–3% in general.

Individualised prescription of fluids must remain within the limits of how much fluid can be absorbed (i.e. typically a maximum of about 1.2 L/h). It is also important to recognise that hydration regimens should never result in significant over-hydration, as this can have serious health consequences (so called "hyponatremia", an imbalance of the salts in the body) that can be more severe than dehydration and even result in death. Simple techniques such as measuring body mass before and after exercise or evaluating urine colour in the morning (first void) can help athletes assess fluid losses through sweating and estimate hydration needs and status. It is of paramount importance that athletes establish their optimal personal drinking strategies during training and well before arriving at the competition.

# What to drink

***Figure 11:*** *Hydration index (i.e. amount of water retained as compared to still water) of common beverages*




Source: Maughan, R. J. et al. Am J Clin Nutr 103, 717–723 (2016).

Sodium (salt) supplementation during exercise lasting longer than one hour is recommended for heavy and "salty" sweaters. Sodium intake may be increased before and after hot-weather training and racing. Electrolyte tablets or some salt (a pinch of salt at a time) may be used by athletes during training and competition by those who tolerate it. It is also advisable to include 30–60 g/h of carbohydrates to drinks for sporting performances lasting about one hour and up to 90 g/h for longer events. These recommendations can be achieved through a combination of fluids and solid foods. After training or competition in the heat, recovery drinks should include sodium, carbohydrate and if necessary, protein to optimise recovery. The preferred method of rehydration is through the consumption of fluids with foods, including salty food.

# What about pre- and per-cooling?

***Figure 12:*** *An example of a cooling vest that can be used during the warm-up*

Before the start of competition, it is advisable to minimise unnecessary heat exposure and heat gain.

Athletes should therefore warm up in the shade if possible. Athletes should consider external (ice vests, cold towels, or fanning) and internal (cold fluid or ice slurry ingestion) pre-cooling methods, or a combination of both.

External pre-cooling during warm-up such as with commercially available ice-cooling vests can provide effective cooling without affecting optimal muscle temperature and function.

During competition, athletes should also protect their eyes by wearing UV-ray blocking sunglasses in a dark tint (i.e. Category 3) and their skin by using non-greasy sun-screen (water-based sun screen should be preferred to oil-based sun-screen that may affect sweating).

Light-coloured clothing can also minimise the effect of the sun's radiation and should therefore be preferred, but clothing should not impair sweat evaporation. Self-dousing with water or other cooling techniques that are commonly adopted are less evidence-based but may offer some psychological benefit.

Any cooling method should be tested and individualised during training and not in competition, to minimise disruption to the athlete.

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www.olympic.org/athlete365/well-being/beat-the-heat