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Exercising in a thermally stressful environment is a challenge regularly faced by athletes competing in summer sports. Hot, humid climates limit the body's ability to dissipate heat because the temperature gradient between the skin and the surrounding environment approaches zero. High ambient temperatures in combination with heat produced by working muscle during exercise can increase core temperature dangerously above the resting level of 37°C. In addition to a rise in core temperature these conditions result in increased skin temperature, increased heart rate and increased sweat rate (which can lead to dehydration). It is generally accepted that athletic performance is reduced in the heat. The negative effects of heat on the physiology of performance include:

- Increased anaerobic metabolism and blood lactate accumulation
- Increased rate of carbohydrate use by working muscle
- Decreased VO₂max
- Decreased endurance, strength and power performance
- Increase perceived exertion
- Increased resting metabolic rate

Repeated exercise sessions in the heat over four to 10 days can improve performance in hot conditions through a number of physiological adaptations. Sweat rate increases, while salt concentration of the sweat is reduced. The nervous system eventually adapts and sweating begins at a lower core temperature. Blood volume also increases. Ultimately this leads to a lower rate of rise in core temperature and heart rate. The body relies more on carbohydrates as a fuel when it is first exposed to a hot environment, thus more lactate is produced. After repeated exercise in the heat, fuel selection is similar to that in a cooler environment and carbohydrate is spared. Taken together, these benefits improve heat tolerance, increase work output and improve performance in the heat.

Guidelines for heat adaptation:

Heat adaptation strategies typically involve 10 to 12 days of exercising in the heat (>30°C), but changes can occur in as few as four days. This can be achieved naturally in a warm climate (heat acclimatization) or it can be simulated artificially using sweat clothing or artificially hot environments (heat acclimation), however sweat clothing is less effective.

- The goal of heat acclimation is to elevate core temperature (38.5°C for approximately an hour).
- Start the training session at moderate to high intensity for the first 20-30 minutes (or use hard intervals) to elevate core temperature (target 38.5°C) and then decrease the intensity to maintain core temperature at 38.5°C for the remainder of the workout. If core temperature cannot be measured, then measure heart rate (75-80% of heart rate maximum) for the first 20-30 minutes and then reduce the intensity (40-50% of heart rate maximum) for the next 40-60 minutes.
- Don't assume that just because it is hot out that athletes increase core temperature enough to stimulate acclimatization (consider convective cooling through wind, shade and the intensity of the workout). Measure core temperature to confirm.
- The ideal environment for acclimatization is one that is hot and dry because there is a shift in the sweat rate and core temperature.
- In hot and wet environments the sweat mechanism will shut off because the skin is saturated and wet. However, the athlete will adapt with multiple exposures and the sweat mechanisms will turn on despite the skin being wet.
- Ensure adequate hydration. The benefits of heat acclimation will be lost when the athlete is in a dehydrated state
- Minimize accumulative heat load between sessions, try use cooling baths or vests post exercise to assist recovery. Keeping the room temperature cool while you sleep is also critical for regeneration.

For more information on heat acclimatization please consult your Canadian Sport Centre Pacific Physiologist.



Olympian Seamus McGrath competes in the heat.

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