

# Center for Athletic Medicine

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## Keeping Young Athletes Safe in the Heat

Exposure to excessive heat and humidity poses special problems for young athletes. Exercising muscle generates 10 to 20 times the heat generated by resting muscle. In addition, radiant heat (from direct sunlight) and reflected heat (from all surfaces, but especially sand or artificial turf) contribute to elevating the body's core temperature.

To maintain appropriate core temperature, the body shunts blood away from the internal organs to the skin and then uses several mechanisms to dissipate heat. Radiation (direct transfer of heat to air of lower temperature), conduction (to objects of lower temperature, such as water in a swimming pool), and convection (radiation aided by moving air) are the most important heat-control mechanisms for the body at rest. During exercise, a fourth mechanism, the evaporation of sweat, becomes the most important for dissipating excess body heat. Proper hydration is required for efficient sweating and cooling. Dehydration of as little as 2% to 3% can interfere with the body's thermoregulatory mechanisms. Athletic performance can be compromised by as little as 1% to 2% dehydration.

Children are at greater risk for heat illness than adults for several reasons. Children produce more internal heat for a given amount of work. They also have a higher surface-area to body weight ratio, which means they absorb more heat from the environment. Their sweating capacity is less, and they acclimatize more slowly than adults (7 to 10 days versus 4 to 7 days). Transition to adult thermoregulation does not begin until after puberty. Children also lack the experience and judgment to perceive the early warning signs of heat illness.

Heat illness can take many forms. Heat cramps, heat exhaustion, and heat stroke are the most common. Heat cramps are painful, sustained muscle contractions, most often involving the calf muscles and hamstrings, thought to be due to inadequate blood flow to exercising muscle. Treatment includes stopping exercise, beginning oral rehydration, resting in a recumbent position, and stretching the involved muscles.

Heat exhaustion occurs in athletes who sweat profusely and experience significant volume depletion. They often have core body temperatures between 38°C (100.4°F) and 40.5°C (104.9°F). Symptoms include nausea, vomiting, dizziness or syncope, weakness, and mild mental status changes (eg, confusion, inattention). Treatment consists of vigorous rehydration with oral fluids (or intravenous fluids if mental status or gastrointestinal problems preclude oral intake). Victims should be moved to a cooler environment, and measures to cool the body (eg, ice bags to the neck or axilla, cool towels, fanning) should be used. If symptoms do not resolve rapidly, transfer to an emergency medical facility is indicated.

Heat stroke is an acute medical emergency caused by an extreme buildup in body heat, with a failure of the body's normal thermoregulatory mechanisms. It manifests with very high core temperature (usually > 40.5°C [>104.9°F] and sometimes > 41.7°C [>107.0°F]). It is life-threatening, with a mortality rate of around 10% despite good medical management. Shock, circulatory abnormalities, disseminated intravascular coagulation, rhabdomyolysis, arrhythmias, and seizures are prominent features. Treatment involves immediate transport to an emergency medical facility. Rapid cooling, close management of circulation and hydration, and intensive multisystem monitoring and support are essential.

Heat illness can be prevented with proper hydration and close attention to weather conditions. Proper hydration means drinking sufficient fluids before, during and after exercise. The following are general guidelines for a 40-60kg child

Two hours prior to prolonged physical activity

500 ml (18 oz)

750 ml (25 oz)

Every 20 minutes during activity

150 ml (5 oz)

250 ml (9 oz)

Thirst is an unreliable indicator of hydration status. Children should be encouraged to drink during activity even if they are not thirsty. Children can be weighed before and after exercise to determine actual fluid loss. Each pound lost should be replaced with 16 to 24 ounces of fluid. If fluid replacement has been inadequate (weight loss >5% of

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body weight), the athlete should be held out of activity until weight returns to baseline. Drinks that are chilled will promote gastric emptying and stimulate thirst. Water is a good choice if the exercise will last an hour or less. Sports drinks are recommended if exercise will last longer than an hour, because glycogen stores become depleted at this point, and sports drinks supply the glucose needed for fuel. Sports drinks also provide flavoring and additional electrolytes, which may help stimulate thirst and encourage further oral intake.

Close attention to weather conditions is equally important. When heat and humidity are excessively high, outdoor exercise should be limited. The American Academy of Pediatrics policy entitled Climatic Heat Stress in the Exercising Child contains guidelines to determine the relative risk of vigorous activity in different temperature and humidity settings (available at [www.aap.org/policy/re9845.html](http://www.aap.org/policy/re9845.html)). Scheduling activities before 11 AM or after 6 PM can lower the total heat load. Clothing should be lightweight and non-restrictive. Equipment should not be bulky. Direct sun exposure should be avoided whenever possible. Gradual acclimation should be encouraged.

It is important for pediatricians to educate parents and coaches about the signs and symptoms of heat illness, and assist them with formulating strategies for prevention.

### Reference

American Academy of Pediatrics, Section on Sports Medicine and Fitness: Exertional Heat-Related Illness, AAP News, May 2000