

# Environmental Issues for Team Physicians

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As outdoor sports continue to gain popularity, understanding the environmental factors that may influence athletes is becoming a more important aspect of medical care for team physicians. Temperature, ultraviolet light, lightning, and altitude are some of the most common elements that cause illness. Understanding how to prevent, diagnose, and promptly treat conditions caused by environmental factors is essential to optimizing athletic performance in outdoor sports and avoiding morbidity.

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As outdoor sports continue to gain popularity among active individuals, it is essential for sports medicine physicians to understand the environmental factors that may significantly influence the performance and overall health of the athletes who are under their care. Heat-related illness, cold injury, ultraviolet light, lightning, and altitude represent some of the most common elements of nature that may afflict the outdoor athlete during activity. This review provides a synopsis of the physiology, clinical presentation, and treatment for each of these conditions. Understanding the symptoms and signs of each condition is essential to providing prompt care and preventing long-term disability and death.

## HEAT-RELATED ILLNESS

Although medical research has led to a better understanding of fluid balance among athletes, heat-related illness continues to be a significant threat to athletic performance and overall health. Among high school athletes, for example, heat-related illness is the third most common cause of death.<sup>37</sup> Common risk factors include lack of acclimation to the environment, underhydration, medications (alcohol, stimulants), and illness (sweat gland dysfunction, urinary infection). Prepubescent age, obesity, poor fitness, and sleep deprivation may also play a role.<sup>71</sup> For the most part, the conditions that define heat-related illness are largely preventable with careful attention to the environment, fluid balance, and activity level.

Most energy produced by the body is converted to heat. Heat production is proportional to body weight, while heat loss is proportional to body surface area.<sup>27</sup> Heat dissipates through evaporation, radiation, conduction, and convection

(Figure 1). Among these mechanisms, evaporation is the primary mechanism through which heat is dissipated by the body.<sup>37</sup> Radiation occurs when a warm body gives off heat as infrared radiation to a colder body or surroundings. This method of heat loss is described in more detail in the section on cold injury. Conduction is the transfer of heat from one object to another by direct physical contact. Conduction losses are greatest when an individual is wet because water is a much stronger conductor than air.<sup>27</sup>

Convection losses are secondary to the motion of air across the body surface. Increased air speed across the body surface results in increased convection losses. Evaporation as well as perspiration and insensible losses from respiration lead to a significant amount of water loss and accompanying heat loss from the body to the surrounding environment. The hypothalamus controls 2 physiologic mechanisms that are essential to heat loss.<sup>27,37,71</sup> One of the mechanisms is an increase in skin blood flow, and the other is an increase in sweat production.

Heat acclimation is a process that the body uses to protect itself from heat-related illness. Physiologically, acclimation is manifested as an increase in sweat rate and a decrease in electrolyte loss. As a result of these processes, there is an increased resistance to dehydration and improvement in "demand" drinking. In general, the key to preventing heat illness is hydration. Athletes should be encouraged to drink before, during, and after activity.<sup>29,37</sup> Several methods (eg, measuring body weight) have been described to determine appropriate amounts of fluid intake. Many factors contribute to the amount of fluid athletes may need depending on their level of fitness and acclimation. Physicians should consult sports medicine nutritionists and the references in this article for specific details on this issue with regard to the types of athletes under their care. In general, the goal is the same for all athletes—to maintain adequate hydration throughout their activity. Rehydration requires maximizing voluntary intake and gastric emptying. The specifics on how to achieve these goals should be individualized to each athlete.

The mechanisms of heat production and dissipation influence the risk of developing heat illness. For example,

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