

VHSL HEAT ACCLIMATIZATION GUIDELINES

Proper heat-acclimatization plans in secondary school athletic programs are essential to minimize the risk of heat-related illness (HRI) during activity any time of year and especially during the fall preseason practice period. Gradually increasing athletes' exposure to the duration and intensity of physical activity and to the environment minimizes exertional heat illness risk while improving athletic performance. Progressive acclimatization is especially important during the initial three to five days of preseason practices,¹ and when an athlete progresses through a proper heat-acclimatization progression, physiological function, exercise heat tolerance, and exercise performance are all enhanced. In comparison, athletes who are not exposed to a proper heat-acclimatization progression are at increased risk for HRI.¹

The Korey Stringer Institute (ksi.uconn.edu) provides a wealth of information and resources related to the prevention, recognition and treatment of heat-related illness. For additional information, please see the Resources section of this document.

PREVENTION OF HEAT-RELATED ILLNESS

In conjunction with the pre-participation exam, student-athletes should be screened for risk factors and a history of HRI. Athletes should be acclimatized to heat gradually over a 7-14 day period.² Special considerations and/or modifications are needed for those wearing protective equipment during days of high heat and humidity. Athletes should remain well hydrated and replace fluids lost through sweat during activity, including conditioning/training sessions, practices and games. It should be emphasized that ***athletes should have free access to readily available fluids at any time***, not just during breaks. It is imperative that relevant personnel be trained in prevention, signs and symptoms, and treatment of HRI.²

When high temperatures and/or humidity is forecasted, those supervising practices and competitions should make accommodations based on these conditions, including:

- Increasing frequency and duration of water breaks
- Increasing frequency and duration of rest breaks
- Reducing the amount of equipment worn during activity
- Modifying total amount of time engaged in practice
- Changing activity location

Additional details on participation modifications can be found in the "Exercise in Hot and Humid Environments" section of this document. Forecasting tools, including online resources and/or mobile "apps" can be used to better anticipate if/when activity modifications may be required. While these services can provide guidance for planning purposes, they should never replace the "real-time" evaluation of environmental conditions on-site at the activity location. Weather forecasts tend to be generalized over a large area, can and do change frequently, and ultimately may not be specific for the athletic venue.

Risk Factors for Heat-Related Illness:

- General
 - Exercising in hot and humid environment (air temp > 91°F/33°C)
 - Inadequate fluid intake before or during exercise resulting in dehydration

- Inappropriate work to rest ratios with too much work compared to rest breaks
- Body mass index > 27 kg/m²
- Intrinsic Factors:
 - History of heat-related illness
 - Inadequate heat acclimatization
 - Low overall fitness level
 - Overweight or obese
 - Inadequate hydration
 - Lack of sleep
 - Fever
 - Stomach illness
 - Highly motivated/ultra-competitive personality
 - Pre-pubescent individuals
- Extrinsic Factors:
 - Intense or prolonged exercise with minimal breaks
 - Repeated/prolonged exposure to high temperature/humidity/sun
 - Elevated Wet Bulb Globe Temperature (WBGT)
 - Inappropriate work/rest ratios based on intensity
 - Wearing dark colored or heavy-weight clothing
 - Wearing protective equipment
 - Poor overall fitness
 - Peer or organizational pressure
 - Lack of education and awareness of heat illness risk factors among coaches, athletes, and medical staff
 - Absence of an emergency action plan (EAP) and/or policies and procedures to manage heat-related illness
 - No or limited access to fluids or breaks during practice
 - Delay in recognition of signs and symptoms associated with exertional heat stroke (EHS)

TYPES OF HEAT-RELATED ILLNESS

Exertional heat illness ranges in severity from exercise associated muscle cramps to exertional heat stroke. However, heat-related illnesses are not part of a continuum in the sense that an individual experiencing heat exhaustion who continues to exercise will in turn develop heat stroke. While some of the signs and symptoms are similar, these are unique conditions. That said, experiencing muscle cramps or syncope one day may predispose an individual to more significant heat-related illnesses in the future.

Exercise-Associated Muscle Cramps²

Exercise-associated muscle cramps are sudden or sometimes progressively and noticeably evolving, involuntary, painful contractions of skeletal muscle during or after exercise. These cramps are often associated with the heat, but in fact are not directly related to elevated body temperature and can present during exercise in warm, cool or temperature-controlled environments even though excessive sweating is often present. Proposed contributing factors to exercise associated muscle cramps are as followed: dehydration, electrolyte imbalances, altered neuromuscular control, fatigue or any combination of these factors.

Signs and Symptoms

- Visible cramping in part or all of the muscle (group)

- Localized pain
- Dehydration
- Thirst
- Sweating
- Fatigue

Heat Syncope²

Heat syncope often occurs in unfit or heat-unacclimatized people who stand for a long period of time in the heat or during sudden changes in posture (moving from sitting to standing) in the heat. This condition is often attributed to dehydration, venous pooling of blood and low blood pressure. Heat syncope often occurs in the first five days of unaccustomed heat exposure, before blood volume expands and cardiovascular adaptations are complete, and in those with heart disease or taking diuretics.

Signs and Symptoms

- Dizziness/lightheadedness
- Tunnel vision
- Weakness
- Loss of consciousness
- Pale or clammy skin
- Decreased pulse rate

Heat Exhaustion²

Heat exhaustion describes the body's reaction to an excessive loss of water and salt, usually through excessive sweating. This condition is manifested by an elevated core body temperature, usually less than 105 degrees F, and is often associated with a high rate or volume of skin blood flow, heavy sweating and dehydration. It often occurs in hot or humid (or both) conditions, but it can also occur in normal environmental conditions with intense physical activity. Heat exhaustion occurs most often in individuals who are heat-unacclimatized or dehydrated.

Signs and Symptoms

- Excessive fatigue
- Syncope
- Weakness
- Collapse
- Headache
- Dizziness
- Confusion
- Irritability
- Diarrhea
- Chills
- Vomiting
- Nausea
- Lightheadedness
- Low blood pressure

Exertional Heat Stroke^{2, 3}

Exertional heat stroke is the most severe heat illness and is characterized by neurological impairment combined with a core body temperature above 105 degrees. This condition is a product of the body's heat production due to exercise and or inhibited heat loss. While exertional heat illness most often occurs in hot, humid weather, it can also present due to intense physical activity in the absence of extreme environmental conditions. The risks of morbidity and mortality increase the longer that athletes body temperature remains elevated above 105 degrees, while risk of morbidity and mortality are greatly reduced if body temperature is lowered promptly after onset.

Signs and Symptoms

- Central nervous system dysfunction
- Rectal temperature above 105 degrees
- Disorientation
- Confusion
- Dizziness
- Headache
- Loss of balance
- Staggering
- Irrational behavior, irritability or emotional instability
- Apathy
- Aggressiveness
- Hysteria
- Delirium
- Collapse
- Loss of consciousness
- Coma
- Hot, sweaty skin
- Hot, dry skin
- Dehydration
- Hypotension
- Hyperventilation

Exertional Sickling

While not a heat-related illness, exertional sickling is associated with intensive exercise in hot and/or humid conditions, particularly with individuals who may be poorly acclimatized or deconditioned and may be confused with heat cramps. Exertional sickling is a medical emergency in which the red blood cells of a person carrying the sickle cell trait change shape (sickle) leading to decreased blood flow. This decrease in blood flow can lead to a breakdown of muscle tissue and cell death, a condition known as fulminant rhabdomyolysis.

Differentiating muscle cramps and exertional sickling

While both conditions present with pain, the pain associated with cramping usually occurs in a specific area while the pain associated with exertional sickling is more generalized. Cramping muscles appear tight and will “lock-up” limiting function and leading individuals to stop activity. With exertional sickling, muscles become weak leading the individual to try to push through the experience. Cramping generally occurs during or after activity whereas exertional sickling typically occurs within the first 30 minutes of an intense workout.

MANAGEMENT OF HEAT-RELATED ILLNESS

Schools sponsoring athletic programs are required to develop comprehensive Emergency Action Plans (EAPs) for each athletic venue. These important resources are intended to help staff prepare for and respond to a variety of emergency medical situations. Advanced planning is essential to promote successful outcomes when responding to an emergency. The Virginia High School League has developed an EAP template to help schools develop this essential tool.

Individuals experiencing or suspected of experiencing a heat-related illness should be removed from activity immediately to a shaded area or ideally, an air-conditioned environment if available. Staff must also be prepared to rapidly cool a student-athlete using the following methods:

- Cold-water immersion, essential when heat stroke is suspected
- Dousing the student-athlete with cold water (cold shower)
- Rotating ice towels and/or ice bags over as much of the body as possible
- Using fans to cool the student-athlete

The specific treatment and any return to activity recommendations will depend on the condition.

- Exercise-associated muscle cramps
 - Remove from activity to a cool or shaded area.
 - Stretch and/or massage the affected area.
 - Provide water and/or a sports drink to replenish fluids.
 - The student-athlete can return to activity that same day once the cramps have subsided and following a period of rest and fluid replacement. The cramps may return if the fluids have not been adequately replaced.
- Heat syncope
 - Remove from activity to a cool or shaded area.
 - Have the student-athlete sit or lie down at first indication of symptoms.
 - Monitor the student-athlete for signs or symptoms of another medical condition.
 - Elevate the student-athlete's legs.
 - Provide water and/or a sports drink to replenish fluids.
 - The student-athlete can return to activity following a period of rest, fluid replacement, and once symptoms have resolved and other medical conditions have been ruled out. Medical clearance is advised prior to returning to activity.
- Heat exhaustion
 - Remove from activity to a cool or shaded area and remove excess clothing and/or protective equipment.
 - Cool the student-athlete by dousing with cold water (cold shower), by rotating ice towels and/or ice bags over as much of the body as possible, and/or using fans.
 - Monitor for changes in central nervous system function.
 - Elevate the student-athlete's legs.
 - Provide water and/or a sports drink to replenish fluids.
 - If central nervous system changes develop or the student-athlete is slow to recover, suspect heat stroke and treat accordingly.
 - The student-athlete should rest and hydrate for at least 24-48 hours before returning to play. The return to play process should include gradual increases in exercise intensity and duration. Medical clearance is strongly recommended.
- Heat stroke

- Immediately remove all clothing and protective equipment as quickly as possible. If this proves challenging, avoid further delay by leaving clothing/equipment in place and proceed with rapid cooling.
- Cool the student-athlete as quickly as possible using whole-body, cold-water immersion by placing the individual into a 35-58°F tub or tank filled with ice and water.
 - If whole-body cold-water immersion is not available, take the student-athlete to a cool or shaded area and cool by dousing with cold water (cold shower), rotating ice towels and/or ice bags over as much of the body as possible, and/or using fans.
- Monitor and maintain an open airway, breathing, and circulation.
- Once cooling has been initiated, activate EMS/call 911.
- Continue to monitor vital signs and for central nervous system changes.
- If rectal temperature is available, prior to transport, continue to cool until rectal temperature reaches 101-102°F.
- A student-athlete experiencing heat stroke requires adequate time to rest, hydrate, as well as a formal medical evaluation prior to a return to activity.

FLUID REPLACEMENT RECOMMENDATIONS

Evaporation of sweat is the primary source of heat dissipation during exercise. Athletes whose sweat loss exceeds rehydration during activity become dehydrated. Dehydration of greater than 1% of body weight begins to negatively impact one's ability to regulate body temperature along with physiological function and athletic performance while dehydration of 3% or greater of body weight puts an athlete at risk for exertional heat illnesses.^{4, 5}

Signs and Symptoms of Dehydration⁵

- Thirst
- Flushed skin
- Apathy
- Dizziness or lightheadedness
- Nausea, diarrhea, or vomiting
- Heat sensations or chills
- Headache
- Dyspnea (shortness of breath)
- Gastrointestinal cramping
- General discomfort
- Acute body weight loss

Recommendations for Fluid Replacement

- Establish a fluid replacement protocol that meets the needs of the athlete and the sport.
- Supervised monitoring of pre and post practice weight.
- Restrict or modify activity of those athletes who are not within 1% of their previous day's pre practice weight.
- During activity, 7-10 oz of fluid should be taken in every 10-20 minutes.⁴
- Water should be available at all times and access should never be denied to exercising individuals.
- Athletes should replace fluid at 24 oz per pound lost.

Educational Components

- Educate athletes on how dehydration affects physical performance.
- Educate athletes on how to monitor hydration status by monitoring urine color.
- Educate athletes that maintaining hydration is a 24 hour a day process.
- Educate athletes that they should enter each practice session or game well hydrated with a focus on maintaining hydration.

EXERCISE IN HOT AND HUMID ENVIRONMENTS

Exercising in hot and humid environments can predispose a student-athlete to HRI. The higher the temperature, the more heat the body absorbs while higher humidity limits the body's ability to cool itself through evaporation (sweating). Gradually increasing the intensity and duration of activity in hot and humid environments (acclimatization) is an important step in preventing HRI as is assessing the environmental conditions during activity.

Activities, including practices and competitions, should be modified when environmental conditions are extreme. The Wet Bulb Globe Temperature (WBGT) is the recommended method for assessing environmental conditions and should be used to determine the nature of any modifications.² The WBGT takes into account ambient air temperature, relative humidity, and radiant heating from the sun and is utilized extensively in athletics and the US military to modify activity when conditions warrant.²

WET BULB GLOBE TEMPERATURE (WBGT) PARTICIPATION RECOMMENDATIONS

Level	WBGT	Duration	Fluid Consumption	Practices	Scrimmages and Contests
1	<80°	3 hours maximum	Insist that adequate fluid be ingested	Full gear; minimum of 3 water breaks per hour	No modifications
2	80.0°-82.4°	3 hours maximum	Insist that 4 – 6 oz fluid be ingested every 20 minutes; ensure ice is available	Full gear; minimum of 3 water breaks per hour	No modifications
3	82.5°-84.9°	3 hours maximum	Insist that 6 – 8 oz fluid be ingested every 20 minutes; ensure ice is available	Remove helmets unless active in drill; minimum of 3 water breaks per hour	Monitor athletes, rest as needed
4	85.0°-87.4°	3 hours maximum; includes max of 45 minutes of work and ≥ 15 minutes of rest in a shaded or air-conditioned space each hour	Insist that 8 – 10 oz fluid be ingested every 15 minutes; ensure ice is available	No equipment during non-contact drills; remove helmet unless active in contact drill; remove equipment when instructional periods exceed 10 minutes; minimum of 4 water breaks per hour	Monitor athletes, rest as needed
5	87.5°-89.9°	2 hours maximum; includes max of 40 minutes of work and ≥ 20 minutes of rest in a shaded or air-conditioned space each hour	Insist that 8 – 10 oz fluid be ingested every 15 minutes; ensure ice is available	No equipment- shirts and shorts only; reduce intensity of activity; minimum of 4 water breaks per hour	Monitor athletes, rest as needed. Remove helmets if not actively participating
6	90.0° +	NO OUTDOOR PRACTICES, SCRIMMAGES or COMPETITIONS	Re-hydrate 24 oz for every pound of body weight loss per day	Practices conducted indoors must follow the Heat Policy	Delay/postpone scrimmage or game until conditions improve

REFERENCES

1. Casa, DJ, Csillan D. Preseason Heat-Acclimatization Guidelines for Secondary School Athletics. *J Athl Train.* 2009;44(3):332-333.
2. Casa, DJ, DeMartini JK, Bergeron MF, et al. National Athletic Trainers' Association Position Statement: Exertional Heat Illness. *J Athl Train.* 2015;50(9):986-1000.
3. Casa, DJ, Almquist, JL, Anderson, SA, et al. The Inter-Association Task Force for Preventing Sudden Death in Secondary School Athletics Programs: Best-Practices Recommendations. *J Athl Train.* 2013;48(4):546-553.
4. Casa, DJ, Armstrong, LE, Hillman, SK, et al. National Athletic Trainers' Association Position Statement: Fluid Replacement for Athletes. *J Athl Train.* 2000;35(2):212-224.
5. McDermott, BP, Anderson, SA, Armstrong, LE, et. Al. National Athletic Trainers' Association Position Statement: Fluid Replacement for the Physically Active. *J Athl Train.* 2017;52(9):877-895.

RESOURCES

<https://nfhslearn.com/courses/heat-illness-prevention-2>

<https://ksi.uconn.edu/prevention/heat-acclimatization/>

<https://ksi.uconn.edu/prevention/hydration/>

<https://ksi.uconn.edu/prevention/emergency-action-plans/>

<https://ksi.uconn.edu/prevention/wet-bulb-globe-temperature-monitoring/>

Heat Stroke

<https://ksi.uconn.edu/emergency-conditions/heat-illnesses/exertional-heat-stroke/heat-stroke-prevention/>

<https://ksi.uconn.edu/emergency-conditions/heat-illnesses/exertional-heat-stroke/heat-stroke-treatment/>

Heat Exhaustion

<https://ksi.uconn.edu/emergency-conditions/heat-illnesses/heat-exhaustion/>

Heat Cramps

<https://ksi.uconn.edu/emergency-conditions/heat-illnesses/heat-cramps/>

Heat Syncope

<https://ksi.uconn.edu/emergency-conditions/heat-illnesses/heat-syncope/>