

# Inter-Association Task Force on Exertional Heat Illnesses Consensus Statement

These guidelines were established to increase safety and performance for individuals engaged in physical activity, especially in warm and hot environments. Dangers associated with exercise in the heat are well documented but have not been adequately disseminated and implemented. Many cases of exertional heat illness are preventable and can be successfully treated if onsite personnel identify the condition and implement appropriate care.

Strategies to optimize proper care of dehydration, exertional heat stroke (EHS), heat exhaustion, heat cramps, and exertional hyponatremia are presented here. This consensus statement was developed by medical/scientific experts experienced in the prevention, recognition, and treatment of exertional heat illnesses.

## Overall Strategies for the Prevention of Exertional Heat Illnesses

Every athletic organization should have a policy, procedure, or emergency plan established to address exertional heat illnesses. A thorough plan includes the key factors to identifying the early stages of exertional heat illnesses.

Scientific evidence indicates the following factors may increase the risk associated with exercise in the heat. Although some factors can be optimized (e.g., fitness status), others cannot (e.g., health problems). Regardless, these factors may help in developing a proactive approach to caring for exertional heat illnesses.

### *Intrinsic factors include:*

- History of exertional heat illness
- Inadequate heat acclimatization
- Lower level of fitness status
- Higher percent body fat
- Dehydration or overhydration
- Presence of a fever
- Presence of gastrointestinal illness
- Salt deficiency
- Inadequate meals/insufficient calorie intake
- Skin condition (e.g., sunburn, skin rash, etc.)
- Ingestion of certain medications (e.g., antihistamines, diuretics) or dietary supplements (e.g., ephedra)
- Motivation to push oneself/warrior mentality
- Reluctance to report problems, issues, illness, etc.
- Prepubescence

### *Extrinsic factors include:*

- Intense or prolonged (several hours) exercise with minimal breaks
- High temperature/humidity/sun exposure (Table 1 and Figure 1)
- Exposure to heat/humidity in preceding days

- Inappropriate work/rest ratios based on intensity, WBGT, clothing, equipment fitness, and athlete's medical condition
- Lack of education and awareness of heat illnesses among coaches, athletes, and medical staff
- No emergency plan to identify and treat exertional heat illnesses
- No shade or rest breaks
- Limited access to fluids before and during practice and rest breaks
- Delay in recognition of early warning signs

## General Considerations for Risk Reduction

- Encourage proper education regarding heat illnesses (for athletes, coaches, parents, medical staff, etc.). Education should focus on hydration needs, acclimatization, work/rest ratio, signs and symptoms of exertional heat illnesses, treatment, dietary supplements, nutritional issues, and fitness status.
- Provide medical services onsite (e.g., athletic trainers, emergency medical technicians [EMTs], physicians).
- Ensure preparticipation physical examination has been completed that includes specific questions regarding fluid intake, weight changes during activity, medication and supplement use, and history of cramping/heat illnesses.
- Assure that the medical staff has authority to alter work/rest ratios, practice schedules, amount of equipment, and withdrawal of individuals from participation based on environment and/or athlete's medical condition.

## DEHYDRATION

### *Factors Contributing to Onset of Condition*

When athletes do not replenish lost fluids, they become dehydrated. Mild dehydration (<2% body weight loss) is often unavoidable because athletes cannot always replenish fluids at a rate equal to that being lost. Dehydration as minimal as 1% to 2% BWL can begin to hinder performance and thermoregulatory function.

**Table 1**  
Wet Bulb Globe Temperature Risk Chart

WBGT	Flag Color	Level of Risk	Comments
<18°C (<65°F)	Green	Low	Risk low but still exists on the basis of risk factors
18°-23°C (65°-73°F)	Yellow	Moderate	Risk level increases as event progresses through the day
23°-28°C (73°-82°F)	Red	High	Everyone should be aware of injury potential; individuals at risk should not compete
>28°C (>82°F)	Black	Extreme or hazardous	Consider rescheduling or delaying the event until safer conditions prevail; if the event must take place, be on high alert. Take steps to reduce risk factors (e.g., more and longer rest breaks, reduced practice time, reduced exercise intensity, access to shade, minimal clothing and equipment, cold tubs at practice site, etc.).

The WBGT can be measured with a WBGT meter. The calculation for the determination of WBGT is:  $WBGT = .7$  (Wet Bulb temperature) +  $.2$  (Black Globe Temperature) +  $.1$  (Dry Bulb Temperature).

This table was originally printed in Roberts WO. Medical management and administration manual for long distance road racing. In: Brown GH, Gudjonsson B, eds. *IAAF Medical Manual for Athletics and Road Racing Competitions: a Practical Guide*. Monaco: International Association of Athletics Federations;1998:39-75.

Optimal hydration is the replacement of fluids and electrolytes in accordance with individual needs. Fluid intake should nearly approximate fluid losses. Athletes must personally establish and monitor fluid requirements and modify behavior to ensure optimal hydration status. Fluid intake beyond fluid needs for many hours also can be quite harmful (see Exertional Hyponatremia).

### Recognition

Indicators of dehydration include dry mouth, thirst, irritability, general discomfort, headache, apathy, weakness, dizziness, cramps, chills, vomiting, nausea, head or neck heat sensations, excessive fatigue, and/or decreased performance.

### Treatment

The following procedures are recommended if dehydration is suspected:

- Dehydrated athletes should move to a cool environment and rehydrate.
- Maintaining normal hydration (as indicated by baseline body weight) is the key to avoiding heat illnesses. If an athlete's BWL is greater than 1% to 2% within a given day or on consecutive days, that athlete should return to normal hydration status before being allowed to practice. (Remember that pre-exercise/event/participation examination body weight baseline measures may not accurately assess hydration status if baseline is measured in a dehydrated state. Urine specific gravity or urine color can help with this assessment if an athlete is suspected to be dehydrated at the time baseline measurements are taken.)
- Athletes should begin exercise sessions properly hydrated. Any fluid deficits should be replaced within 1 to 2 hours after exercise is completed.

- Given the nature of sweat and variability and timing of nutritional intake, hydrating with a sports drink containing carbohydrates and electrolytes (i.e., sodium and potassium) before, during, and after exercise is optimal to replace losses and provide energy. Because athletes replace only about half of the fluid lost when drinking water, the flavoring of a sports drink may enhance voluntary rehydration.
- Athletes should have convenient access to fluids during practice and be allowed to hydrate beyond prescribed breaks. These factors can minimize dehydration and may maximize performance.
- A nauseated or vomiting athlete or one with central nervous system dysfunction may have heat stroke or hyponatremia and should be referred to or taken for immediate medical attention and laboratory workup.

### Return-to-Play Considerations

If the degree of dehydration is minor and the athlete is symptom free, continued participation is acceptable. The athlete must maintain appropriate hydration status and should receive periodic checks from onsite medical personnel.

### EXERTIONAL HEAT STROKE

#### Factors Contributing to Onset of Condition

Heat stroke is the metabolic (e.g., sweating, fluid and electrolyte shifts, and renal adjustments) and circulatory (e.g., increased cardiac output and increased blood flow to the skin) consequences of an overwhelmed thermoregulatory system. Body temperature increases as heat production during exercise exceeds dissipation. As thermoregulatory capacity is exceeded, body temperature rises and extreme circulatory and metabolic stresses may produce tissue damage and/or severe physiologic dysfunction, called EHS.

## Recognition

The ability to rapidly and accurately assess core body temperature and CNS functioning is critical to the proper evaluation of EHS; axillary, oral, and tympanic (aural canal) temperatures are not valid measures. Medical staff should be properly trained and equipped to assess core temperature via rectal thermometer when feasible.

*Most critical criteria for determination are* (1) hyperthermic (rectal temperature >104°F/40°C) immediately post-incident and (2) CNS dysfunction (altered consciousness, coma, convulsions, disorientation, irrational behavior, decreased mental acuity, irritability, emotional instability, confusion, hysteria, apathy).

*Other possible salient findings include* (1) nausea, vomiting, diarrhea, (2) headache, dizziness, weakness, (3) hot and wet or dry skin (important to note that skin may be wet or dry at time of incident), (4) increased heart rate, decreased blood pressure, increased respiratory rate, (5) dehydration, and (6) combativeness.

## Treatment

Aggressive and immediate whole-body cooling is the key to optimizing treatment.

The duration and degree of hyperthermia may determine adverse outcomes. If untreated, hyperthermia-induced physiologic changes resulting in fatal consequences may occur within vital organ systems (e.g., muscle, heart, brain, etc.). Due to superior cooling rates, immediate whole-body cooling (i.e., cold water immersion) is the best treatment for EHS and should be initiated within minutes post-incident.

It is recommended to cool first and transport second if onsite rapid cooling is possible. Cooling can be successfully verified

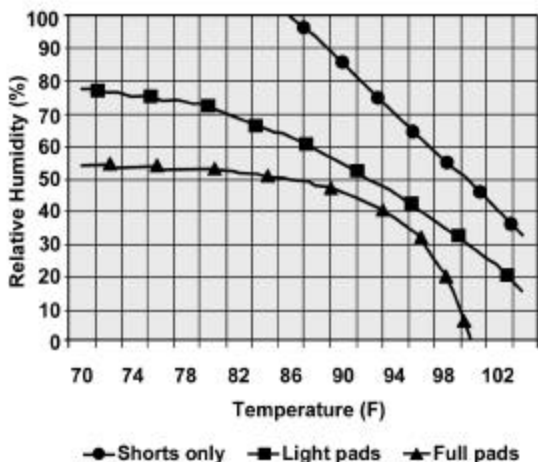
by measuring rectal temperature. If onsite cooling is not an option, immediate transport to the nearest medical facility is strongly encouraged.

The following procedures are recommended if EHS is suspected:

- Immediately immerse athlete in tub of cold water (approximately 35°- 58°F/1.67°- 14.5°C), onsite if possible. Remove clothing/equipment. (Immersion therapy mandates constant monitoring of core temperature by rectal thermistor [or thermometer] in case the patient has a seizure or further alteration in mental status.)
- If immersion is not possible, alternative cooling strategies should be implemented. Examples include one or more of the following: spraying the body with cold water, fans, ice bags or ice over as much of the body as possible, and/or cold towels (replace towels frequently). Move immediately to shaded area or air-conditioned facility.
- Monitor ABCs, core temperature, and CNS (cognitive, convulsions, orientation, consciousness, etc.).
- Place an intravenous line using normal saline (if appropriate medical staff is available).
- Cease aggressive cooling when core temperature reaches approximately 101°F (38.3°C); continue to monitor.
- Transport athlete to medical facility for monitoring of possible organ system damage.

## Return-to-Play Considerations

Physiologic changes may occur after an episode of EHS. For example, the athlete's heat tolerance may be temporarily or permanently compromised. To ensure a safe return to full participation, a careful return-to-play strategy should be decided by the athlete's physician and implemented with the assistance of the certified athletic trainer (ATC) or other qualified health care professional.



**Figure 1. Heat stress risk temperature and humidity graph.** Heat stroke risk rises with increasing heat and relative humidity. Fluid breaks should be scheduled for all practices and scheduled more frequently as the heat stress rises. Add 5° to temperature between 10 AM and 4 PM from mid May to mid September on bright, sunny days. Practices should be modified for the safety of the athletes to reflect the heat stress conditions. Regular practices with full practice gear can be conducted for conditions that plot to the left of the triangles. Cancel all practices when the temperature and relative humidity plot is to the right of the circles; practices may be moved into air-conditioned spaces or held as walk through sessions with no conditioning activities.

Conditions that plot between squares and circles: increase work/rest ratio with 15 to 20 minutes of activity followed by 5- to 10-minute rest and fluid breaks, practice should be in shorts only (with all protective equipment removed, if appropriate for activity).

Conditions that plot between triangles and squares: increase work/rest ratio with 20 to 30 minutes of activity followed by 5- to 10-minute rest and fluid breaks; practice should be in shorts (with helmets and shoulder pads only, not full equipment, if appropriate for activity).

Conditions that plot beneath triangles: increase work/rest ratio with 30 to 40 minutes of activity followed by 5- to 10-minute rest and fluid breaks.

This figure was originally printed in Kulka J, Kenney WL. Heat balance limits in football uniforms: how different uniform ensembles alter the equation. *Physician Sportsmed.* 2002;30(7):29-39.

The following guidelines are recommended for return-to-play after EHS:

- Physician clearance is strongly recommended before returning to exercise. The athlete should avoid all exercise until completely asymptomatic and all laboratory tests are normal.
- Severity of the incident should dictate the length of recovery time.
- The athlete should avoid exercise for the minimum of 1 week after release from medical care.
- The athlete should cautiously begin a gradual return to physical activity to regain peak fitness and acclimatization under the supervision of an ATC or other qualified health care professional. Type and length of exercise should be determined by the athlete's physician and might follow this pattern:
  1. Easy-to-moderate exercise in a climate-controlled environment, followed by strenuous exercise in a climate-controlled environment
  2. Easy-to-moderate exercise in heat, followed by strenuous exercise in heat
  3. (If applicable) Easy-to-moderate exercise in heat with equipment, followed by strenuous exercise in heat with equipment

## HEAT EXHAUSTION

### *Factors Contributing to Onset of Condition*

Heat exhaustion is a moderate illness characterized by the inability to sustain adequate cardiac output, resulting from strenuous physical exercise and environmental heat stress. Inherent needs to maintain blood pressure and essential organ function, combined with a loss of fluid due to acute dehydration, create a challenge the body cannot meet, especially if intense exercise were to continue unabated.

### *Recognition*

*Most critical criteria for determination are* (1) athlete has obvious difficulty continuing intense exercise in heat, (2) lack of severe hyperthermia (usually <104°F/40°C), although it would be expected to find mild hyperthermia at the time of the incident (more commonly, 100°-103°F/37.7°-39.4°C), and (3) lack of severe CNS dysfunction. If any CNS dysfunction (see symptoms listed under EHS) is present, it will be mild and symptoms will subside quickly with treatment and as activity is discontinued.

*Other possible salient findings include* (1) physical fatigue/dizziness, (2) dehydration and/or electrolyte depletion, (3) ataxia and coordination problems, syncope, (4) profuse sweating, pallor, (5) headache, nausea, vomiting, diarrhea, (6) stomach/intestinal cramps, persistent muscle cramps, and (7) rapid recovery with treatment.

## **Treatment**

The following procedures are recommended if heat exhaustion is suspected:

- Remove athlete from play and immediately move to a shaded or air-conditioned area.
- Remove excess clothing and equipment.
- Cool athlete until rectal temperature is approximately 101°F (38.3°C).
- Have athlete lie comfortably with legs propped above heart level.
- If athlete is not nauseated, vomiting, or experiencing any CNS dysfunction, rehydrate orally with chilled water or sports drink. If athlete is unable to take oral fluids, implement intravenous infusion of normal saline.
- Monitor heart rate, blood pressure, respiratory rate, core temperature, and CNS status.
- Transport to an emergency facility if rapid improvement is not noted with prescribed treatment.

## **Return-to-Play Considerations**

The following guidelines are recommended for return-to-play after heat exhaustion:

- Athlete should be symptom free and fully hydrated.
- Recommend physician clearance or, at minimum, a discussion with supervising physician before return.
- Rule out underlying condition or illness that predisposed athlete for continued problems.
- Avoid intense practice in heat until at least the next day to ensure recovery from fatigue and dehydration. (In severe cases, intense practice in heat should be delayed for more than 1 day.)
- If underlying cause was lack of acclimatization and/or fitness level, correct this problem before athlete returns to full-intensity training in heat (especially in sports with equipment).

## HEAT CRAMPS

### *Factors Contributing to Onset of Condition*

The etiology of muscle cramps is not well understood and there may be a number of causes. Heat cramps are often present in athletes who perform strenuous exercise in the heat. Conversely, cramps also occur in the absence of warm or hot conditions (e.g., common in ice hockey players).

Whether or not heat related, cramps tend to occur later in an activity, in conjunction with muscle fatigue and after fluid and electrolyte imbalances have reached a critical level.

Dehydration, diet poor in minerals (especially magnesium), and large losses of sodium and other electrolytes in sweat appear to increase the risk of severe, often whole-body, muscle cramps. Muscle cramps can largely be avoided with adequate conditioning, acclimatization, rehydration, electrolyte replacement, and appropriate dietary practices.

## Recognition

Most critical criteria for determination are (1) intense pain (not associated with acute muscle strain) and (2) persistent muscle contractions in working muscles during and after prolonged exercise and most often associated with exercise in heat.

Other possible salient findings include (1) "salty sweaters" (those with high salt concentration in sweat), (2) high sweat rate, heavy sweating, (3) lack of heat acclimatization, (4) insufficient sodium intake (during meals and practice), (5) dehydration, thirsty, (6) irregular meals, (7) increased fatigue, and (8) previous cramping history.

## Treatment

The following procedures are recommended if heat cramps are suspected:

- Reestablish normal hydration status and replace some sodium losses with a sports drink or water.
- Some additional sodium may be needed (especially in those with a history of heat cramps) earlier in the activity (pre-cramps) and is best administered by dilution into a sports drink. For example, 1 g of sodium dissolved in 20 to 32 oz (600-1000 mL) of a sports drink early in the exercise session provides ample fluids and sodium, and the flavor (while certainly saltier) is still very palatable.

- Light stretching, relaxation, and massage of the involved muscle may help acute pain of a muscle cramp.

## Return-to-Play Considerations

Athletes should be assessed to determine if they can perform at the level needed for successful participation. After an acute episode, diet, rehydration practices, electrolyte consumption, fitness status, level of acclimatization, and use of dietary supplements should be reviewed and possibly modified to decrease risk of recurring heat cramps.

## EXERTIONAL HYPONATREMIA

### Factors Contributing to Onset of Condition

When an athlete consumes more fluids (especially water) than necessary, sodium in the bloodstream can become diluted and cause cerebral and/or pulmonary edema. This is called hyponatremia (low blood-sodium levels) and tends to occur during warm/hot weather activities. Sodium lost in sweat and inadequate sodium intake during lengthy events can increase the rate at which dangerous hyponatremia develops. (Although excessive fluid intake is likely the most common cause of exertional hyponatremia, it can also occur in the absence of overhydration in athletes who do not adequately replace sodium.)

**Table 2**

Sample Sweat Rate Calculation\*

A	B	C		D	E	F	G	H	I	J
Name	Date	Body Weight		Change in BW (C-D)	Drink Volume	Urine Volume †	Sweat Loss (E+F-G)	Exercise Time	Sweat Rate (H/I)	
		Before Exercise	After Exercise							
		kg (lb/2.2)	kg (lb/2.2)	g (kg x 1000)	mL (oz x 30)	mL (oz x 30)	mL (oz x 30)	min h	mL/min mL/h	
		kg (lb/2.2)	kg (lb/2.2)	g (kg x 1000)	mL (oz x 30)	mL (oz x 30)	mL (oz x 30)	min h	mL/min mL/h	
		kg (lb/2.2)	kg (lb/2.2)	g (kg x 1000)	mL (oz x 30)	mL (oz x 30)	mL (oz x 30)	min h	mL/min mL/h	
		kg (lb/2.2)	kg (lb/2.2)	g (kg x 1000)	mL (oz x 30)	mL (oz x 30)	mL (oz x 30)	min h	mL/min mL/h	
Kelly K. ‡	9/15	61.7 kg (lb/2.2)	60.3 kg (lb/2.2)	1400 g (kg x 1000)	420 mL (oz x 30)	90 mL (oz x 30)	1730 mL (oz x 30)	90 min 1.5 h	19 mL/min 1153 mL/h	

\* Reprinted with permission from Murray R. Determining sweat rate. *Sports Sci Exch.* 1996; 9 (Suppl 63).

† Weight of urine should be subtracted if urine was excreted prior to post-exercise body weight.

‡ In the example, Kelly K. should drink about 1 L (32 oz.) of fluid during each hour of activity to remain well hydrated.

### Formula for Calculating Sweat Rate

Calculate each athlete's sweat rate (sweating rate = pre-exercise body weight - post-exercise body weight + fluid intake - urine volume/exercise time in hours) for a representative range of environmental conditions, practices, and competitions (Table 2).

The simplest way to get athletes to focus on their hydration needs is to teach them to compare preexercise and postexercise body weights. If the athletes lost weight, they need to drink more at the next practice. This gives the athletes immediate feedback about their drinking habits.

A simple way to assess fluid means would be to weigh the athletes before and directly after activity, and then modify rehydration based on findings. If weight loss, hydrate more. If weight gain, hydrate less.

Hyponatremia may be completely avoided if fluid consumption during activity does not exceed fluid losses. Because progressive dehydration may also compromise thermoregulatory function, it is of great value for an athlete to be aware of individual fluid needs, to protect against both dehydration and overhydration.

Fluid needs can be determined by establishing an athlete's "sweat rate" (liters per hour) or the amount of fluid lost in a given length of time (usually discussed in an amount per hour) during a given intensity of activity, while wearing a given amount of clothing/equipment, for a given set of environmental conditions (Table 2). Variations can exist in sweat rates, so individual assessments can be quite helpful. When establishing fluid needs, it is best to mimic the same conditions of the athletic event to establish an accurate sweat rate.

### **Recognition**

*Most critical criteria for determination are* (1) absence of severe hyperthermia (most commonly  $<104^{\circ}\text{F}/40^{\circ}\text{C}$ ), (2) low blood-sodium levels ( $<130$  mmol/L). Severity of condition increases as sodium levels decrease, (3) likelihood of excessive fluid consumption before, during and after exercise (weight gain during activity), (4) low sodium intake, (5) likelihood of sodium deficits before, during, and after exercise, and (6) if condition progresses, CNS changes (e.g., altered consciousness, confusion, coma, convulsions, altered cognitive functioning) and respiratory changes resulting from cerebral and/or pulmonary edema, respectively.

*Other possible salient findings include* (1) increasing headache, (2) nausea, vomiting (often repetitive), (3) swelling of extremities (hands and feet), (4) irregular diet (e.g., inadequate sodium intake), (5) during prolonged activity (often lasting  $>4$  hours), (6) copious urine with low specific gravity, (7) lethargy/apathy, and (8) agitation.

### **Treatment**

The following procedures are recommended if exertional hyponatremia is suspected:

- If blood sodium levels cannot be determined onsite, hold off on rehydrating athlete (may worsen condition) and transport immediately to a medical facility.
- The delivery of sodium, certain diuretics, or intravenous solutions may be necessary. All will be monitored in the emergency department to ensure no complications develop.

### **Return-to-Play Considerations**

The following guidelines are recommended for return-to-play after exertional hyponatremia:

- Physician clearance is strongly recommended in all cases.

- In minor cases, activity can resume a few days after completing an educational session on establishing an individual-specific hydration protocol. This will ensure the proper amount and type of beverages and meals are consumed before, during, and after physical activity (see Table 2).

## EXPERT PANEL

The Inter-Association Task Force on Exertional Heat Illnesses is comprised of representatives from the following organizations:

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*The information contained within this document does not necessarily reflect endorsement from the individual organizations listed above.*