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. The risks associated with exercise in the heat are well documented, but policies and procedures often do not reflect current state-of-the-art knowledge. Many cases of exertional heat illness are preventable and can be successfully treated if onsite personnel identify the condition and implement appropriate care in a timely manner.

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 prevent, identify and treat 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., heat acclimatization), others cannot (e.g., health problems). Regardless, these factors may help in developing a proactive approach to preventing exertional heat illnesses.

Intrinsic factors include:

- History of exertional heat illnesses
- 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
- Skin condition (e.g., sunburn, skin rash, etc.)
- Ingestion of certain medications (e.g., antihistamines, diuretics, etc.) or dietary supplements (e.g., ephedra, etc.)
- Motivation to push oneself/warrior mentality
- Reluctance to report problems, issues, illness, etc.
- Pre-pubescence

Extrinsic factors include:

- Intense or prolonged exercise with minimal breaks
- High temperature/humidity/sun exposure (Table 1 and Figure 1), as well as exposure to heat/humidity in preceding days
- Inappropriate work/rest ratios based on intensity, wet bulb globe temperature (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 access to shade during exercise or during rest breaks
- Duration and number of rest breaks is limited
- Minimal 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 about risk factors 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., certified athletic trainer [ATC], emergency medical technician [EMT], physician).
- Ensure pre-participation physical examination that includes specific questions regarding fluid intake, weight changes during activity, medication and supplement use and history of cramping/heat illnesses has been completed.
- Assure that onsite 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 [BWL]) is often unavoidable because athletes cannot always replenish fluids at a rate equal to that being lost. Dehydration as minimal as 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
<65°F (<18°C)	Green	Low	Risk low but still exists on the basis of risk factors
65°-73°F (18°-23°C)	Yellow	Moderate	Risk level increases as event progresses through the day
73°-82°F (23°-28°C)	Red	High	Everyone should be aware of injury potential; individuals at risk should not compete
>82°F (>28°C)	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 CH, 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 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 critical 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 post-practice body weight is being compared to a baseline that 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 complete.
- 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 and during exercise is optimal to replace losses and provide energy. Because athletes replace only about half of the fluid lost when drinking water, a flavored sports drink may promote an increase in the quantity of fluids consumed.
- Replacing lost sodium after exercise is best achieved by consuming food in combination with a rehydration beverage.
- Athletes should have convenient access to fluids throughout practice and be allowed to hydrate in addition to prescribed breaks. These factors can minimize dehydration and may maximize performance.
- A nauseated or vomiting athlete should seek medical attention to replace fluids via an intravenous line.

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 hydration status and should receive periodic checks from onsite medical personnel.

EXERTIONAL HEAT STROKE

Factors Contributing to Onset of Condition
Exertional heat stroke is a severe illness characterized by central nervous system (CNS) abnormalities and potentially tissue damage resulting from elevated body temperatures induced by strenuous physical exercise and increased environmental heat stress.

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 temperatures are not valid measures in individuals exercising in hot environments. Medical staff should be properly trained and equipped to assess core temperature via rectal thermometer when feasible.

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

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 physiological changes resulting in fatal consequences may occur within vital organ systems (e.g., muscle, heart, brain, liver, kidneys, etc.). Due to superior cooling rates, immediate whole-body cooling via cold water immersion is the best treatment for EHS and should be initiated within minutes post-incident.

Provided that adequate emergency medical care is available onsite (i.e., ATC, EMT or physician), it is recommended to cool first via cold water immersion, then transport second. Cooling can be successfully verified by measuring rectal temperature. If onsite rapid cooling via cold water immersion is not an option or if other complications develop that would be considered life threatening (i.e., airway, breathing, circulation), immediate transport to the nearest medical facility is essential.

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 should include constant monitoring of core temperature by rectal thermistor [or thermometer].)
- If immersion is not possible, transport immediately. Alternative cooling strategies should be implemented while waiting for and during transport. These strategies could include: 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).
- Monitor airway, breathing, circulation, core temperature, and CNS status (cognitive, convulsions, orientation, consciousness, etc.) at all times.
- Place an intravenous line using normal saline (if appropriate medical staff is available).
- Cease aggressive cooling when core temperature reaches approximately 101°-102°F (38.3°-38.9°C); continue to monitor.
- If rapid onsite cooling was administered and rectal temperature has reached approximately 101°-102°F (38.3°-38.9°C), transport athlete to medical facility for monitoring of possible organ system damage.

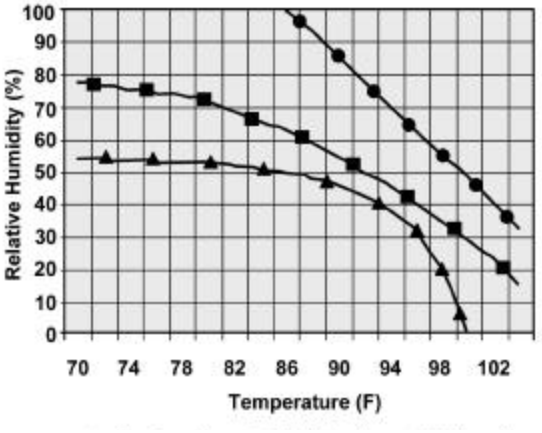

Figure 1. Heat stress risk temperature and humidity graph. Heat stroke risk rises with increasing heat and relative humidity. Fluid breaks should be scheduled for all practices and scheduled more frequently as the heat stress rises. Add 5º to temperature between 10 a.m. and 4 p.m. from mid-May to mid-September 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: use 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 worn for activity).

Conditions that plot between triangles and squares: use work/rest ratio with 20 to 25 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 worn for activity).

Conditions that plot beneath triangles (through remaining range of chart): use work/rest ratio with 25 to 30 minutes of activity followed by 5- to 10-minute rest and fluid breaks.

Adapted with permission from Kulka J, Kenney WL. Heat balance limits in football uniforms: how different uniform ensembles alter the equation. *Physician Sportsmed*. 2002;30(7):29-39.

Return-to-Play Considerations
Physiological 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 ATC or other qualified health care professional.

The following guidelines are recommended for return-to-play after EHS:
- Physician clearance is necessary 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 for several days, followed by strenuous exercise in a climate-controlled environment for several days.
    2. Easy-to-moderate exercise in heat for several days, followed by strenuous exercise in heat for several days.
    3. (If applicable) Easy-to-moderate exercise in heat with equipment for several days, followed by strenuous exercise in heat with equipment for several days.

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, (2) dehydration and/or electrolyte depletion, (3) ataxia and coordination problems, syncope, dizziness, (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, rectal 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, 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:

- Re-establish normal hydration status and replace some sodium losses with a sports drink or other sodium source.
- 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, 1/2 g of sodium (equal to the amount of sodium found in 1/4 tsp of table salt) dissolved in about 1 L (approximately 32 oz) 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.

Table 2

Sample Sweat Rate Calculation*

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

When calculating an athlete's sweat rate (sweat rate = pre-exercise body weight - post-exercise body weight + fluid intake - urine volume/exercise time in hours), do so for a representative range of environmental conditions, practices and competitions.

The simplest way to get athletes to focus on their hydration needs is to teach them to compare pre-exercise and post-exercise body weights. If the athletes lost weight, they need to drink more at the next practice; if they gained weight, they should drink less. This gives the athletes immediate feedback about their drinking habits.

EXERTIONAL HYPONATREMIA

Factors Contributing to Onset of Condition

When an athlete consumes more fluids (especially water) than necessary, and/or sodium lost in sweat is not adequately replaced, 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.

The risk of acquiring hyponatremia can be substantially reduced if fluid consumption during activity does not exceed fluid losses and sodium is adequately replaced. 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 (especially in at-risk individuals). 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) low blood-sodium levels (<130 mmol/L). Severity of condition increases as sodium levels decrease, (2) likelihood of excessive fluid consumption before, during and after exercise (weight gain during activity), (3) low sodium intake, (4) likelihood of sodium deficits before, during and after exercise and (5) 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 following exercise, (7) lethargy/apathy, (8) agitation and (9) absence of severe hyperthermia (most commonly <104°F/40°C).

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 mild 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
was composed 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.