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Sports Science News: Preventing Exertional Heat Illness: A Consensus Statement

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Last February, 20 sports medicine and exercise science experts from 18 professional associations met in Atlanta to discuss Exertional Heat Illness (EHI). The focus of this inter-associational task force was to develop guidelines to help reduce the risks of exertional heat illness. Following are excerpts from the Inter-association Task Force on Exertional Heat Illness Consensus Statement as compiled by Douglas Casa, PhD, ATC, FACSM, director of the athletic training education program at the University of Connecticut, who chaired the event.

We hope you find this information useful.

Bob Murray, PhD, FACSM
Director, Gatorade Sports Science Institute

Preventing Exertional Heat Illness: A Consensus Statement

By Douglas Casa, PhD, ATC, FACSM

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Every athletic organization should have a written plan for recognizing, preventing and treating exertional heat illnesses (i.e., dehydration, heat cramps, heat exhaustion, exertional heat stroke and exertional hyponatremia). The risk factors that must be addressed include:

- Intrinsic factors such as inadequate heat acclimatization, inadequate fitness level, higher body fat, dehydration or overhydration, illness or fever, presence of gastrointestinal distress, salt deficiency, inadequate meals or insufficient energy intake, skin conditions (e.g., sunburn, skin rash, abrasions, infections, etc.), prepubescence, ingestion of medications or dietary supplements, overly motivated athletes, athletes reluctant to report problems.

- Extrinsic factors such as training intensity and duration, frequency and length of rest breaks, wet bulb globe temperature (WBGT) values, exposure to high heat/humidity in preceding days, clothing and equipment, staff awareness/education regarding EHIs, an emergency action plan, a policy to guide fluid replacement and assure adequate hydration.

It is possible to prevent exertional heat illnesses by proper education and the presence of appropriate

on-site medical staff. Pre-participation physical examinations on all athletes that include the athlete's history of cramping or heat illness, use of prescription and over-the-counter medications and intake of dietary supplements is a key part of the prevention and education program.

Dehydration

When athletes do not replenish lost fluids, they become dehydrated. Mild dehydration (less than two percent body weight) is sometimes unavoidable because athletes can not always balance fluid intake with fluid loss. However, even mild dehydration can hinder performance and thermoregulatory function.

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

Preventing Dehydration

Maintaining normal hydration (as indicated by baseline body weight) is an important key to preventing heat illness. Athletes should not be allowed to practice if their total body weight loss is greater than two percent of their baseline (e.g., 4 lbs in a 200-lb athlete). Athletes should begin each exercise session properly hydrated (within two percent of their baseline body weights) and must have easy access to fluids during and after practice.

Treating Dehydration

The athlete should first be moved to a cool environment and rehydrated with a sports drink containing carbohydrates and electrolytes (i.e., sodium and potassium). (A flavored beverage enhances voluntary drinking.)

Return-to-Play Issues for Dehydration

Continued participation is acceptable if dehydration is minimal (i.e., < 2% deficit in baseline body weight) and the athlete is symptom-free. Periodic checks from on-site medical personnel are recommended.

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Heat Cramps

The etiology of muscle cramps is not well understood. Whether or not heat-related, cramps tend to occur later in an activity, in conjunction with muscle fatigue and in the presence of dehydration and large sodium losses. Dehydration due to large sweat losses and inadequate fluid intake, and a diet inadequate in minerals (such as sodium, potassium, calcium, and magnesium) appear to provoke whole-body, muscle cramps.

Muscle cramps can largely be avoided with adequate conditioning, acclimatization, rehydration, electrolyte replacement and appropriate dietary practices.

Muscles cramps are often seen in athletes who:

- Are "salty" or heavy sweaters (those with white residue caked on uniforms and equipment)
- Are not adequately acclimatized to the heat
- Have insufficient intake of sodium during meals and practices
- Are fatigued and dehydrated
- Eat irregular, inadequate meals
- Have a pervious history of cramping

Treating Heat Cramps

Reestablishing normal hydration status and replacing sodium losses are primary treatment steps. Light stretching and massage of the involved muscles may also help reduce the acute pain of a muscle cramp.

Return-to-Play Issues for Heat Cramps

Athletes can return to play once they can perform at the level needed for successful participation. Diet, rehydration practices, electrolyte consumption, fitness status, level of acclimatization and use of dietary supplements should be reviewed and possibly modified to decrease the risk of recurrence.

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Heat Exhaustion

Heat exhaustion results from strenuous physical exercise and environmental heat stress. It is characterized by the body's inability to sustain adequate cardiac output and can be recognized in an athlete who has obvious difficulty continuing intense exercise in heat, by mild hyperthermia (*usually < 104°F/40°C*) and by the absence of CNS dysfunction.

Symptoms can include physical fatigue and dizziness, dehydration and/or electrolyte depletion, syncope, profuse sweating, pallor, headache, nausea, vomiting, diarrhea, stomach or intestinal cramps and persistent muscle cramps. Rehydration in a cool environment will result in rapid recovery. It should be noted that skin color and wetness should not be used to recognize heat illness.

Treating Heat Exhaustion

It is best to remove athletes from activity to a shaded or air-conditioned area and remove excess clothing and equipment. Then:

- Cool athletes until rectal temperature is less than 101°F (38.3°C) and lay them comfortably with legs propped above heart level
- Rehydrate athletes orally with cool water or sports drink, if they can tolerate oral fluids
- If athletes can't tolerate oral fluids, implement intravenous 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

Return-to-Play Issues for Heat Exhaustion

Athletes should be symptom-free, fully hydrated and cleared by a physician before returning to play. Gradual return to full-intensity training and competition is recommended.

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Exertional Heat Stroke (EHS)

Exertional heat stroke is the metabolic, circulatory and neural consequence of an overwhelmed thermoregulatory system. As thermoregulatory capacity is exceeded and body temperature rises, extreme circulatory and metabolic stresses may produce tissue damage and/or severe physiological dysfunction that can culminate in death.

Recognizing EHS

The ability to rapidly and accurately assess core body temperature and CNS function is critical for evaluating EHS. The two most critical parameters are:

- Hyperthermic (rectal temperature > 104° F/40° C) immediately post-incident
- The presence of overt CNS dysfunction (altered consciousness, coma, convulsions, disorientation, irrational behavior, decreased mental acuity, irritability, emotional instability, confusion, hysteria or apathy).

Other symptoms may include nausea, vomiting, diarrhea, headache, dizziness, weakness, increased heart and respiratory rates, decreased blood pressure and dehydration.

Treating EHS

It is best to remove the athletes' clothing and equipment and immediately immerse them in cold water (~35° -58° F/1.7° -14.5° C). If cold-water immersion is not possible, move them to a shaded area or air-conditioned facility and begin alternative cooling strategies such as spraying their bodies with cold water, fans, ice bags on the neck and groin, or applying ice all over. Then:

- Call 911
- Closely monitor ABCs, core temperature and CNS status
- Place an intravenous line using normal saline (if medical staff is available)
- Cease aggressive cooling when core temperature reaches ~101° F (38.3° C)
- Transport to a medical facility

Return-to-Play Issues for EHS

The severity of an incident should dictate the off-time before an athlete can return to play. Athletes should avoid exercise for at least one week after release from medical care, returning gradually to full practice after being completely asymptomatic and cleared by a physician.

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Exertional Hyponatremia

During lengthy athletic events, the sodium lost in sweat, coupled with inadequate sodium intake, increases the risk of hyponatremia. Although excessive fluid intake is likely the most common cause of hyponatremia, exertional hyponatremia can also occur in athletes in very prolonged exercise (e.g., > 6 hours) who are not overhydrated, but who simply do not adequately replace the sodium they lose in sweat.

Hyponatremia can be avoided if fluid consumption does not exceed fluid loss and if adequate sodium is ingested. These fluid and electrolyte needs can be determined by determining a "sweat rate".

Recognizing Exertional Hyponatremia

The most critical criteria for identifying exertional hyponatremia are:

- The absence of severe hyperthermia (most commonly < 104° F/40° C)
- Low blood-sodium levels (< 130 mmol/L)
- Likelihood of excessive fluid consumption before, during and after exercise (e.g., weight gain during activity)
- Low sodium intake during exercise
- Likelihood of sodium deficits before, during and after exercise

CNS changes (e.g., altered consciousness, confusion, coma, convulsions, altered cognitive functioning) and respiratory changes resulting from cerebral and/or pulmonary edema may also be noted. Other symptoms may include increasing headache, nausea or vomiting, swelling of extremities (hands and feet), copious urine with low specific gravity, lethargy, apathy or agitation. Some of these symptoms are similar to those associated with heat illness. For that reason, measurement of core body temperature and blood sodium levels are critical diagnostic tools.

Treating Exertional Hyponatremia

If exertional hyponatremia is suspected and blood sodium levels cannot be determined on-site, delay rehydrating athletes. Instead, implement measures to cool athletes, such as removing or loosening clothing and equipment, fanning or placing cool water on skin and transport them immediately to a medical facility.

Return-to-Play Issues for Exertional Hyponatremia

Physician clearance is strongly recommended in all cases.

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The Inter-Association Task Force on Exertional Heat Illnesses

American Academy of Pediatrics
American College of Emergency Physicians
American College of Sports Medicine
American Dietetic Association
American Medical Society for Sports Medicine
American Orthopaedic Society for Sports Medicine
American Osteopathic Association of Sports Medicine
American Physiological Society
CDC - Nutrition and Physical Activity
Department of Defense Health Affairs
Gatorade Sports Science Institute
National Association of Emergency Medical Services Physicians
North American Society for Pediatric Exercise Medicine
National Association of Sport and Physical Education/AAHPERD
National Athletic Trainers' Association
National SAFE KIDS Campaign
National Strength and Conditioning Association
U.S. Army Center for Health Promotion and Preventative Medicine

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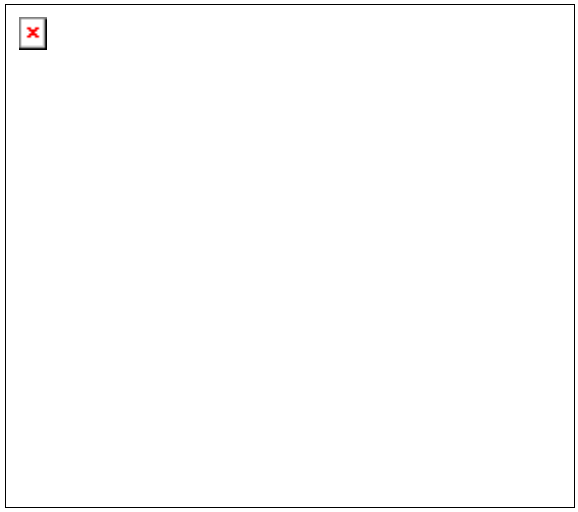
Figure 1



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

Figure 1. Heat stress risk can be assessed based on environmental temperature and humidity. Note that the amount and type of clothing worn by the athlete has a major impact on the overall heat stress the athlete can tolerate.

Moderate Risk (Conditions beneath the line with triangles)

- Work-to-rest ratio of 30 to 40 minutes of activity followed by a five to ten minute rest and fluid breaks
- No equipment limitations

Elevated Risk (Conditions between triangles and squares)

- Work to rest ratio of 20 to 30 minutes of activity followed by a five to ten minute rest and fluid breaks
- Minor equipment limitations

High Risk (Conditions between squares and circles)

- Work to rest ratio of 15 to 20 minutes of activity followed by a five to ten minute rest and fluid breaks,
- Shorts only

Chart 1

Formula for Calculating Sweat Rate

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

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