

## ★ Hydration and Heat Illness Guidelines

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### ★ OVERVIEW

The popularity of soccer among American youth is at an all-time high. Nearly 14 million young (13,832,000) under the age of 18 play soccer at elite and recreational levels in the United States.

The rapid growth of youth soccer participation in recent years, coupled with an increased need for qualified certified coaches, has made insuring the safety of youth soccer players more important than ever. Moreover, new youth soccer research from the University of Connecticut and serious cases of heat illness past few years across a variety of sports has prompted the U.S. Soccer Federation to issue an updated version of its "Youth Soccer Heat Stress Guidelines." The aim is to help parents, young athletes and coaches understand one of the most common and most preventable sports injuries – heat-related illnesses, including dehydration, heat cramps, heat exhaustion and heat stroke.

The following information and youth heat stress guidelines provide suggestions for preventing the potentially dangerous and sometimes deadly effects of playing in hot or humid conditions.

### ★ PHYSIOLOGICAL FACTORS THAT PUT YOUNG ATHLETES AT RISK

Heat-induced illness is one of the most preventable sports injuries. Parents, young athletes and coaches should understand the physiological factors that put children and adolescents at risk for heat-related illness and take steps to prevent it.

Exercising children face unique stresses when they perform intense exercise in the heat. Like adults, they have trouble adapting to the physiological demands of high environmental temperatures when participating in soccer practice and game situations. When a youth is also dehydrated this may exacerbate the respiratory distress during exercise in the heat.

The physiological/psychological reasons that place children at risk are:

- 1) Children absorb more heat from a hot environment because they have a greater surface-area to body weight ratio than adults. The smaller the child the faster the heat absorption.(9)
- 2) Children and adolescents may have a reduced ability to dissipate heat through sweating.(2)
- 3) Children and adolescents frequently do not have the physiological drive to drink enough fluids to replace sweat losses during prolonged exercise. (3,4)
- 4) Youth athletes may be more easily distracted when occasions allow for them to rest and rehydrate.
- 5) Some youth athletes may be under intense pressure to make a competitive squad and may not report feelings of heat distress or take the appropriate amount of time to rehydrate.

### ★ FACTORS THAT PUT YOUNG SOCCER PLAYERS AT RISK

In addition to physiological considerations, several factors specific to the sport of soccer place young players at risk for heat illness. However, these risks can be reduced significantly with the close attention of medical staff (athletic trainers), parents, young athletes and their coaches. These soccer-specific factors are:

- 1) Limited stoppage time during matches, with players constantly running and moving.
- 2) Young soccer players are not encouraged to use the limited stoppage time they do have for fluid consumption.
- 3) Games are held outdoors, often in high temperatures and humidity, on large fields that offer little shade. Heat radiated by the sun is a major component of heat stress. This issue is complicated by limited access to shaded areas for players between halves or between games.
- 4) Young players fail to drink enough fluids at tournaments and summer camps, where numerous games and practices take place each day.
- 5) Games and practice sessions when players are confronted with extreme heat and humidity conditions.

### Additional Factors to Consider

- Communication between playing fields and medical tents at tournaments is sometimes insufficient.
- Many teams fail to recognize the need and/or importance of using light-colored, loose-fitting uniforms.(5)
- Referees could be unaware of the need and/or importance of fluid breaks.
- Mental alertness and skill performance decline with dehydration<sup>6</sup> and could be a factor in injuries occurring in matches and training sessions.

### HEAT ILLNESS PREVENTION TECHNIQUES

Acclimatization to the heat is an important factor in preventing heat illness. The rate of acclimation for children is slower than for adults.

slower than that of adults<sup>7</sup>. A child needs as many as 8 to 10 days (45-60 minutes/day) in the new climate to acclimate sufficiently. Such exposures can be taken at a rate of one per day or one every other day. As the benefits of acclimatization occur in the first 4-6 days and should be considered an absolute minimum of time for children to get used to the heat before beginning intense practice and game situations. During the acclimation process, it's important to practice the methods prescribed and to drink adequate amounts of fluids to build the body's fluid volumes. Lack of acclimatization can be a problem for a team flying to a new environmentally stressful location.

When a child becomes acclimated, their sweat rate and total sweat losses increase. When they exercise, they begin to sweat sooner and produce more sweat than before becoming acclimated. Evaporation of sweat from the body loses heat and this change in sweating allows the child to lose more heat into the environment through evaporation. When a child becomes acclimated and their sweat rate increases, it's important that the child has sufficient fluids to replace the increased sweat losses and stay hydrated. Medical staff, parents, and coaches must understand that thirst is not a good indicator of a child's fluid needs,<sup>8</sup> so children need to drink on a schedule (see FLUID GUIDELINES below).

Children should choose clothing that is light-colored and lightweight that facilitates evaporation of sweat. Coaches should encourage breaks in a shaded area whenever possible, especially during tournament games, and multi-practice days. It's important to be aware of high temperatures and humidity and, if possible, to schedule practice and game times to cooler portions of the day, such as morning and dusk. Additionally, children need to be relaxed during hot weather playing conditions, such as allowing a 5-minute break in the middle of each half, allowing water bags to be carried by players during play, or shortening each half and adding that time to halftime for a longer break. Practices must be modified based on conditions. Use frequent rest breaks to monitor core temperature and provide ample time to rehydrate.

Heat stress is a combination of air temperature, radiant heat, and humidity. This overall heat stress is calculated using the Wet Bulb Globe Temperature (WBGT). The formula follows the next table. Notice WBGT is based 10% on the air temperature, 20% on radiant heat, and 70% on humidity. The temperature on TV or in the newspapers is only the air temperature and does not take into account radiant heat or humidity. It is important to emphasize that the WBGT temperature is not the same # you would see on a regular thermometer. Do not use air temperature or the so-called 'heat index' reported by the media for reviewing the chart below. The chart below was developed by the American College of Sports Medicine as a guideline for individuals or for participation events.

**Examples of the WBGT.**

On a hot sunny day with:

Air temp = 85 F

Dew point = 75 F (88% humidity - formula is ratio of dew point to the air temp.)

Radiant heat = 110 F

The WBGT is = 83 F

Same day with

Air temp = 85 F

Dew point = 43 F

Radiant heat = 110 F

The WBGT is = 61 F

**ACTIVITY RESTRICTIONS FOR OUTDOOR PHYSICAL CONDITIONING IN HOT WEATHER**

<b>WBGT* Degrees C (Degrees F)</b>	<b>Flag Color</b>	<b>Guidance = for non-acclimatized personnel in boldface <i>Guidance for fully acclimatized personnel in italics</i></b>
less than 78.0 F	no flag	<b>Extreme exertion may precipitate heat illness</b> <i>Normal activity</i>
78.0 F - 82.0 F	Green	<b>Use discretion in planning intense exercise</b> <i>Normal activity</i>
82.1 F - 86.0 F	Yellow	Pay special attention to at-risk individuals in both cases. <b>Limit intense exercise to 1 hour, limit total outdoor exercise to 2 hours</b> <i>Use discretion in planning intense physical activity</i>
86.1 F - 89.9 F	Red	Pay special attention to at-risk individuals in both cases. Be on high alert: watch for early signs and symptoms in both cases. <b>Stop outdoor practice sessions and outdoor physical conditioning</b> <i>Limit intense exercise to 1 hour, limit total outdoor exercise to 4 hours.</i>

Be on high alert: watch for early signs and symptoms throughout.

greater than 90 F

BLACK

**Cancel all outdoor exercise requiring intense physical exertion**

*Cancel all outdoor exercise requiring intense physical exertion*

\*WBGT: wet bulb globe temperature Calculation of WBGT:  $0.7 T_{wb} + 0.2 T_{bg} + 0.1 T_{db}$ , where  $T_{wb}$ : wet bulb temperature;  $T_{bg}$ : black globe temperature;  $T_{db}$ : dry bulb temperature \*\*Guidelines assume that players are wearing summer-weight clothing; all activities require constant supervision (i.e. via athletic trainer) to assure detection of problems. The athletic trainer and team physician must decide if these guidelines are too general, conservative or too moderate for the geographical region in which the practice or event is taking place. It is appropriate to modify based on regional considerations and unique circumstance. Modified from: Nunnally, Reardon MJ. Prevention of heat illness. In: *Medical aspects of harsh environments: Volume I*. Pandolf, KB; Burr RE (Eds). TMM Publications, Washington, DC. 2002, pages 209-230.

## FLUID GUIDELINES

The U.S. Soccer Federation provides these guidelines to help parents, players and coaches prevent dehydration and heat illness in young athletes who are active in the heat:

1) Weigh each player before and after activity to determine how much fluid he or she loses during activity. If a player is lighter after activity then encourage a little more fluid consumption during the next practice/game. If a player is heavier after activity then encourage a little less fluid during the next practice/game.

2) According to the American Academy of Pediatrics(10):

- Before prolonged physical activity, the child should be well hydrated.
- During the activity, periodic drinking should be enforced even if the child does not feel thirsty and every 15-20 minutes the child or adolescent should consume:
  - 5 ounces of fluid for a player weighing 90 lbs or less
  - 9 ounces of fluid for a player weighing more than 90 lbs.

Supporting research states:

- To ensure that the child is not dehydrated before the start of the practice session or game, the child should drink 12-16 ounces of fluid approximately 30 minutes before getting to the field.
- Once the activity is over, players should drink water or a sports drink every 20 minutes for an hour

\* Recent research (11) shows that adolescent males typically lose 1-1.5 liters per hour when performing soccer practices/games in the heat, while younger males and females will lose from 0.6 to 1 liter per hour.

3) Teach the youth soccer player to monitor his/her own hydration status with the following tip: If their urine (not when diluted in the bowl) is a pale yellow like lemonade then they are likely pretty well hydrated. If urine is dark yellow like apple juice then they are likely dehydrated. This is an easy and accurate way to monitor hydration status and it gets the kids involved on a personal level.

4) Kids need to drink enough of the right fluids to replenish fluid losses during activity.

- Flavored beverages that contain sodium (sports drinks) are preferable because the child may drink more of them.
  - Research shows that lightly sweetened and flavored non-carbonated beverages, like sports drinks, are preferred during exercise and are consumed in greater volumes than water, 12 diluted fruit juice<sup>13</sup> or carbonated beverages.<sup>(14)</sup>
  - Research shows that fluids containing sodium chloride (sports drinks) increase voluntary drinking 1.5 times compared to drinking plain water.<sup>(3)</sup>

5) In addition to replacing fluid, children also need to replace the electrolytes, such as sodium, lost through sweating. Electrolyte replacement is important to stimulate an adequate thirst mechanism,<sup>15</sup> help the body hold onto fluid,<sup>16</sup> help prevent muscle cramps<sup>17</sup> and to maintain sodium levels in the blood. (18)

6) Fluids children should avoid immediately before and during activity include fruit juices, carbonated beverages, caffeinated beverages and energy drinks.

- Fruit juices have a high sugar content, which can slow fluid absorption and cause upset stomach,<sup>19</sup> and lack sodium.
- Carbonated beverages, such as soft drinks, can reduce voluntary drinking due to stomach fullness and

burn when gulping (20) and lack sodium.

- Energy drinks should be avoided because many contain caffeine and have high carbohydrate concentration which slows the emptying of fluids from the stomach. (21)

7) Be sure that each child has his/her own beverage container and that they have the opportunity to keep it during the practice. An individual container will allow them to monitor fluid consumption more accurately, filled with beverage of personal preference, will help avoid the spread of germs and viruses and the cool liquid will be replenished at a better rate than a container that sits out in the sun.

Additionally, it is important to note that dehydration also hinders exercise performance. So to maintain the level of intensity while dehydrated the athlete will have to work even harder to keep up with everyone else.

#### SIGNS OF DEHYDRATION AND HEAT ILLNESS (22,23)

Unchecked dehydration increases the risk of heat illness. Heat illnesses are three separate degrees of severity: heat cramps, heat exhaustion, and heat stroke; the most serious and deadly heat illness. The symptoms listed below are not always additive and do not necessarily occur in an orderly, predictable progression. A young athlete could experience heat stroke in absence of other indicators.

#### Dehydration

Dehydration during exercise is a common problem. Some young athletes can begin to suffer the consequences of dehydration if they become dehydrated by just 2 percent of their body weight during exercise in the heat. That's why it's important to recognize the warning signs:

- Noticeable thirst
- Irritability
- Decreased performance
- Fatigue
- Weakness
- Nausea
- Headache
- Muscle Cramping
- Dark yellow urine (or no desire to urinate)
- Lightheaded feeling or dizziness
- Difficult paying attention

Treating the symptoms of dehydration is crucial in preventing more serious conditions such as heat exhaustion.

- 1) Have the player rest in a cool place
- 2) Provide a sports drink that contains electrolytes
- 3) Prevent dehydration in the future by insuring the player consumes fluids before, during and after exercise (educate and allow ample time to rehydrate)

#### Muscle Cramping

Muscle cramping can be associated with exposure to excessive heat. Painful involuntary whole-body cramps are often associated with loss of fluids and sodium. Some of the signs and symptoms of muscle cramping include:

Muscle spasms

- "Knotting" of muscles and muscle pain
- Excessive sweat loss
- Excessive saltiness of sweat over the skin or visible dried salt on the skin
- Excessive dehydration

To treat a young athlete suffering from muscle cramps:

- Have them drink fluids with electrolytes, like a sports drink
- Gently stretch and massage cramped muscles
- Have them rest in a cool, shaded area
- Apply ice to the cramped area
- Consider additional sodium in palatable food source, like pretzels, etc.

#### Heat Exhaustion

As a child becomes dehydrated, the likelihood of heat exhaustion may increase if left untreated. Eventually, heat exhaustion and heat stroke occur because the cardiovascular system can no longer support exercise and core temperature control at the same time. Common symptoms of heat exhaustion are:

- Dizziness & Fatigue
- Feeling chilly
- Rapid pulse Treatment of heat exhaustion is similar to that of dehydration and should take place immediately

This treatment includes:

- Rest the child in a cool, shaded area and place ice cold towels on them
- Drink a sports drink that contains electrolytes
- Have the child lie down with legs elevated to promote circulation
- Athlete should begin to feel better relatively soon, if not, assume heat stroke

### Heat Stroke

Heat stroke is a medical emergency, when it is not recognized promptly and treated properly it can result in Exertional heat stroke occurs when the thermoregulatory system is overwhelmed and/or fails to act in an appropriate manner. At this point, damage to critical organs can occur if the organs remain overheated for an extended period of time, hence the need for rapid cooling. If rapid cooling does not occur, the cellular damage to organs could be extreme and have fatal consequences. Symptoms and results of heat stroke include:

- Very high core body temperature (measured rectally - do not use oral, axillary, tympanic, temporal artery) these other modes are not valid immediately following intense exercise in the heat.(24)
- Altered CNS function (i.e. confusion or unconsciousness or altered mental status, feeling out-of-sorts, lethargy)
- Otherwise healthy athlete collapses during intense exercise in the heat

If an accurate temperature cannot be obtained then rely on CNS function. Relying on an inaccurate temperature device could delay treatment. Remember athletes get better relatively quickly with heat exhaustion and get worse with heat stroke. The important thing to remember is that heat stroke must be treated immediately by the following:

- Immediately cool the victim down by whatever means possible
  - An ice bath is preferable due to the superior cooling rates (holding head out of bath)
  - Ice packs over as much of body as possible
  - A cool shower
  - Cool, wet towels
  - Water spray
- SEEK MEDICAL ATTENTION IMMEDIATELY (always transport a suspected exertional heat stroke to hospital! Do not provide fluids since nausea and vomiting are extremely common. Remove from cooling when temperature is lowered to 102 degrees F.

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### REFERENCES

- 1 Sporting Goods Manufacturers Association. National Soccer Participation Survey, 2003.
- 2 Bar-Or, O. Temperature regulation during exercise in children and adolescents. In: Gisolfi C, Lamb D Perspectives in Exercise Science and Sports Medicine, II. Youth, Exercise and Sport. Indianapolis, IN: Ben Press; 1989, 335-367.
- 3 Wilk B. and O. Bar-Or. J Appl Physiol, 80: 1112-1117, 1996.
- 4 Rivera-Brown, A. et al. J Appl Phys 86: 78-84, 1999.
- 5 Murray R. Dehydration, hyperthermia, and athletes: science and practice. J Athl Train 31: 248-252, 1996.
- 6 Gopinathem, P.M. et al. Arch Environ Health 43:15-17, 1998.
- 7 Inbar, O. Acclimatization to Dry and Hot Environment in Young Adults and Children 8-10 Years Old. New York: Columbia University; 1978 Dissertation.
- 8 Yeargin S.M., Casa D.J., Decher N.R., McCaffrey M.A., Levreault M.L., Cross C.L., James C.T., O'Connell Psathas E. Youth's perception of thirst is not a valid indicator of hydration status. Journal of Athletic Training (2S):S20, 2005.
- 9 American Academy of Pediatrics. Pediatrics 106:158-159, 2000.
- 10 American Academy of Pediatrics. Pediatrics 106:158-159, 2000.
- 11 Ganio M. S., Casa D. J., Yeargin S. W. McDermott B. P., Levreault M. L., Decher N. R., Watson G, Cas Huggins R. A. Sweat rate, fluid consumption, and hydration indices for youth soccer players: effects of education intervention. Medicine and Science in Sports and Exercise. 38(5S), 2006.
- 12 Passe, D. et al. Appetite 35:219-225, 2000
- 13 Passe, D. et al. Med Sci Sports Exerc 31:S322, 1999.
- 14 Passe, D. et al. Int J Sports Nutr 7:286-297, 1997.

- 15 Nose, H. et al. *J Appl Physiol* 65:325-332, 1988.
- 16 Maughan, R.J. and Leiper J.B. *Eur J Appl Physiol* 71:311-319, 1995.
- 17 Bergeron, M.F. *Int J Sports Nutr* 6:62-68, 1996.
- 18 Vrijens, D.M.J. and N.J. Rehrer. *J Appl Physiol* 86:1847-1851, 1999.
- 19 Davis, J.M. et al. *Eur J Appl Physiol* 57:563-569, 1988.
- 20 Ploutz-Snyder, L. et al. *Eur J Appl Physiol* 79:212-220, 1999.
- 21 Murray, R. et al. *Int J Sports Nutr* 7:144-153, 1997
- 22 Epstein, Y. *Am J Med Sports* 2:143-152, 2000.
- 23 Watts, S. *Am J Med Sports* 3:286-293, 2001.
- 24 Becker S. M. Casa D. J., Brown C. M., Yeargin S. W., Ganio M. S., Roti M. W., Boots L. M., Huggin Armstrong L. E., Maresh C. M. Examining the validity of devices that assess body temperature during exercise in the heat. *Journal of Athletic Training*. 41(2S), 2006.