

# U.S. Soccer Federation

## 2006 Youth Soccer Heat & Hydration Guidelines

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### OVERVIEW

The popularity of soccer among American youth is at an all-time high. Nearly 14 million young athletes (13,832,000<sup>1</sup>) under the age of 18 in the United States are playing soccer from the recreational through the elite levels.

The rapid growth of youth soccer participation in recent years, coupled with an increased need for qualified and certified coaches, has made insuring the safety of youth soccer players more important than ever before. Moreover, new youth soccer research from the University of Connecticut and serious cases of heat illness in other sports over the past few years 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 need to understand the factors that put children and adolescents at risk for heat-related illness and take steps to prevent it.

Children face unique stresses when they exercise in the heat. Like adults, young players may have trouble adapting to the demands of soccer practice and game situations played in high temperatures. Problems can be made worse when the young player is dehydrated.

Here are physiological/psychological reasons placing children at risk:

- 1) Children absorb more heat from a hot environment because they have a greater surface-area to body-mass ratio than adults. The smaller the child, the faster they absorb heat.<sup>9</sup>
- 2) Children and adolescents may have a reduced ability to lose heat through sweating<sup>2</sup>.
- 3) During prolonged exercise, children and adolescents frequently do not have the physiological drive to drink enough fluids to replenish sweat losses<sup>3,4</sup>.

- 4) Youth athletes may be more easily distracted when they should be resting and rehydrating.
- 5) Some youth athletes may be under intense pressure to make a competitive squad and may not want to report feelings of heat distress or take the appropriate amount of time to rehydrate.

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

Several soccer-specific factors place young players at risk for heat illness, however, these risks can be reduced with the close attention of medical staff (i.e. athletic trainers), parents, young athletes and coaches. These soccer-specific factors are:

- 1) Limited stoppage time during matches.
- 2) Young soccer players are not encouraged to use the limited stoppage time they have for fluid consumption.
- 3) Games are held outdoors, often in high temperatures and humidity, on large fields that offer little or no shade. Heat radiated by the sun is a major component of heat stress. This is complicated by limited access to shaded areas for players to use 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 hot and humid conditions.

### **Additional Factors to Consider**

- Communication between playing fields and medical tents at tournaments is sometimes inadequate.
- Many teams fail to recognize the importance of using light-colored, loose-fitting uniforms<sup>5</sup> or products made of modern moisture management fabrics.
- Referees could be unaware of the importance of fluid breaks or that they have the authority to briefly suspend play for a fluid break.
- Mental alertness and skill performance declines with dehydration<sup>6</sup> and could be a factor in injuries occurring late 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 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. A majority of the benefits of acclimatization occur in the first 4-6 days and should be considered an absolute minimum amount 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 fluid to build the body's fluid volumes. Lack of acclimatization can be a problem for a team flying to a new, more 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 is how 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 drink sufficient fluids to replace the increased sweat losses and stay hydrated. Medical staff, parents, players 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. Parents and coaches should encourage breaks in a shaded area whenever possible, especially during tournaments, multi-game, and multi-practice days. It's important to be aware of high temperatures and humidity and, if possible, move practice and game times to cooler portions in the day, such as morning and dusk. Additionally, competitive rules 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 lower core temperature and provide ample time to rehydrate.

Heat stress is a combination of air temperature, radiant heat, and humidity. This overall heat stress can be calculated using the Wet Bulb Globe Temperature (WBGT). The formula follows the next table. Notice that the WBGT is based 10% on the air temperature, 20% on radiant heat, and 70% on humidity. The temperature stated 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 mass 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** = 61F

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

WBGT* (°F)	Flag Color	Guidance† for non-acclimatized personnel in boldface <i>Guidance for fully acclimatized personnel in italics</i>
<78.0°F	No flag	<b>Extreme exertion may precipitate heat illness</b> <i>Normal activity</i>
78.0°F – 82.0°F	<b>Green</b>	<b>Use discretion in planning intense exercise</b> <i>Normal activity</i>  Pay special attention to at-risk individuals in both cases.
82.1°F – 86.0°F	<b>Yellow</b>	<b>Limit intense exercise to 1 hour, limit total outdoor exercise to 2.5 hours</b> <i>Use discretion in planning intense physical activity</i>  Pay special attention to at-risk individuals in both cases. Be on high alert: watch for early signs and symptoms in both cases.
86.1°F – 89.9°F	<b>Red</b>	<b>Stop outdoor practice sessions and outdoor physical conditioning</b> <i>Limit intense exercise to 1 hour, limit total outdoor exercise to 4 hours (Be on high alert: watch for early signs and symptoms throughout)</i>
≥ 90°F	<b>Black</b>	<b>Cancel all outdoor exercise requiring intense physical exertion</b> <i>Cancel all outdoor exercise involving intense physical exertion</i>

\*WGBT: 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 early detection of problems. The athletic trainer and team physician must decide if these guidelines are too general or too conservative or too moderate for the geographical region in which the practice or event is taking place. It is very appropriate to modify based on regional considerations and unique circumstance.

Modified from: Nunnally, SA & Reardon MJ. Prevention of heat illness. In: *Medical aspects of harsh environments: Volume 1*. Pandolf, KB and 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) Encourage each player to weigh before and after activity to determine how much fluid was lost during activity.<sup>9</sup> If a player is lighter after activity then encourage a little more fluid consumption during the next practice/game. If the player is heavier after activity then encourage a little less fluid during the next practice/game. Players should try to limit fluid losses to 1-2% of body weight or less.
- 2) According to the American Academy of Pediatrics:<sup>10</sup>
  - 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. Each 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.

The medical research further suggests:

- 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 15-20 minutes for the first hour after activity. The rate of fluid ingestion is generally 1.5 pints of fluids for each pound of weight lost. Volume overload can make it difficult for some athletes to fully rehydrate between multiple sessions within a single day. The goal is to begin training each day at the same weight.

\* Recent research<sup>11</sup> shows that adolescent males typically lose 1-1.5 liters per hour when performing intense 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 their own hydration status with the following tip: If their urine (during flow, not once the urine is diluted in the bowl) is a pale yellow like lemonade then they are likely pretty well hydrated. If their urine is dark yellow like apple juice, then they are likely dehydrated. This is an easy and accurate way to assess hydration status and it gets the kids involved on a personal level.

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

- Flavored beverages that contain sodium (sports drinks) are preferable because the child may drink more.
  - 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,<sup>12</sup> diluted fruit juice<sup>13</sup> or carbonated beverages<sup>14</sup>.
  - Research shows that fluids containing sodium chloride (sports drinks) increase voluntary drinking by 90%, compared to drinking plain water<sup>3</sup>.

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

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

- Fruit juices have a high sugar content that can slow fluid absorption, cause an upset stomach,<sup>19</sup> and may also lack sodium.
- Carbonated beverages, such as soft drinks, can reduce voluntary drinking due to stomach fullness, throat burn when gulping<sup>20</sup> and lack sodium.
- Energy drinks should be avoided because many contain caffeine and have high carbohydrate concentrations which slows the emptying of fluids from the stomach<sup>21</sup>.

7) Be sure that each child uses their own beverage container and that they can keep cool during the practice. An individual container allows monitoring fluid consumption more accurately, can be filled with beverage of personal preference, will help avoid the spread of germs and viruses, and the cool fluid will be replenished at a better rate than a container that sits out in the sun.

Additionally, dehydration also hinders exercise performance. The dehydrated player will have to work harder to maintain the same level of intensity than their hydrated teammate.

## **SIGNS OF DEHYDRATION AND HEAT ILLNESS<sup>22, 23</sup>**

Unchecked dehydration increases the 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 outlined 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
- Difficulty paying attention

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

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

## **Muscle Cramping**

Muscle cramping can be associated with exposure to excessive heat. Painful involuntary whole-body muscle cramps are often associated with loss of fluids and sodium. Some of the signs and symptoms of muscle cramps 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, fatigue and exhaustion occur because the cardiovascular system can

no longer support both exercise and control the core body temperature. 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 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. It can result in death when not recognized promptly and treated properly. Exertional heat stroke occurs when the thermoregulatory system is overwhelmed, fails to act in an appropriate manner, or both. 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 the organs could be extreme and have fatal consequences. Symptoms and results of heat stroke include:

- Very high core body temperature (measured rectally because other sites are not valid immediately following intense exercise in the heat<sup>24</sup>.)
- Altered CNS function (i.e. confusion, unconsciousness, altered mental status, feeling out-of-sorts, extreme lethargy)
- An otherwise healthy athlete collapses during intense exercise in the heat

If an accurate temperature can not be obtained, rely on CNS function. Relying on an inaccurate temperature device or site could delay treatment. Remember, athletes get better relatively quickly with heat exhaustion, but they get worse with heat stroke. It is important to remember that heat stroke must be treated immediately by doing the following:

- **SEEK MEDICAL ATTENTION IMMEDIATELY.** Heat stroke is a medical emergency. Always transport a suspected exertional heat stroke to the hospital! It is probably safe to say that you are not qualified to treat exertional heat stroke.
- Immediately begin to 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 as body as possible
  - A cool shower
  - Cool, wet towels
  - Water spray
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Do not provide fluids since nausea and vomiting are extremely common. Remove the player from cooling source(s) when core temperature is lowered to 102 degrees F.

## CONSULTANT & LEAD RESEARCHER

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## REFERENCES

- <sup>1</sup> Sporting Goods Manufacturers Association. *National Soccer Participation Survey, 2003*.
- <sup>2</sup> Bar-Or, O. Temperature regulation during exercise in children and adolescents. In: Gisolfi C, Lamb DR, eds. *Perspectives in Exercise Science and Sports Medicine, II. Youth, Exercise and Sport*. Indianapolis, IN: Benchmark Press; 1989, 335-367.
- <sup>3</sup> Wilk B. and O. Bar-Or. *J Appl Physiol*, 80: 1112-1117, 1996.
- <sup>4</sup> Rivera-Brown, A. et al. *J Appl Phys* 86: 78-84, 1999.
- <sup>5</sup> Murray R. Dehydration, hyperthermia, and athletes: science and practice. *J Athl Train* 31: 248-252, 1996.
- <sup>6</sup> Gopinathem, P.M. et al. *Arch Environ Health* 43:15-17, 1998.
- <sup>7</sup> Inbar, O. *Acclimatization to Dry and Hot Environment in Young Adults and Children 8-10 Years Old*. New York, NY: Columbia University; 1978 Dissertation.
- <sup>8</sup> Yeargin S.M., Casa D.J., Decher N.R., McCaffrey M.A., Levreault M.L., Cross C.L., James C.T., O'Connor C.B., Psathas E. Youth's perception of thirst is not a valid indicator of hydration status. *Journal of Athletic Training*. 40(2S):S20, 2005.
- <sup>9</sup> American Academy of Pediatrics. *Pediatrics* 106:158-159, 2000.
- <sup>10</sup> American Academy of Pediatrics. *Pediatrics* 106:158-159, 2000.
- <sup>11</sup> Ganio M. S., Casa D. J., Yeargin S. W. McDermott B. P., Levreault M. L., Decher N. R., Watson G, Casa T. M., Huggins R. A. Sweat rate, fluid consumption, and hydration indices for youth soccer players: effects of educational intervention. *Medicine and Science in Sports and Exercise*. 38(5S), 2006.
- <sup>12</sup> Passe, D. et al. *Appetite* 35:219-225, 2000
- <sup>13</sup> Passe, D. et al. *Med Sci Sports Exerc* 31:S322, 1999.
- <sup>14</sup> Passe, D. et al. *Int J Sports Nutr* 7:286-297, 1997.
- <sup>15</sup> Nose, H. et al. *J Appl Physiol* 65:325-332, 1988.
- <sup>16</sup> Maughan, R.J. and Leiper J.B. *Eur J Appl Physiol* 71:311-319, 1995.
- <sup>17</sup> Bergeron, M.F. *Int J Sports Nutr* 6:62-68, 1996.
- <sup>18</sup> Vrijens, D.M.J. and N.J. Rehrer. *J Appl Physiol* 86:1847-1851, 1999.
- <sup>19</sup> Davis, J.M. et al. *Eur J Appl Physiol* 57:563-569, 1988.
- <sup>20</sup> Ploutz-Snyder, L. et al. *Eur J Appl Physiol* 79:212-220, 1999.
- <sup>21</sup> Murray, R. et al. *Int J Sports Nutr* 7:144-153, 1997
- <sup>22</sup> Epstein, Y. *Am J Med Sports* 2:143-152, 2000.
- <sup>23</sup> Watts, S. *Am J Med Sports* 3:286-293, 2001.
- <sup>24</sup> Becker S. M. Casa D. J., Brown C. M., Yeargin S. W., Ganio M. S., Roti M. W., Boots L. M., Huggins R. A., Armstrong L. E., Maresh C. M. Examining the validity of devices that assess body temperature during outdoor exercise in the heat. *Journal of Athletic Training*. 41(2S), 2006.