

SPORTS MEDICINE

Handbook



**NATIONAL FEDERATION OF
STATE HIGH SCHOOL ASSOCIATIONS**

PO Box 690

Indianapolis, Indiana 46206

Phone: 317-972-6900, Fax: 317.822.5700

www.nfhs.org

Fourth Edition

May 2011

Updates and final documents prepared for the NFHS by: NFHS Sports Medicine Advisory Committee

NFHS Staff Liaison: Bob Colgate, Assistant Director

NFHS Sports Medicine Advisory Committee Chair/Editor: Michael C. Koester, M.D., ATC

NFHS is a registered trademark of the National Federation of State High School Associations and use in any manner is prohibited without prior approval of the NFHS.

Member state associations and schools in those associations may reproduce information in this publication for their own use, provided the NFHS copyright is included in the material. The Preparticipation Physical Evaluation Chapter may not be reproduced.

Copyright 2011, by National Federation of State High School Associations.
Printed in the United States of America.

Fluid Replacement and Dehydration

By Colin Wallace, MSc, ATC, CAT(C)

- Athletic performance declines with dehydration, beginning with a fluid loss equaling one to two percent of the athlete's body weight.
- It is important for all athletes to begin each exercise session well-hydrated.
- Rehydration should consist of water, carbohydrates and electrolytes, as all are lost during exercise.
- Athletes should never be punished through the restriction of fluids.

SIGNIFICANCE

In order for an athlete to perform at an optimal level, close attention must be paid to the body's water and electrolyte levels. With many athletes focusing on specific aspects of their sport, along with the outcome of the event, many neglect the need for fluid replacement during activity. Many athletic events pose a challenge (e.g., very little rest) for the athlete to maintain optimal fluid levels, so it is important for athletes to have water or a sports drink close at hand in order to avoid poor performance or other detrimental physiological effects due to dehydration.

BACKGROUND

Minimal fluid loss can impair performance during exercise. At moderate exercise intensity, the human body generally produces 0.5 to 1.5 liters of sweat in one hour, but this may be higher in some individuals. The sweat rate increases as the intensity of exercise increases. During intense exercise in hot conditions, some individuals can lose up to three liters of sweat in one hour. A one percent drop in body weight due to fluid loss can lead to an increased core body temperature during exercise. When an athlete loses one to two percent of body weight due to fluid loss, aerobic exercise performance can decrease. When an athlete loses three percent or more of body weight, there is an increased risk for heat illness. Prevention of dehydration occurs before exercise begins, and should include a hydration protocol agreed upon by coaches, athletic trainers and all others involved in the well-being and performance of a team or athlete.

Pre-exercise Hydration

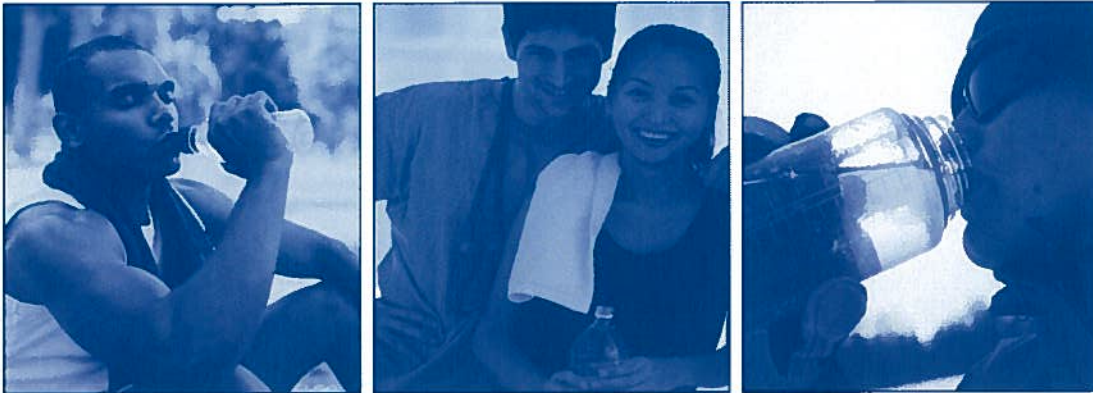
It is important for all athletes to begin each exercise session well-hydrated. Ideally, athletes should monitor their weight before and after exercise sessions in order to replace any fluids lost. It is recommended that an athlete consume 16 ounces (two cups) of water two hours before exercise begins. Another eight to 16 ounces (one to two cups) should be consumed 15 minutes prior to exercise.

Maintaining Hydration During Exercise

Fluid replacement during exercise should equal fluid lost through sweat and urine, at a rate no higher than 48 ounces per hour. As previously stated, fluid loss of one to two percent of body weight can decrease aerobic performance, so the goal of the athlete should be to minimize dehydration to less than two percent loss of body weight, with less than one percent loss of body weight being optimal.

Unfortunately, relying on the body's thirst mechanism cannot prevent dehydration, so thirst should not be relied upon to determine fluid intake. By the time a person becomes thirsty, he or she is already dehydrated. An athlete should drink early and often, and be allowed unrestricted fluid replacement. Athletes should never be punished through the restriction of fluids. Unrestricted access to water or sports drinks should lead to the consumption of four to eight ounces (one-half to one cup) of fluid every 15 minutes. It is important to remember that some athletes may have a higher sweat rate than others and require more fluids to remain well hydrated. These athletes can safely tolerate up to 48 ounces per hour.

Some sports present rehydration challenges, such as soccer or certain running events. A cross country race can last up to 30 to 40 minutes for some runners and water stations should be set-up with consideration given to the course and climate. In all settings, allowing athletes to drink as much fluid as they feel necessary is important.



Post-exercise Rehydration

Fluid replacement after exercise should aim at achieving the athlete's pre-practice or pre-event weight. Ideally, this should occur before the next practice session or competition. However, this may not be possible if there is minimal time between competition. Consumption of 16-20 ounces (2-2½ cups) of fluid for every pound lost during exercise will help achieve normal fluid state. Rehydration should consist of water, carbohydrates and electrolytes, as all are lost during exercise.

At the beginning of the fall sports season, athletes often participate in twice daily practices, and rehydration becomes even more important during this time. Athletes may be weighed prior to and after each practice session. If the athlete has not returned back to previous weight before the start of the second session, the athlete should be held out of participation in order to avoid dehydration-related illness.

Hyponatremia

Hyponatremia is extremely rare in high school athletics, but deserves mention. This is a potentially deadly disorder that results from the over-consumption of fluids (water and sports drinks). It is most commonly seen during endurance events, such as marathons, when adult participants consume large amounts of water over several hours in the absence of significant sweating. The opposite of dehydration, hyponatremia is a condition where the sodium content of the blood is diluted to dangerous levels. Affected individuals may exhibit disorientation, altered mental status, headache, lethargy and seizures. The diagnosis can only be made by testing blood sodium levels. Suspected hyponatremia is a medical emergency and EMS (Emergency Medical Services) must be activated. It is treated by administering intravenous fluids containing sodium.

RECOGNITION

Dehydration is common in all sports and can occur very rapidly, especially in a warm or hot environment or if the athlete starts activity less than fully hydrated. All coaches and athletes must be aware of the signs and symptoms of dehydration (Table 17). The volume and color of urine is an excellent way of determining if an athlete is well hydrated. A normal amount of nearly clear or light-colored urine indicates that an athlete is well-hydrated; small amounts of dark urine point to the need to increase fluid intake. A Urine Color Chart can be accessed at:

<http://at.uwa.edu/admin/UM/urinecolorchart.doc>.

Table 17. Signs and symptoms of dehydration.

▪ Thirst	▪ Dizziness	▪ Heat sensations in the head or neck
▪ Irritability	▪ Muscle cramps	▪ Decreased performance
▪ Headache	▪ Chills	
▪ Weakness	▪ Nausea and vomiting	

PREVENTION AND MANAGEMENT

Sports drinks and energy drinks are commonly seen in advertisements and differ in their ingredients. A sports drink is designed to provide re-hydration during or after an athletic activity. Most sports drinks contain six to eight percent carbohydrate solution and are a good source of electrolytes. Carbohydrate and electrolyte concentrations are formulated to allow the body's gastrointestinal tract to absorb the fluid as efficiently as possible.

Sports drinks can provide water, energy and appropriate electrolytes during competition. A carbohydrate concentration of six to eight percent can provide energy, while the higher concentration of carbohydrates found in juices and energy drinks will produce slow emptying of the stomach and may leave the athlete feeling bloated. The lower concentration of sodium found in sports drinks may also help avoid abdominal cramping. While sports drinks provide some benefits during exercise (Table 18), the main focus of an athlete's hydration protocol should be on water. With an adequate diet and water intake, athletes will be properly prepared for practice and competition.

Table 18. Indications for the use of sports drinks.

Traditional sports drinks with appropriate carbohydrates and sodium may provide additional benefit in the following general situations:

- Prolonged continuous activity of greater than 45 minutes
 - Extremely intense activity with risk of heat illness
 - Hot and humid conditions
 - Individuals who are poorly hydrated prior to participation
 - Individuals with an increased sweat rate
 - Individuals with poor caloric intake prior to participation
 - Individuals with poor acclimatization to heat and humidity
-

Energy drinks were originally marketed towards athletes as a means of rehydration and electrolyte replacement during activity. Companies that manufactured the energy drinks claimed they improved performance on the field – both in practice and games. In recent years, energy drink companies have targeted the general population and the market has been saturated with different energy drinks containing many different ingredients.

In 2006, nearly 500 new energy drink brands were introduced, often touting false claims of performance enhancement and improved recovery. Energy drinks may contain carbohydrates, caffeine, taurine and other substances that manufacturers claim enhance performance. Energy drinks **ARE NOT** recommended for pre-hydration or rehydration during or after activity. Some ingredients, such as caffeine, may act as a diuretic, and can lead to even greater fluid loss. Please see the NFHS Position Statement on The Use of Energy Drinks by Young Athletes.

References

Casa DJ, et al. National Athletic Trainers' Association Position Statement: Fluid replacement for athletes. *Journal of Athletic Training* 2000; 35:212-224.

McKeag DB, Moeller JL. *ACSM's Primary Care Sports Medicine*. 2nd Ed, Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins, 2007.

Position Statement and Recommendations for Hydration to Minimize the Risk for Dehydration and Heat Illness, *National Federation of State High School Associations; Sport Medicine Advisory Committee*. April 2008.

Position Statement and Recommendations on the Use of Energy Drinks by Young Athletes. *National Federation of State High School Associations; Sport Medicine Advisory Committee*. October 2008.



POSITION STATEMENT AND RECOMMENDATIONS **FOR HYDRATION TO MINIMIZE THE RISK FOR** **DEHYDRATION AND HEAT ILLNESS**

National Federation of State High School Associations (NFHS)
Sports Medicine Advisory Committee (SMAC)

DEHYDRATION, ITS EFFECTS ON PERFORMANCE, AND ITS RELATIONSHIP TO HEAT ILLNESS:

- Appropriate hydration before, during, and after physical activity is an important ingredient to healthy and successful sports participation.
- Weight loss during exercise and other physical activity represents primarily a loss of body water. A loss of just 1 to 2% of body weight (1.5 to 3 pounds for a 150-pound athlete) can negatively impact performance. A loss of 3% or more of body weight can significantly increase the risk for exertional heat-related illness. If an athlete is already dehydrated prior to beginning activity, these effects will occur even sooner.
- Athletes should be weighed (in shorts and T-shirt) before and after warm or hot weather practice sessions and contests to assess their hydration status.
- Athletes with high body fat percentages can become significantly dehydrated and over-heat faster than athletes with lower body fat percentages while working out under the same environmental conditions.
- Athletes have different sweating rates and some lose much more salt through their sweat than others. “Salty sweaters” will often have noticeable salt stains on clothing after workouts, and often have a higher risk of developing exertional muscle cramps.
- Poor heat acclimatization/fitness levels can greatly contribute to an athlete’s heat intolerance and heat illness risk.
- Certain medications, or fever, can negatively affect an athlete’s hydration status and temperature regulation, increasing the risk for heat illness.
- Environmental temperature and humidity each independently contribute to dehydration and heat illness risk.
- Clothing that is dark or bulky, as well as protective equipment (such as helmets, shoulder pads, and other padding and coverings), can increase body temperature, sweat loss and subsequent dehydration and heat illness risk.

- Even naturally dry climates can have high humidity on the field if irrigation systems are scheduled to run prior to early morning practices start. This temporary increase in humidity will continue until the water completely soaks into the ground or evaporates.
- A heat index chart should be followed to help determine if practices/contests should be modified or canceled. The NOAA National Weather Service's heat index chart can be found at: <http://www.weather.gov/om/heat/index.shtml>
 - On-site wet-bulb temperature should be measured 10-15 minutes before practices or contests. The results should be used with a heat index to determine if practices or contests should be started, modified, or stopped.
 - If wet-bulb temperature measurement is not available, the heat index for your approximate location can be determined by entering your postal zip code: <http://www.osaa.org/heatindex/>

Example of the effects of relative humidity on the risk for dehydration and heat illness:

- A relative humidity of 40 percent and a temperature of 95 degrees Fahrenheit are associated with a *likely risk* of incurring heat illness if strenuous physical activity is conducted. However, even with a *lower air temperature* of only 85 degrees Fahrenheit, the risk for exertional heat illness could be the *same or greater with a higher relative humidity* of 70 percent.

WHAT TO DRINK DURING EXERCISE AND OTHER PHYSICAL ACTIVITY:

- For most exercising athletes, water is appropriate and sufficient for pre-hydration and rehydration. Water is quickly absorbed, well-tolerated, an excellent thirst quencher and cost-effective.
- Traditional sports drinks with an appropriate carbohydrate and sodium formulation may provide additional benefit in the following general situations:
 - Prolonged continuous or intermittent activity of greater than 45 minutes
 - Intense, continuous or repeated exertion
 - Warm-to-hot and humid conditions
- Traditional sports drinks with an appropriate carbohydrate and sodium formulation may provide additional benefit for the following individual conditions:
 - Poor hydration prior to participation
 - A high sweat rate or “salty sweater”
 - Poor caloric intake prior to participation
 - Poor acclimatization to heat and humidity
- A 6 to 8% carbohydrate formulation is the maximum that should be utilized in a sports drink. Any greater concentration will slow stomach emptying and potentially cause the athlete to feel bloated. An appropriate sodium concentration (0.4–1.2 grams per liter) will help with fluid retention and distribution and decrease the risk of exertional muscle cramping.

WHAT NOT TO DRINK DURING EXERCISE:

- Fruit juices with greater than 8 percent carbohydrate content and carbonated soda can both result in a bloated feeling and abdominal cramping.

- Athletes should be aware that nutritional supplements are not limited to pills and powders as many of the new “energy” drinks contain stimulants such as caffeine and/or ephedrine.
 - These stimulants may increase the risk of heat illness and/or heart problems with exercise. They can also cause anxiety, jitteriness, nausea, and upset stomach or diarrhea.
 - Many of these drinks are being produced by traditional water, soft drink and sports drink companies which can cause confusion in the sports community. As is true with other forms of supplements, these “power drinks”, “energy drinks”, or “fluid supplements” are not regulated by the FDA. Thus, the purity and accuracy of contents on the label is not guaranteed.
 - Many of these beverages which claim to increase power, energy, and endurance, among other claims, may have additional ingredients that are not listed. Such ingredients may be harmful and may be banned by governing bodies like the NCAA, USOC, or individual state athletic associations.
 - See the **NFHS Position Statement and Recommendations for the use of Energy Drinks by Young Athletes** for further information.

HYDRATION TIPS AND FLUID GUIDELINES:

- Many athletes do not voluntarily drink enough water to prevent significant dehydration during physical activity.
- Drink regularly throughout all physical activities. An athlete cannot always rely on his or her sense of thirst to sufficiently maintain proper hydration.
- Drink before, during, and after practices and games. For example:
 - Drink 16 ounces of fluid 2 hours before physical activity.
 - Drink another 8 to 16 ounces 15 minutes before physical activity.
 - During physical activity, drink 4 to 8 ounces of fluid every 15 to 20 minutes (some athletes who sweat considerably can safely tolerate up to 48 ounces per hour).
 - After physical activity, drink 16 to 20 ounces of fluid for every pound lost during physical activity to achieve normal hydration status before the next practice or competition.
- The volume and color of your urine is an excellent way of determining if you’re well hydrated. Small amounts of dark urine means that you need to drink more, while a “regular” amount of light-colored or nearly clear urine generally means you are well-hydrated. A Urine Color Chart can be accessed at: <http://at.uwa.edu/admin/UM/urinecolorchart.doc>
- Hyponatremia is a rare, but potentially deadly disorder resulting from the over consumption of water. It is most commonly seen during endurance events, such as marathons, when participants consume large amounts of water over several hours, far exceeding fluid lost through sweating. The opposite of dehydration, hyponatremia is a condition where the sodium content of the blood is diluted to dangerous levels. Affected

individuals may exhibit disorientation, altered mental status, headache, lethargy, and seizures. The diagnosis can only be made by testing blood sodium levels. Suspected hyponatremia is a medical emergency and EMS (Emergency Medical Services) must be activated. It is treated by administering intravenous fluids containing high levels of sodium.

References:

Casa DJ, Armstrong LE, Hillman SK, et al. National Athletic Trainers' Association position statement: Fluid replacement for athletes. *Journal of Athletic Training* 2000;35:212-224.

McKeag DB, Moeller JL. *ACSM's Primary Care Sports Medicine*. 2nd Ed, Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins, 2007.

Montain SJ. Hydration recommendations for sport 2008. *Current Sports Medicine Reports* 2008;7:187-92.

National Collegiate Athletic Association. Guideline 2c: Prevention of heat illness. 2010-11 *Sports Medicine Handbook* (21st edition).

Sawka MN, Burke LM, Eichner ER, et al. American College of Sports Medicine position stand. Exercise and fluid replacement. *Medicine & Science in Sports & Exercise* 2007;39:377-90.

Revised and Approved October 2011