

Hydration for Athletes:

What coaches can do to keep their athletes healthy and performing their best

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Although water is the most essential nutrient, there is more to hydration than having a few coolers of water on the sideline. As a coach, educating your athletes about hydration is one of the most important steps you could take to keep your athletes healthy and performing at optimal levels. Despite recent headlines about heat illnesses, for some coaches getting a drink of water during a practice session is often seen as a weakness. As athletic trainers, we have often seen coaches frown upon an athlete attempting to rehydrate during a practice, even in hot and humid conditions!

The negative stigma sometimes associated with hydration can be extremely dangerous, as it can increase the degree of dehydration. The pressure placed on athletes can often lead to athletes ignoring the signs and symptoms of a potentially dangerous condition in order to win the coach's respect or a starting position. Episodes of heat illnesses occur at various levels of competition; unfortunately, some of these occurrences have resulted in death.

Hydration status is only one of several factors that can decrease an athlete's exercise heat tolerance and increase the risk of heat illnesses. Other factors include, but are not limited to, a lack of acclimatization, fitness level, inappropriate work/rest ratios, and illness (Casa et al, 2003). Below are a few tips on what coaches can do to assist athletes in staying hydrated and healthy (See Figure 1).

Figure 1: Top 10 Hydration Tips for Coaches

1. Hold weigh-ins before and after exercise.
2. Educate athletes on urine color (the lighter the urine, the better hydrated).
3. Modify practice in hot, humid conditions by adjusting practice times, decreasing intensity, allowing frequent hydration breaks, and minimizing equipment worn.
4. Encourage athletes to drink fluids before, during and after exercise.
5. Choose a sports drink over water for high-intensity exercise or exercise lasting more than one hour.
6. Encourage fluid intake before signs of dehydration, such as thirst.
7. Use sweat rates to determine athletes' fluid needs.
8. Examine athletes' nutritional habits and modify as needed.
9. After exercise, replenish fluids equal to sweat losses.
10. EDUCATE your athletes on how to:
 - Monitor hydration status
 - Stay hydrated
 - Recognize signs of dehydration

How Can Athletes Tell if They are Hydrated?

There are a few simple ways to determine if someone is hydrated. As a coach, you can implement some, or all, of these techniques with your athletes, just as you would your stretching program or the proper technique for a skill. The most common methods of determining one's hydration status are:

- Body weight
- Sweat rate
- Urine color, and
- Urine specific gravity

Body Weight

One of the easiest ways an athlete can prevent dehydration is by weighing before and after exercising (See Figure 1). By determining the percentage of body mass lost, an athlete can determine how dehydrated he/she is. The first step is to determine an athlete's euhydrated (or hydrated) body mass. This is achieved by having an average of the athlete's body weight across several days, since a person's body weight may fluctuate due to various factors, such as the time of day, time of meals, etc. Once athletes know their baseline body mass, they can use their pre- and post-exercise body mass to determine two factors: (1) how much they need to drink before the next practice or competition, and (2) whether they need to change their rehydration behaviors during future practices.

Most body mass lost during exercise is a result of fluid lost through sweating; therefore, weigh-ins can tell the athlete how well they replaced the lost fluid or how much they need to replace after exercising. Dehydration of one to two percent of body mass can result in decreased athletic performance as well as decreased physiologic functioning (Casa, 2000). Furthermore, body mass losses of three percent or greater can further decrease athletic performance and possibly lead to heat illness (Casa, 2000). Therefore, when athletes calculate their percentage of body mass lost, they can match their fluid losses with their fluid intake. This is performed by having your athletes determine what a three-percent body mass loss means to them in pounds or kilograms so that they know what to look for when they step on the scale. For instance, three-percent body mass of an athlete weighing 145 pounds is 4.35 pounds. If this athlete is weighing 141 pounds after practice, she can determine that she needs to 1) drink fluids to replace that loss and 2) do a better job of replacing fluids during exercise in future practices.

Sweat Rate

Along with pre- and post-exercise weigh-ins, knowing an athlete's sweat rate can provide a good indication of how to keep athletes hydrated. Although there are average sweat rates for various types of athletes (between 0.5 liters/hour to more than 2.5 liters/hour) (Casa, 2000), not all athletes have the same sweat rate. As a coach, you have probably noticed some athletes who are sweating profusely five minutes into practice, while others are barely sweating after 30 minutes. Because athletes' fluid losses vary, determining their sweat rates is another tool in determining how much an athlete should be drinking (See Table 1). Once you have each individual athlete's sweat rate, you can determine what each athlete's fluid needs are and provide fluids accordingly.

Table 1a: Sample Sweat Calculations

	Example 1* Soccer (F)	Example 2 Cross Country (M)	Example 3 Football (M)
Pre-exercise Body Weight	125 lb (56.8 kg)	132 lb (60 kg)	190 lb (86.4 kg)
Post-exercise Body Weight	124 lb (56.4 kg)	129 lb (58.6 kg)	186 lb (84.5 kg)
Fluid Consumed	24 oz (710 mL)	16 oz (473 mL)	40 oz (1183 mL)
Exercise Time	1 hr	1 hr	1 hr
Sweat rate/ per hour	1110 mL	1873 mL	3083 mL

* See sample calculation

Table 1b: Sweat Rate Calculator

	Example
A. Enter pre-exercise body weight in kilograms (To convert lb to kg, divide lb by 2.2)	56.8
B. Enter post-exercise body weight in kilograms	- 56.4
C. Subtract B from A	= .04
D. convert your total in C to grams by multiplying by 1000	x1000 = 400
E. Enter the amount of fluid consumed during exercise in milliliters (To convert from ounces to milliliters, multiply ounces by 30)	+ 710
F. Add E to D	= 1110 mL (47 oz)

The final figure is the number of mL needed to consume per hour to remain well-hydrated. To divide mL back to ounces, divide by 30.

Sweat rate can be determined by calculating the difference in pre- and post-exercise body weight, while incorporating fluid intake and urine volume (See Figure 2). The easiest way to determine your athletes' sweat rate is to set aside a one-hour practice session where you do not allow rehydration or urination. The difference between the pre-and post-exercise body weight is their sweat rate per hour of exercise. You can also give each athlete his or her designated water bottle and measure how much fluid the athlete drank during the session, and then incorporate the amount of fluid consumed into the equation (See Table 1 a & b). Having a calculated sweat rate helps athletes understand that if they sweat more than their teammates, they should be consuming more fluids. It also helps the coaches understand the importance for athletes to be able to consume fluids throughout exercise sessions when needed.

Figure 2: Sweat Rate Formula

$$SR = [(pre\ BW - Post\ BW) + Fluid\ Consumed - Urine\ Volume] / Exercise\ Time\ (Hours)$$

SR = Sweat Rate Pre BW - Pre-exercise body weight Post BW - Post-exercise body weight

Urine Color

Another simple way for coaches to educate athletes about hydration is through urine color. The lighter someone's urine color, the more hydrated they are; conversely, the darker someone's urine, the less hydrated, or dehydrated, they are. By educating your athletes to check their urine color, they will be able to tell if they are replacing lost fluids adequately. The key is for athletes to monitor their urine color to ensure it remains a pale yellow (like lemonade), even after exercising. If it's a little on the dark side (like apple juice), then they know they probably didn't replace enough fluids and need to make sure they do before exercising again. One of the best guides for your athletes would be to post a urine color chart (Armstrong, 2000) in the locker room so that they can use their urine color to determine how well they are hydrated. The urine color chart also uses numbers, whereby urine colors 1, 2 and 3 represent someone who is adequately hydrated, and 6, 7 and 8 represent someone who is dehydrated (Armstrong, 2000). Be sure to inform your athletes that taking a multi-vitamin may cause their urine to be darker; if this is the case, you should still be able to see differences in urine color before and after exercise, but you should incorporate other methods of determining hydration status. The urine color chart can be found on the back cover of Armstrong's Performing in Extreme Environments (Armstrong, 2000).

Urine-specific Gravity

Urine-specific gravity is another means of determining a person's hydration status. Urine-specific gravity is a measure of urine concentration and can be measured using a clinical refractometer. This device costs between \$60 and \$400; however, one of the inexpensive ones will do just fine. If your athletic trainer is comfortable measuring urine-specific gravity, taking pre- and post-exercise measures would be another means of determining your athletes' hydration status. A hydrated athlete's urine-specific gravity would be less than 1.015; and athlete whose urine specific gravity is more than 1.025 is considered dehydrated. Urine-specific gravity is a good means of confirming whether the pre-exercise weight is a hydrated body weight in athletes who may be showing up to practice already dehydrated.

Fluid Consumption: When, How Much and What to Drink

Athletes should be consuming fluids before, during and after exercise, but what happens when athletes go home? Many athletes have a misconception that as long as they drink during practice or competition they will stay hydrated. However, we usually don't know what our athletes are doing before they arrive at practice or how well they hydrate once they leave the premises. Many athletes are already dehydrated when they arrive to a practice or game.

We like to remind athletes that if they don't rehydrate after a practice or game, they don't just wake up the next day with a clean slate; they are still dehydrated and need to drink fluids before exercising the next day. When playing in tournaments, athletes should be aware that rehydrating after an event is beneficial for the next event as well. Therefore, educating athletes on what they need to do to stay hydrated both before and after practice or a game is just as important as what fluids they are consuming during exercise.

Although the nature of some athletic events is not conducive to rest breaks for fluid consumption, coaches need to be creative in finding ways to keep their athletes hydrated. Many soccer players have given the excuse, as I am stretching their calf cramp in the second half, that the lack of time-outs is the reason for their lack of fluid intake. However, having a bottle close to the sideline or near the

goal are some ways you can have easy access to fluids during a game. Despite the lack of time-outs, there are still breaks in the game, such as penalties or injuries, where fluid consumption can be encouraged.

Other sports, like distance running, many run into similar obstacles. These scenarios may require planning ahead and creativity in order to place drinking stations at certain mile markers or find other means of getting fluids to your athletes. When sports are very demanding, such as two-a-day practices in the heat, encourage your athletes to drink an extra 20 ounces of a sports drink in the evening after dinner and an extra 20 ounces in the morning after breakfast; this will help assure that a proper hydration status is attained prior to the onset of the next practice.

According to the National Athletic Trainers' Association position statement on Fluid Replacement for Athletes, an athlete should drink approximately 17 to 20 ounces of water or a sports drink two to three hours before exercise and seven to 10 ounces of water or a sports drink about 10 to 20 minutes before exercise to ensure he/she is hydrated before exercising (Casa, 2000). In order to maintain hydration status during exercise, an athlete should replenish lost fluids by drinking about 8 ounces of water or a sports drink about every 15 minutes. Fluid replacement after exercise should consist of replacing lost fluids based on need (Table 1). Despite general guidelines for fluid intake, not all athletes require the same amount or kind of fluid replacement. Once you have determined your athletes' sweat rates, you can better determine their fluid needs. The pre- and post-exercise weigh-ins help athletes determine how much they should be drinking.

Coaches may have a tough time deciding what type of drink to offer their athletes because of all the options on the market as well as myths about what works and what doesn't. With the growing number of products and claims to improve performance, hydration and the research behind it may sometimes take the back burner. When deciding what type of fluids to give your athletes, you may want to incorporate factors such as the type, intensity and duration of exercise, environmental conditions and amount of equipment worn during exercise. Coaches can work together with the athletic trainer to set up a hydration protocol and determine what would be best for your athletes.

The simplest way to determine what your athletes need is to determine what they are losing during exercise. Athletes are going to be losing fluid through sweating; therefore, water needs to be replaced. There are also some electrolytes, mostly sodium and some potassium, that are lost in sweat. When athletes have been exercising for a while, they are also going to need added energy in the form of carbohydrates.

When exercise lasts under an hour, replacing lost fluid with water should suffice in keeping your athletes hydrated. In high-intensity activities or those lasting longer than an hour, you may want to incorporate a sports drink that will replace water as well as electrolytes and carbohydrates (See Figure 1). A non-carbonated sports drink of six- to eight-percent carbohydrate solution will work best in replacing fluids, electrolytes and carbohydrates. Including another source of calories, such as yogurt, will also further help replenish nutrients used during exercise.

Many coaches have asked if too much water is bad. They have probably heard about cases of hyponatremia, where sodium levels are too low due to excess water intake or excessive sodium losses with sweating. Since hyponatremia mainly occurs in endurance events lasting longer than four hours, it would not be a good idea to discourage your athletes from drinking water. Athletes should still be educated, however, on the dangers of excessive fluid intake.

You may have also heard that athletes should take salt tablets or drink pickle juice to prevent heat cramps. Although there may be some truth to sodium intake preventing heat cramps, there are easier and better-tasting solutions such as adding some pretzels to their diet. Simply asking your athlete about his/her diet and salt intake will usually give you the answers to what they could change. For very salty sweaters, however, salt tablets or "Gatorlytes" may help to ensure they are replacing those lost electrolytes. Sodium should be administered in a diluted solution of one-half gram of sodium (1/4 teaspoon table salt) in approximately 32 ounces of a sports drink early during exercise (Casa et al, 2003).

There are many other beverages on the market that may contain protein, caffeine, creatine, and/or ephedra, to name a few. However, caution should be used when recommending these products to your athletes for several reasons. First of all, if you are working with high school athletes, they are most probably minors. Secondly, supplements are not regulated by the FDA; therefore, you don't really know what you are getting despite what the label says.

Educating athletes on hydration is essential in keeping your athletes healthy and performing well. By implementing a few simple things (See Figure 1) like weigh-ins, urine color and proper hydration, coaches can ensure their athletes have the tools and knowledge they need to stay hydrated.

References

- Armstrong, L. E. (2000). *Performing In Extreme Environments*. Champaign, IL: Human Kinetics.
 - Casa, D. J. et al. (2000). National Athletic Trainers' Association Position Statement: Fluid replacement for athletes. *Journal of Athletic Training*, 35(2), 212-224.
 - Casa, D. J., Almquist J., Anderson, S., et al. Inter-Association Task Force on Exertional Heat Illnesses Consensus Statement. *NATA News*, June, 2003. pp. 24-29.
- Human Performance Laboratory, Department of Kinesiology, Neag School of Education, University of Connecticut