

SPORT SCIENCE

Heat and Hydration Concerns for Tennis Players

When the air temperature is above 95 degrees, you can make up to 60 mistakes per hour. Think about that for a minute.



SIGNS AND SYMPTOMS OF DEHYDRATION:

Thirst • Irritability • Fatigue
Muscle Cramps • Loss of Performance • Vomiting

EFFECTS OF DEHYDRATION:

Dehydration can affect a tennis player's performance in less than an hour, even sooner if the athlete comes into the practice session or match dehydrated.

Dehydration of as little as 1-2% of body weight (only 1.5-3 pounds for a 150 lb. athlete) has been shown to reduce performance.

Dehydration of 3% or more of body weight increases a tennis player's risk of heat-related illness (heat cramps, heat exhaustion or heat stroke).

For every percent of body weight that is lost during play, an athlete's core body temperature can rise by 0.5°F. This results in the athlete's heart working harder by 3-7 beats per minute at the same workrate.

When a tennis player loses 3% of body weight due to sweating, it can result in an increase in core body temperature of more than 1°F and an increase in heart rate of between 10-20 beats per minute. This results in an athlete needing to work more than 10% harder to accomplish the same amount of work as when he/she is fully hydrated.

Dehydration is not only a health concern, but it also reduces a tennis player's on-court performance.



Recommended Guidelines



Before Practice or Matchplay

Drink at least 16-20 oz. of water (one standard bottle) or electrolyte-enhanced sports drink two hours before the tennis practice or matchplay.

During Practice or Matchplay

Drink 4-8 oz. (4-8 normal swallows or $\frac{1}{4}$ - $\frac{1}{2}$ a regular size bottle) for a light to medium sweater and 8-16 oz. (8-16 normal swallows or a $\frac{1}{2}$ - $\frac{3}{4}$ full regular size bottle) for a heavy sweater of water or electrolyte-enhanced carbohydrate fluid every changeover during practice or matchplay (32-60 oz. of fluid per hour). If practice or matchplay is expected to be longer than 60 minutes, an electrolyte-enhanced carbohydrate beverage would be a better option.

After Practice or Matchplay

Drink at least one regular size bottle (20 oz.) of electrolyte-enhanced carbohydrate sports drink per pound of body weight lost within a two hour period. Replace between 120%-200% of body weight lost per exercise session. It is also helpful to consume some protein to help aid recovery. 10-20 grams of protein within 30 minutes of practice or matchplay will help speed recovery. Adding extra sodium to the beverage will also speed rehydration by allowing the athlete to drink more fluid and retain more fluid in the system.

What carbohydrate content should I drink on court?

Drinks that contain more than 7-9% carbohydrates (19 grams per 8 oz., or 48 grams per 20 oz.) may slow the rate at which fluid is absorbed, and is not recommended during exercise. An ideal sports drink will contain between 6-8% carbohydrates and electrolytes to help replenish lost nutrients during heavy training or matchplay.

Beverages containing caffeine, alcohol or carbonation are not as effective as sports drinks in rehydrating the body.

Fluids with salt (sodium chloride) not only help replace lost salt in an athlete's sweat, but also increase thirst and voluntary fluid intake as well as offsetting losses due to urination.



Heat Illness

Athletes increase their risk of heat illness as they become dehydrated. According to the *National Athletic Trainers' Association*, it is not uncommon for athletes to reach significant dehydration and place themselves at risk of developing exertional heat illness in as little as an hour of exercise. This can be even sooner if the athlete comes into the practice or match already dehydrated.

Heat Cramps: A number of factors have been linked to heat cramps. Unlike other muscle cramps, such as those experienced with eccentric exercise, heat-related muscle cramps are usually a result of strenuous exercise in hot and humid conditions which results in a sweat and sodium loss. Muscle cramps can be largely avoided with adequate conditioning, acclimatization, rehydration, electrolyte replacement (specifically sodium) and appropriate dietary practices.



HEAT RELATED ILLNESSES

	Causes	Symptoms	Treatments
Heat Cramps	Excessive fluid loss; electrolyte imbalance; low-salt; poor acclimatization	Excessive sweating; cramping in abs or extremity	Rest in cool place; passive stretching; water/electrolyte replacement; ice massage; stretch
Heat Exhaustion	Excessive fluid loss (sweating, diarrhea and vomiting); stimulant use; poor acclimatization; prolonged exercise in hot and/or humid conditions	Weakness, faintness, dizziness; headache; excessive thirst; vomiting; small urine volume or odor; skin is pale, cold, and clammy	Rest in cool place, lying down; cold towel or sponge; water/electrolyte replacement; discontinue activity for 24 hours; Monitor weight
Heat Stroke	Same as for Heat Exhaustion, but cooling mechanisms of body are overwhelmed	Drowsy; hysteria; irritability; aggressiveness; disorientation; glassy stare; feel like "burning up"; rapid pulse and respirations; absence of sweat; skin is red, hot, dry	CALL 911 – MEDICAL EMERGENCY!!! Immediate full body immersion in cold water; fan over body

10 Steps to Succeed in the Heat



- 1. Physically Prepare** – The more physically fit the tennis player is, the less likely they will experience heat-related issues.
- 2. Drink, Drink, Drink** – Drinking a combination of water and electrolyte-enhanced beverages throughout the day will help keep the tennis player well hydrated.
- 3. Don't Rely on Thirst** – Drink consistently, not just when thirsty. The body may be 2% dehydrated by the time thirst is experienced.
- 4. Increase Salt Content in Food and Drink** – As salt is the major electrolyte lost in sweat, it is essential to replace this important electrolyte throughout the day. Foods that contain high salt content include vegetable juice, canned soups, sports drinks and salted pretzels.
- 5. Use Ice and Other Cooling Mechanisms** – Keeping the body cool before, during and after practice or competition is helpful in maintaining an appropriate body temperature. However, putting ice directly on muscles and joints during play is not advised due to the possibility of muscle and joint stiffening.
- 6. Appropriate fuel before, during and after practice or match**
- 7. Clothing** – It is best to choose light colored, breathable and loosely woven fabrics to help sweat evaporate easily.
- 8. Sunscreen** – In addition to helping reduce the instances of skin cancer, which is important for long-term health, applying liberal amounts of sunscreen will also prevent short-term sunburn that increases an athlete's skin temperature and may make them more susceptible to heat-related problems.
- 9. Acclimation** – It is important to get the body adapted to a hot environment. Most occurrences of heat illness take place in the first 2-3 days of training or competition in a hot and humid environment.
- 10. Reduce contact with direct sunlight when not playing**

Sports Drinks vs. Water

	SPORTS DRINK*	WATER
Flavor	Has sweet flavor, which has been shown to encourage athletes to drink more fluid.	Lack of flavor, which may limit individual's drinking tolerance.
Carbohydrates	Contains approximately 14 grams of carbohydrates per 8 oz. of fluid. This amount provides needed carbohydrates to help in long duration practices and matches, and also helps speed the absorption of fluid in the body.	Provides no energy for long duration exercise.
Electrolytes: Sodium & Potassium	Contains small amounts of sodium (approximately 110mg per 8 oz. of fluid). Sodium increases the thirst mechanism (makes athletes drink more) and also keeps more water in the system, instead of losing it through urination.	Contains no electrolytes. Water alone stimulates kidneys to increase urine production more than if sodium was added. Does not replace electrolytes.



* Not all sports drinks are the same



Quinn Rooney/Getty Images



Julian Finney/Getty Images

Heat and Hydration

Common Questions & Answers



Question: Is water the best fluid replacement during tennis in the heat?

Answer: Water is a great drink for low to moderate intensity activities that last less than an hour. However, for activities that last more than an hour, a carbohydrate and electrolyte sports drink may be more beneficial.

- Flavored drinks encourage drinking, especially in younger athletes.
- Water turns off thirst mechanism before fully hydrated.
- Water lacks carbohydrates (energy) and electrolytes to help tennis players perform at their best over long periods.

Question: Does wearing dark clothes in the heat makes a tennis player more susceptible to heat illness and dehydration?

Answer: The color of clothing can affect heat gain. White clothing reduces radiative heat gain and the subjective feelings that players have of how hot it is. Black clothing increases radiative heat gain and players feel that it is hotter than if they were wearing white clothing.

Question: Don't sports drinks have too much salt?

Answer: Most sport drinks have about 110mg of sodium per 8 oz. of fluid. This amount is classified by the Food and Drug Administration as a low-sodium beverage. Most sports drinks have less sodium than is lost in an athlete's sweat, especially in hot and humid conditions, and should not typically be a concern.*

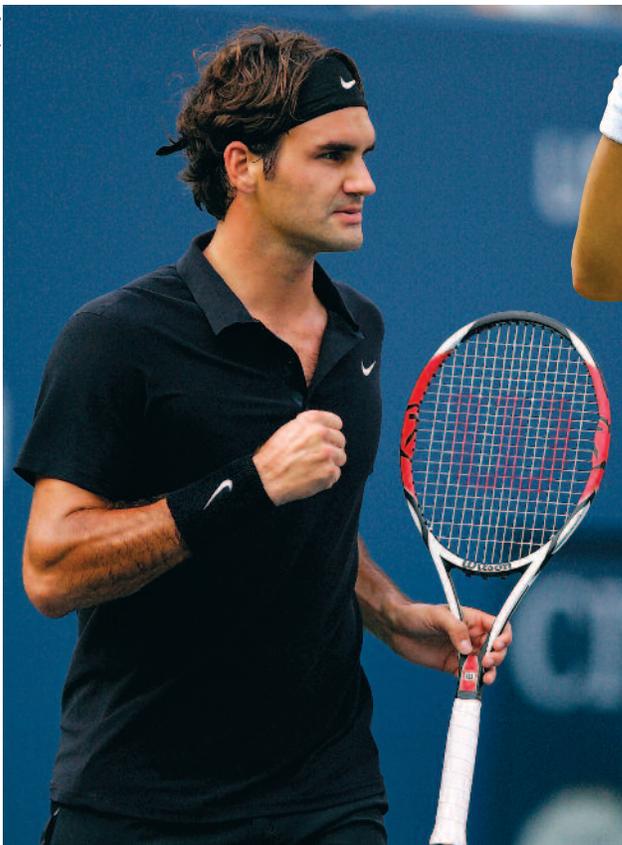
Question: Are bananas a great on-court snack to prevent muscle cramping?

Answer: Although bananas have been a staple in a tennis player's diet for decades, the actual benefits for prevention of muscle cramps is limited. Bananas are high in potassium and this was once thought of as an important electrolyte in muscle cramping. However, potassium is low in sweat and is not a major factor in muscle cramping. Sodium is the major electrolyte lost in sweat.

Question: What is hyponatremia?

Answer: Hyponatremia is a form of water intoxication. This happens when an athlete consumes only water and sweats out large amounts of sodium, which results in diluting the fluid throughout the body. This can cause major physiological problems and is of most concern post-training or matchplay when the athlete is rehydrating. Remember that if the athlete is sweating a lot, it is important to rehydrate with fluids that contain enough electrolytes, so as not to dilute the fluids in the body.

Al Bello/Getty Images



Ryan Pierse/Getty Images

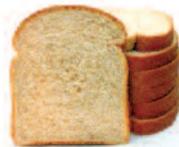


**Disclaimer: Sodium (Salt) should not be consumed in large amounts if you have high blood pressure and/or a heart or kidney condition.*

Basic Nutrition Suggestions During Tournaments

Nutrition for tennis is vital in preventing heat and hydration concerns in tennis.

FUELING GUIDELINES		
Timing	Type of Intake	Examples
Pre-Tennis Training or Matchplay (2 hours prior)	<ul style="list-style-type: none"> – Low/medium glycemic Index (GI) carbohydrate, with a moderate amount of protein. Drink at least 16-20 oz. of water. 	<ul style="list-style-type: none"> – Bowl of oatmeal with two eggs – Turkey, ham or roast beef sandwich
During Training or Matchplay	<ul style="list-style-type: none"> – Medium/high GI carbohydrate with small amount of protein (if tolerable) – Water – Sports drink (6% carbohydrate solution with enhanced electrolytes) 	<ul style="list-style-type: none"> – Nutritional bars with between 200-300 calories (including 5-15 grams of protein)
Immediately Post-Training or Matchplay	<ul style="list-style-type: none"> – High GI carbohydrate with moderate protein using 1.5 grams/kilogram – Rehydrate with 120%-200% of fluid lost during the match (Sports drink with added sodium—$\frac{1}{4}$-$\frac{1}{2}$ teaspoon of salt in a 32 oz. product) 	<ul style="list-style-type: none"> – Sports drinks – Recovery shakes or bars – Jelly beans (high sugar) combined with nuts (protein) – Trail mix – Chocolate milk
Post-Training Follow-Up	<ul style="list-style-type: none"> – Solid Low/medium GI carbohydrate meal with moderate amount of protein and liberal amount of salt added to foods. 	<ul style="list-style-type: none"> – Chicken with rice and vegetables – Fish with potatoes and salad – Steak and potatoes with vegetables

FOOD CHOICES		
Choose this Food	Instead of this Food	
	Baked Potatoes	French Fries
	Boiled Egg Whites	Fried Eggs
	100% Orange Juice	Sunny Delight
	Boiled Whole Wheat Spaghetti	Spaghetti-Os
	Homemade Whole Wheat Brownies	Little Debbie Cakes
	Homemade Foods from Fresh Ingredients	Processed Foods
	Fresh Fruit	Canned Fruit
	Water	Sodas
	100% Stone Ground Whole Wheat Bread	White Bread
	Broiled Skinless Chicken Breast	Fried Chicken
	Bean Burrito with No Fat Cheese	Burrito Supreme
	Fat Free Frozen Yogurt	Ice Cream
	Shredded Wheat & Bran	Frosted Mini-Wheats
	Broiled or Steamed Food	Breaded and Fried Food
	Baked Potato Chips	Fried Potato Chips
	Fresh Vegetables	Canned Vegetables
	Bagels	Donuts
	Ground Lean Steak	Hamburger
	Oatmeal	High Sugar Cereal
	Skinless Chicken Breast	Chicken with Skin

Am I Hydrated?

URINE COLOR CHART		
1		<p>If your urine matches the colors 1, 2, or 3, you are likely properly hydrated.</p> <p>Continue to consume fluids at the recommended amounts.</p> <p>Nice job!</p>
2		
3		
4		<p>If your urine color is below the RED line, you may be DEHYDRATED and at greater risk for heat illness!!</p>
5		
6		<p>YOU NEED TO DRINK MORE!</p>
7		
8		
		<p>Speak to a health care provider if your urine is this dark and is not clearing despite drinking fluids</p>

RESOURCES

Please see the [USTA Player Development website](http://www.playerdevelopment.usta.com) for more information on heat and hydration issues in tennis or to obtain an electronic copy of this booklet.

www.playerdevelopment.usta.com

ACKNOWLEDGEMENTS

The material in this booklet was compiled with the assistance of the following individuals:

Mark Kovacs, PhD, CSCS – Manager of Sport Science

Michael Yorio, MD – US Open Tournament Physician

Jessica Battaglia, MS, ATC/L – Assistant to Coaching Education and Sport Science

Paul Lubbers, PhD – Director of Coaching Education

Paul Roetert, PhD, FACSM – Managing Director of Player Development