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Water + Electrolytes: How They Prevent Dehydration

Intense work or exercise in the heat and serious illness can quickly lead to dehydration. Drinking lots of fluid with electrolytes can prevent it. Here's what you need to know about water, electrolytes, and why you shouldn't reach for those calorie-dense, sugary-sweet sports drinks to meet your hydration needs.

Dehydration. You may have read or heard that if you're working or exercising outdoors in hot temperatures or experiencing illness (such as vomiting and/or diarrhea), you need to stay hydrated and that the simplest solution is to drink plenty of water or an electrolyte-fortified beverage such as Gatorade®. Despite all of the attention focused on the dangers of dehydration, many people are unaware of this all-too-common condition, which can be fatal if one doesn't recognize the signs.

To shed some light on the issue and clear up some common misunderstandings and misconceptions, this article explains why water is so important, what dehydration is, who's at risk, and the three stages of dehydration. In addition, it discusses electrolytes, explaining what they are and how they, when coupled with fluid replacement, can prevent and treat dehydration. Finally, this article covers the issue of sports drinks. Despite their popularity amongst certain groups, sports drinks are a poor choice to stay hydrated. This article presents the limitations of many electrolyte-fortified beverages and why they fall short in meeting many people's hydration needs.

Water: The Most Important Nutrient

Water is *the* most important nutrient for your body. On average, the human body is 60 percent water by weight, depending on certain factors such as age, gender, and body weight.¹ The average 70 kilogram (kg) (154 lb.) man is made up of 42 liters (l) (or ~11 gallons) of water while the average 55-kg (121 lb.) adult female is made up of 27.5 l (~7.2 gallons) of water.¹

Within the body, water is divided between two major fluid compartments—40 to 50 percent of total body water is contained within the cells, called intracellular fluid; 50 to 60 percent is outside the cells (extracellular fluid).

So, why is water so important? It performs numerous important biological functions in the body. First, at the cellular level, it provides structural firmness.¹ Second, water makes up blood, lymph, gastric secretions, and urine. It helps lubricate our joints (synovial fluid), which allows bones to move freely against each other.² It also

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forms blood plasma, which transports oxygen, glucose, and amino acids to active muscle and tissue while carrying away carbon dioxide and lactic acid. During exercise, muscles produce lactic acid (plus other acids), and too much lactic acid can impair muscle contractility and performance. Third, water helps maintain core body temperature (thermoregulation). Your body uses water as a cooling mechanism (through sweating) to adequately control its temperature. Even in moderately warm weather, significant amounts of water are lost through sweat.¹ Under more arduous training conditions, it's estimated that sweat losses in endurance athletes exercising in heat and humidity can be nearly 3 liters per hour.¹

Dehydration Defined

Even a mild deficit of water can have a substantial impact on well-being, exercise performance, and attentiveness. Defined, dehydration is the loss of body water and important ions (blood salts like potassium and magnesium). It simply means your body doesn't have as much water and electrolytes as it should have, which interferes with normal body processes.

It's easy to become dehydrated, and you don't have to run a marathon to become dehydrated. Each day you lose approximately two to two-and-a-half cups (450 to 600 ml) of water just going about your usual activities, so it is important to replace fluid losses throughout the day. Coffee, tea, and sodas are not an ideal choice. These beverages have a diuretic effect (*i.e.*, trigger water loss) and actually *increase* your daily fluid requirement.

The current RDA for water for adults at rest under average conditions of environmental exposure is 1 ml/kcal of energy expenditure.³ For women, this amount would equal 2.2 l/day; for men, 2.9 l/day.³

Who's At Risk?

Any individual can become dehydrated from the following conditions:

- Excessive sweating (*e.g.*, endurance exercise, working outdoors, etc.)
- Vomiting and/or diarrhea
- Fever
- Excessive urine output (*e.g.*, uncontrolled diabetes, diuretic medications).

Infants, children, pregnant and breastfeeding women, those experiencing illness, and elderly adults have increased needs for water.³ Infants and children, because of their smaller size and weight, can quickly become dangerously dehydrated if they're experiencing vomiting, diarrhea, fever, and refuse to eat or drink anything.

Excessive vomiting and diarrhea (lasting longer than 24 hours) is a cause for concern and is a risk factor for dehydration. Usually, the best way to treat it is to increase fluid intake to replace fluids lost through diarrhea/vomiting. In addition, one can also add a rehydration solution, which can be sipped on every two or three minutes. If, however, a baby or adult is showing signs of dehydration (see below), one should seek medical attention *immediately*.

Elderly adults are another group at risk for dehydration because the thirst desire is reduced as people age. It's imperative that elderly adults (especially those who live in hot climates and/or who do not air-conditioning) drink plenty of fluids before they become thirsty.

There are three classifications of dehydration: mild, moderate, and severe with each classification based on the amount of fluid lost from the body and not replaced.

*Mild Dehydration*⁴

The symptoms of mild dehydration are as follows:

- Dry lips and mouth
- Thirst
- Inside of mouth slightly dry
- Low urine output; concentrated urine appears dark yellow

*Moderate Dehydration*⁴

The signs of moderate dehydration include:

- Thirst
- Very dry mouth
- Sunken eyes
- Sunken fontanelles (the soft spots on an infant's head)
- Tenting (pinch and lift skin lightly—if it doesn't bounce back readily)
- Low or no urine output
- Not producing tears

At these signs, children under the age of 12 should see a physician immediately.

*Severe Dehydration*⁴

Signs of severe dehydration include:

- All signs of moderate dehydration
- Rapid and weak pulse
- Cold hands and feet
- Rapid breathing
- Blue lips
- Lethargic, comatose, seizures

Severe dehydration requires immediate hospitalization.

How to Monitor Your Hydration Status

Thirst is a signal that your body needs fluid; however, it's a poor indicator of your body's fluid needs because you can lose two percent of your body weight before you feel thirsty.

A better way to gauge your hydration status is to monitor the output and color of your urine. A well-hydrated individual should void 1,000 to 1,500 ml/day, and urine color should be no darker than a pale yellow color.¹ If your urine is darker, it is a sign you are dehydrated, and you need to increase your fluid intake.

Dehydration's Effect on Exercise Performance

Those who work exercise in intense temperatures need to stay hydrated. Athletes should rely on urine output and color or checking their body weight both before and after each exercise session or event to gauge water losses. Ideally, athletes should replace approximately 1 liter of water per kg of weight lost (or ~2 cups/lb).⁵

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Even mild water losses can significantly impede performance. For every one percent of body weight lost, blood volume decreases by 2.5 percent, muscle water decreases by one percent, and the body's core temperature can increase 0.4 to 0.5° C.⁷ Changes in blood volume during prolonged exercise impair the body's ability to deliver oxygen and key nutrients to active muscles, organs, and glands and negatively affect thermoregulation (the body's ability to regulate core body temperature) by diminishing the body's ability to expel heat. Losses of three percent are associated with physiological changes, such as decreased blood volume, decreased urine output, diminished performance, and decreased endurance, while losses of nine to twelve percent are fatal.^{1,7}

“Electrolytes are certain minerals (*i.e.*, calcium, chloride, magnesium, potassium, sodium ions) essential to human health...and cannot be substituted by any other nutrient in the diet.”

What Are Electrolytes?

No discussion of dehydration would be complete without an explanation of electrolytes and their respective functions. Most people, when asked, aren't sure what electrolytes are or why they're so important in preventing dehydration.

Electrolytes are certain minerals (*i.e.*, calcium, chloride, magnesium, potassium, sodium ions) essential to human health. As an essential mineral, an electrolyte cannot be substituted by any other nutrient in the diet. That means that your body will only accept that particular mineral or electrolyte.

Without electrolytes, you could not move, think, or live. Within the body, electrolytes are dissolved in body fluids. In terms of hydration, electrolytes are responsible for directing water (and nutrients) to the areas of the body where its needed most and maintaining optimal fluid balance inside the cells. Besides maintaining fluid balance, electrolytes help your muscles to contract and relax and assist in the transmission of nerve impulses from your nervous system to different body parts.

The chart below explains the important functions electrolytes perform in your body:

Fig. 1: How Electrolytes Help Prevent/Treat Dehydration

SODIUM	POTASSIUM
<u>HYDRATES:</u> Maintains water balance; Activates thirst response; Prevents water intoxication & hyponatremia	<u>HYDRATES:</u> Maintains water balance
<u>PREVENTS CRAMPS:</u> Enables normal muscle contraction	<u>ENERGIZES:</u> Stimulates metabolism of proteins & carbohydrates; Helps muscles use glycogen, their main source of energy
<u>ALSO:</u> Influences performance of other minerals; Enables nerve impulse transmission Maintains normal blood pressure	<u>PREVENTS CRAMPS</u> Prevents muscle fatigue; Enables normal muscle contraction;

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	<u>ALSO:</u> Influences performance of other minerals; Enables nerve impulse transmission; Maintains normal blood pressure
CHLORIDE	MAGNESIUM
<u>HYDRATES:</u> Maintains water balance; Prevents dehydration	<u>ENERGIZES:</u> Participates in the conversion of ATP (adenosine triphosphate), which are the energy packets the body uses to produce and store energy; Stimulates the metabolism of carbohydrates & fats; Helps the body build proteins
<u>ENERGIZES:</u> Helps the body break down protein, absorb minerals & vitamin B ¹²	<u>PREVENTS CRAMPS:</u> Decreases pain from sports-related injuries & excessive physical activity; Enables normal muscle relaxation; Prevents muscle cramps & spasms
<u>PREVENTS CRAMPS:</u> Enables normal muscle contraction & relaxation	<u>ALSO:</u> Influences performance of other minerals; Enables nerve impulse transmission; Decreases vulnerability to disease; Alleviates symptoms of numerous medical and psychiatric conditions
<u>ALSO:</u> Enables nerve impulse transmission	

Besides the functions listed above, studies show that repletion of one important electrolyte—magnesium—has a significant impact on athletic performance. Moderately trained athletes who took magnesium supplements showed decreased blood pressure, heart rate, and oxygen intake. Triathletes supplementing with extra magnesium demonstrated improved cycling, swimming, and running times.⁸

Population studies consistently show that most adults do not get enough magnesium in their diet.

Don't Count on Sports Drinks to Stay Hydrated

Sports drinks are often touted as the ideal way to prevent dehydration. Many claim to hydrate the body “better” than water, and, now, many contain a host of novel ingredients including vitamins, herbs, and caffeine, which claim to boost athletic performance. But are sports drinks more effective in hydrating the body than water?

Make no mistake—sports drinks are adult Kool-Aid with some sodium and, in some instances, potassium added. Sports drinks are loaded with sugar, and many athletes find them overwhelming when consumed during an event or exercise. Many commercial sports drinks are flavored (and colored) with chemicals and sweetened with high fructose corn syrup, a simple sugar that can cause fluctuations in blood sugar.

The most common complaints with sports drinks is stomach upset and a “mucous-y” or “gagging” sensation in the back of the throat. Electrolytes—not sugar—support hydration to the cellular level, and with sports drinks, you will max out on sugar before you’re adequately hydrated.

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If you compared the grams of sugar (carbs) found in a typical 16- oz. serving of several leading brands of sports drinks with the carb content found in your average Tootsie Roll, you would discover the following:

- Gatorade® contains 100 calories and 28 grams of carbs, which is equivalent to 13 Tootsie Rolls.
- Powerade® contains 34 grams of carbs, equivalent to 16 Tootsie Rolls.
- Endurox R-4 (Fruit Punch) contains 360 calories and 69 grams of carbs, equal to 33 Tootsie Rolls.

Incidentally, a 16 oz.- serving of Kool-Aid* provides roughly the same amount of calories and carbs per ounce as sports drinks (120 calories and 32 grams of carbs, roughly equivalent to 15 Tootsie Rolls), yet it also provides ten percent of the RDA for vitamin C.

The sugar content alone restricts the use of sports drinks for people with diabetes, which is highly telling. Besides the effect of sports drinks on blood-sugar levels, the long-term effects of the sweeteners, coloring agents, and other chemicals in sports drinks is not known, but some recent research does raise some questions. A 2005 study published in *General Dentistry* reported that some popular sports and energy drinks destroyed tooth enamel more effectively than cola. The study, which analyzed the effects of exposed dental enamel to 12 different brands of soft drinks, non-cola, and sports beverages, found that irreversible enamel damage was three to eleven times greater among the non-cola and sports beverages than cola-based drinks.⁹

A second limitation of sports drinks is their electrolyte balance. Many claim to contain electrolytes to replace sweat losses, but the fact is, the primary electrolytes these beverages contain are sodium and potassium, and that's it. Most people already get too much sodium from foods. The electrolyte content of Gatorade is 220 mg of sodium and 60 mg of potassium, based on a 16 oz. serving size. Powerade contains 110 mg of sodium and 60 mg of potassium. Gatorade's latest product introduction, Endurance, which claims to have five electrolytes, contains a whopping 400 mg of sodium and 180 mg of potassium. What about the other electrolytes? Calcium and magnesium are mentioned; however, Endurance provides less than two percent of the Daily Value for these two critical electrolytes.

A balance of ALL electrolytes is necessary to maintain optimal hydration and endurance. Not only do you lose sodium in sweat, but you also lose other critical electrolytes like magnesium, and since most people don't get enough magnesium, serious deficits can be occurring.

The bottom line is don't count on plain water and sports drinks to meet your body's hydration and electrolyte needs. Plain water (including bottled "mineral waters") doesn't contain a substantial quantity or balance of the essential electrolytes you require to stay adequately hydrated, replace electrolytes lost in sweat, and maintain optimum performance. As for sports drinks, the high-sugar content of most of these beverages often causes bloating, stomach cramps, and can impair your hard-fought training and performance at the moment when it may matter the most.

ELETE is an electrolyte add-in you add to water or any other beverage to make an instant sports drink. It provides pure electrolytes and nothing else. ELETE powers rapid hydration and quickly replaces ALL lost electrolytes—not just sodium. It supports performance, stamina, and recovery, and delivers electrolytes evenly to ensure optimal hydration. ELETE allows you, the user, the option of consuming carbohydrates in whatever way works best for you. And unlike sugar-loaded sports drinks, ELETE doesn't contain calories, flavorings, sweeteners, colors or sugar, which can hinder performance.

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*Sample products compared were Gatorade Berry Citrus, Powerade Fruit Punch, and Kool-Aid Sugar-Sweetened Soft Drink, Grape Flavor.

**Gatorade, Powerade, and Kool-Aid are registered trademarks. Comparison based on 16-oz. serving.