Name:_____ Date:_____

Water vs. Sports Drink Article Response Sports Medicine

*First Read: .pdf article on Water vs Sports Drinks

1.) What is the main argument of this article?

2.) Why do we need to drink water or Gatorade? What are we trying to replenish?

3.) What are some of the myths about drinking Gatorade that were addressed in this article?

4.) Why might athletes be inclined to drink water during practices where they are in hot climates?

5.) How does the body maintain core temperature? What process is this called, where the body maintains a constant temperature?

BONUS THINKER!!

-What if you couldn't perspire? What might you do to keep yourself cool during practice in hot climates?

NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

Asthma Attack!

by
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Part I – Background Information

Jaden Hunter, 11 years old, stumbled into his parents' bedroom. It was 4 a.m. and completely dark. Unable to talk, he simply grabbed his mother's foot to get her attention. His mom awoke immediately and shouted "Brandon, get up!" Without explanation, she knew what the problem was. She helped Jaden onto the bed next to her husband, then raced down the stairs and grabbed the backpack full of medical equipment they used when things got this bad.

When she returned Jaden was sitting on the bed being comforted by his father. While slipping a mask over his face to deliver nebulized albuterol, his mother recalled the events earlier in the day. Jaden had enjoyed a field trip with his STEM club where they attended the local race track to learn about the engineering of race cars. At one point during the event, one of the drivers offered to start up the car for the group of excited school kids. He warned "Before I do this, if you have asthma you'll want to step way back." A happy and excited Jaden didn't want to leave, but his mom recognized the danger and led him away from the car. Just a few moments later the driver revved the engine. The deafening sound was followed by a plume of green smoke—nitromethane exhaust. Jaden immediately needed his quick-relief rescue inhaler, and his mother took him home.

Asthma is a condition caused by chronic inflammation of the small airways in the lungs. This leads to swelling and increased mucus production within conducting zone passageways. Due to the chronic inflammation, an asthmatic's airways are already more narrow than the airways of an individual without this disease (Figure 1). Situations that may cause the airways to constrict or spasm are common. Exposure to dry and/or cold air, contact with pollen or other allergens, illnesses such as a cold or the flu, certain medications and foods, or even just stress can cause this bronchoconstriction to occur (AAAAI, *n.d.*). This usually does not cause a problem for a non-asthmatic, but for someone with asthma, bronchoconstriction can severely decrease the diameter of the already swollen, mucus-producing airways, making it very difficult to move air into and out of the lungs. The decrease in air flow can range from mild to life-threatening, and may cause a great deal of anxiety for someone actively suffering from an acute asthma exacerbation, or asthma attack.

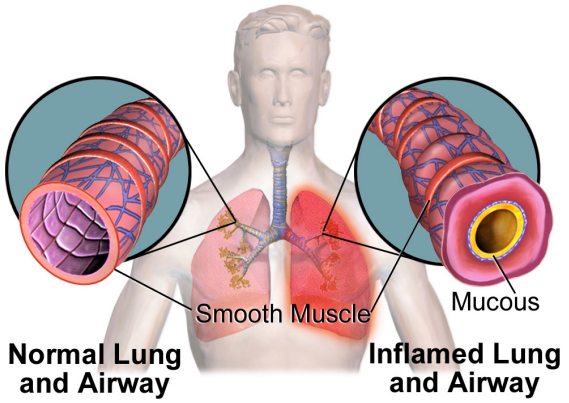

Figure 1. The respiratory passageways in a non-asthmatic (L) and asthmatic (R) lung. *Credit:* BruceBlaus, CC BY 3.0.

Questions

You may need to use the internet or another source to help answer some of the questions in this case study.

1. According to the passage above, what are the three factors involving the airways that lead to an asthma attack?
2. What is contained within a quick-relief rescue inhaler?
3. How did the quick-relief rescue inhaler help Jaden to breathe easier at the race track?
4. What is nebulized albuterol, and how does it help with an asthma exacerbation?

Part II – The Oxygen-Hemoglobin Dissociation Curve

Following his nebulizer treatment, Jaden was breathing a little better and able to talk.

"I used my rescue inhaler all night . . . it didn't help!" He paused for a breath and then said, "We used my nebulizer . . . right before bed . . . I still couldn't sleep . . . My chest feels tight."

"Do you feel like we need to go to the hospital?" his mom gently asked. Jaden looked down and simply nodded his head yes. Having suffered from asthma since the age of four, he understood that his symptoms had reached a point where they couldn't be adequately managed at home.

Luckily, the hospital was just a short drive away. Brandon stayed home with Jaden's little sister, Chloe, and Jaden and his mom headed to the car. It wasn't the first time they had made this trip in the middle of the night. In fact, it seemed like every time Jaden had breathing problems severe enough to warrant an emergency room trip it was in the middle of the night.

As they arrived at the hospital Jaden's chest tightness was once again beginning to increase and he was unable to take deep breaths. The panic this caused him lead to tears, which only made his breathing problems worse. His mom knew that the best thing she could do to help him was to stay calm herself and gently guide him through breathing exercises, so she set aside her own fears and panic, and started to do just that as she checked him into the ER.

Once back in the examining room a pulse oximeter was immediately placed on Jaden's finger and vital signs monitored. Jaden's oxygen saturation (So_2), or the percentage of his hemoglobin binding sites bound to oxygen, was 82%.

Use Figure 2 of the oxygen-hemoglobin dissociation curve to answer the questions below.

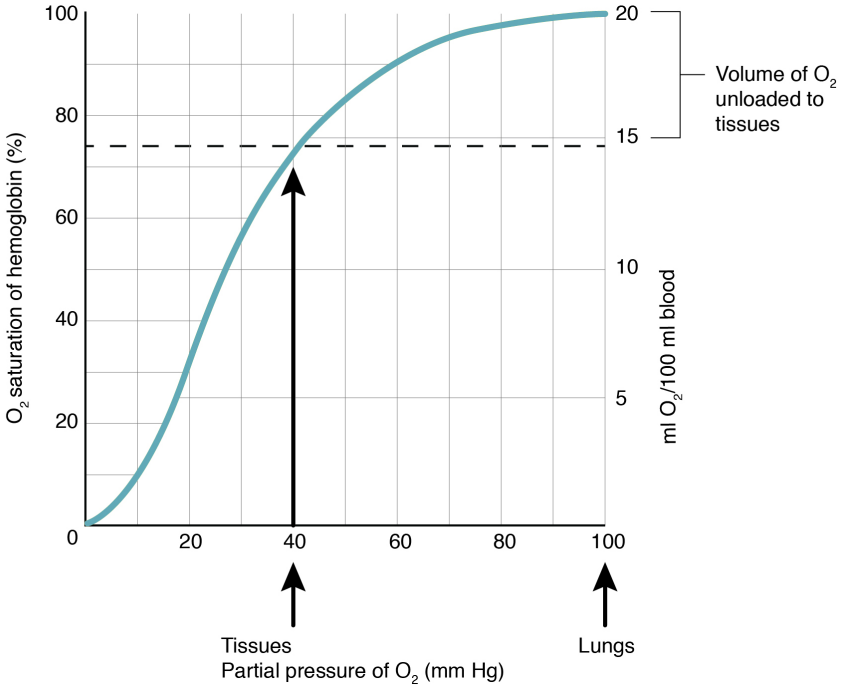

Figure 2. The oxygen-hemoglobin dissociation curve.
Credit: OpenStax College, CC BY 3.0.

Questions

1. Based on his So_2, what is the partial pressure of oxygen (Po_2) dissolved in Jaden's blood plasma?

2. How does Jaden's Po_2 compare to the normal, expected Po_2 for arterial blood?

3. Provide a reason for the change from normal arterial Po_2, and explain how this change affects oxygen delivery to Jaden's tissues.

Part III – The Effects of Air Flow on P_{O_2} and P_{CO_2}

Because asthma is an obstructive respiratory disease caused by a decreased diameter in the respiratory passageways, Jaden was having problems both with breathing in and with breathing out. Air flow through the respiratory passageways can be calculated by using the following formula:

$$F = \Delta P / R$$

Where:

F = air flow

ΔP = the difference between atmospheric and intrapulmonary pressure

R = resistance

Questions

1. How does the body create a difference between atmospheric and intrapulmonary pressures to cause air flow to and from the lungs?

2. In Jaden's case, which factor in the above equation changed, causing air flow to and from his lungs to decrease?

3. Without medication or treatment, how could Jaden compensate to maintain airflow to and from his lungs despite his narrowed airways? In your answer, be sure to reference the formula for air flow given above.

4. Explain why asthma exacerbations and other obstructive lung diseases that make it difficult for air to move into and out of the lungs can be exhausting for the sufferer. (*Note:* this goes beyond the fact that the sufferer is oxygen deficient and that often the problem happens at night. You need to discuss the mechanical strain that this places on the body due to the requirements to maintain airflow to and from the lungs.)

5. The P_{CO_2} of venous blood is normally 45 mmHg. How would you expect Jaden's current P_{CO_2} level to compare to the normal level? Explain your answer.

6. How would Jaden's P_{CO_2} level affect the rate at which his oxygen is dissociating from hemoglobin? (Remember the Bohr effect.)

Part IV – Spirometry

Spirometry is a test that is done as part of a normal, routine check-up for an asthmatic. In addition, it is also often performed during asthma exacerbations to assess lung function. During the test a patient is required to breathe through a tube that measures air flow into and out of their lungs. Usually the patient is asked to breathe in and out normally, before being required to breathe in as deeply as possible and then breathe out as deeply and quickly as possible.

Familiarize yourself with Figure 3 and then answer the questions below.

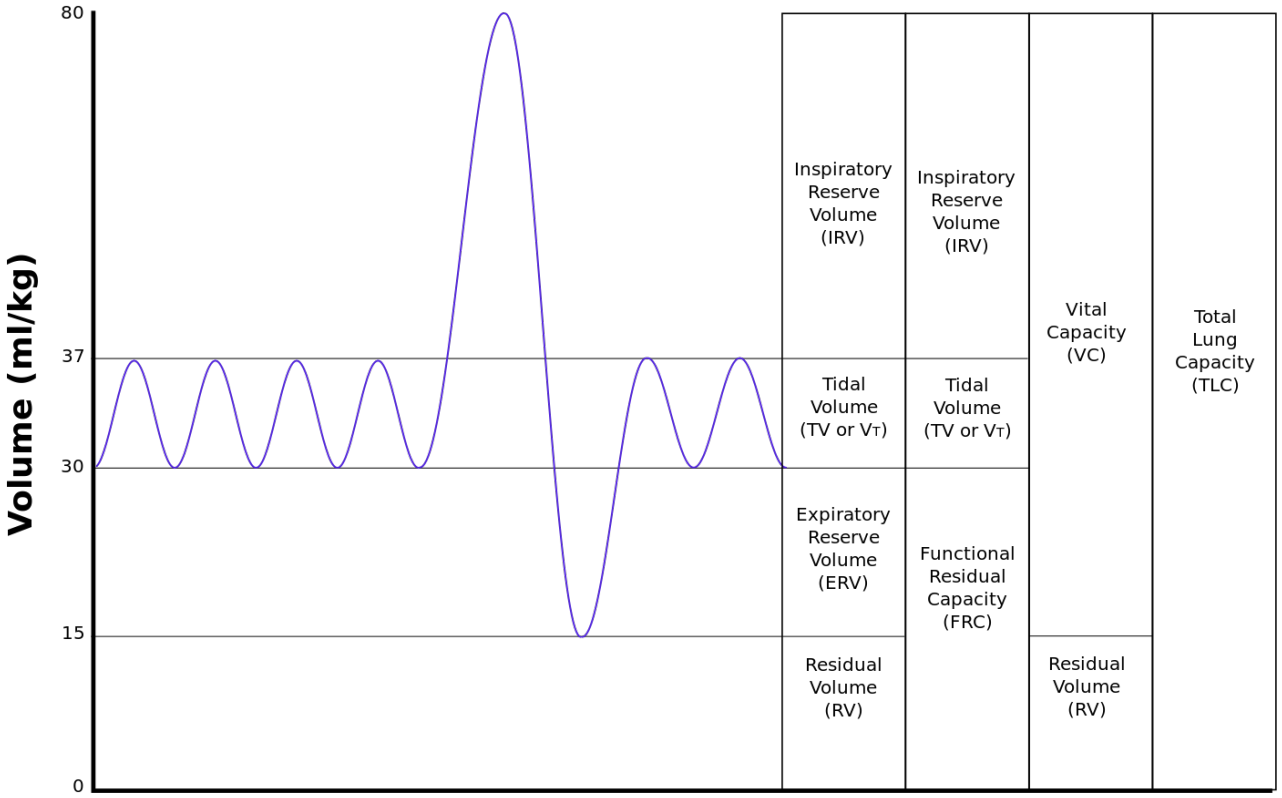

Figure 3. Respiratory volumes. *Credit:* LungVolume.jpg, CC BY-SA 3.0, <https://commons.wikimedia.org/wiki/File:Lungvolumes.svg>.

Questions

1. Provide definitions for the following: *tidal volume, inspiratory reserve volume,* and *expiratory reserve volume.*

2. How do you think that each of these lung volumes (tidal, inspiratory reserve, and expiratory reserve) would change for someone experiencing an asthma attack?

3. Explain why spirometry (the measuring of these lung volumes) can be used to get an idea of basic lung function and determine whether or not someone is currently suffering from asthma or another respiratory disorder.

Part V – Treatment

Jaden's asthma specialist, Dr. Palmer, was on call at the hospital and popped into the ER to see how Jaden was doing. Jaden had been placed on a continuous nebulizer, given 20 mg of prednisone, and was continuing to have his vitals monitored. His So_2 had increased to 95% and had remained there for approximately an hour.

"Well, it looks like we've had some improvement," the doctor said. "Blood oxygen levels have been above 90% for a while now. Let's discontinue the nebulizer. If we can keep his So_2 above 90% without it, then we'll let you guys out of here soon."

It was now 7 a.m. and Jaden was dozing on the table. Dr. Palmer put his hand on Jaden's shoulder to gently wake him and said, "It seems like the last time I saw you we put you on a long-term asthma preventative—Advair was it? Have you been taking your Advair twice a day like we talked about?"

"Well, I take it sometimes. But I forgot to take it for a while because I couldn't find the inhaler."

"Jaden, if you don't want to come to the hospital in the middle of the night, or at any other time for that matter, you've got to take your Advair like we talked about. We're going to keep you on prednisone for the next five days. Please take 20 mg twice a day and continue to use your nebulizer every 4–6 hours until you feel like you are breathing better and your chest is no longer tight."

An hour later Jaden and his mom headed home after a very long night.

Questions

1. Use the oxygen-hemoglobin dissociation curve (Figure 2 in Part II) to determine what Jaden's Po_2 is if So_2 is 95%.

2. Why is Dr. Palmer concerned that Jaden's So_2 stay above 90%?

3. How do long-term asthma control medications such as Advair work to prevent asthma attacks?

4. How did prednisone help to reverse Jaden's symptoms?

Internet Resources

AAAAI (American Academy of Allergy, Asthma and Immunology). *n.d.* Asthma triggers and management. <https://www.aaaai.org/conditions-and-treatments/library/asthma-library/asthma-triggers-and-management>.

Mayo Clinic. *n.d.* Hypoxemia. <http://www.mayoclinic.org/symptoms/hypoxemia/basics/definition/sym-20050930>.

Bottrell, J. 2015. Understanding oxygen and oxygen levels with COPD. <http://www.healthcentral.com/asthma/c/52325/175572/understanding-oxygen-levels/>.

National Center for Biotechnology Information. PubChem Compound Database. Prednisone, *CID=5865.* <https://pubchem.ncbi.nlm.nih.gov/compound/5865>.

LOST IN THE DESERT!

by
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Part I: July 13th, AM

Mark, a white, 35-year-old male weighing approximately 70 kilogram (kg) started a three-hour drive across the desert on US 95 from Yuma, Arizona, to Blythe, California. He set out at 7 AM on what was expected to be a very hot July day. He anticipated that it would take him about three hours to reach Blythe—plenty of time to make his 11 AM appointment with Sarah, his fiancée. When he failed to appear by noon, Sarah became concerned and called the highway patrol.

By 12:30 PM, Search and Rescue Officer Maria Arroyo, who was patrolling nearby, reported finding an abandoned car on the side of the road with a damaged radiator that matched Sarah's description of Mark's vehicle. Maria noticed shoe prints leading into the desert toward some low mountains in the distance. At that point Maria called for helicopter assistance, consulted her GPS, and relayed the exact coordinates to base.

By 1 PM Henry Morningstar, paramedic and a member of the helicopter crew, reported a shirtless, hatless man wandering down a desert wash. The local radio station reported at about the same time that the air temperature was hovering at 105° F in the shade (and there was darned little of that). The relative humidity was less than 5%. The helicopter crewmembers spotted a man staggering on the desert. They realized they had found Mark. His driver's license identified him as the missing man. Mark was still conscious but clearly delirious. Henry also noted that Mark was weak, nauseous, disoriented, and complained of a headache. His blood pressure was quite low—70/50—and he was not sweating despite the oppressive heat. His body temperature was also high—105°. The patient was diagnosed as having **heat stroke**. The paramedic also noted **first degree burns** on his face and back.

Suddenly, Susan Liu, the pilot, reported that they had lost radio contact with the hospital. It was all up to Henry now!

> *Given the conditions, what should Henry do to try to save Mark? He must decide very quickly. Mark has very little time left and may not survive the trip by helicopter to the hospital. Gather into your groups and use your textbooks as resources to gather for information about what Henry should do. What has caused Mark's weakness, nausea, disorientation, headache, and low blood pressure? Why isn't he sweating?*

Part II: July 13th, PM

Henry started oral rehydration with an isotonic solution containing **electrolytes**, **glucose**, and water.

Why didn't the paramedic give Mark distilled water rather than an electrolyte/glucose solution?

As Mark recovered in the hospital, he related what happened to him earlier in the day. Since he was a newcomer to desert areas, he saw no need to bring UV A/B sunblock or extra water on his trip from Yuma to Blythe. Mark recalled seeing a coyote dart out between two bushes and he seemed to recollect hitting the animal. The area was so isolated that his cell phone was useless. He waited by the car for a while but then, about 10 AM, as the sun climbed, he saw a large body of water in the distance, possibly, he thought, the Colorado River. The "river" was, in reality, a mirage, as he realized later after he had walked some distance. He then started to become confused and could not find his way back to the highway. Eventually he became very hot and threw away his shirt and hat.

Why did Mark become disoriented? How would you test your ideas to see if you are right? What does your group think based on the information in the text?

Part III: Subsequent Months

After he left the hospital, Mark saw extensive new **melanin** formation in his skin. Much later Mark noticed some new moles on his shoulders. The moles grew, changed color, and bled.

What should Mark be concerned with regarding these moles? He talked to dermatologist Dr. Charles Culp about the moles. What tests might Dr. Culp conduct after removing the moles?

Final Set of Case Questions

1. Define the terms in the case study highlighted in boldface.
2. Assuming that Mark lost around 4 liters of water, what percentage of his body water did he lose? Would you expect his urinary volume to decrease or increase during his trek? Please explain your answer.
3. Why was Mark's blood pressure so low? Would his pulse rate decrease or increase? Please explain. Why was Mark dizzy and disoriented?
4. Assume that Mark had an unopened six-pack of beer in his car. Would it have been a good idea for Mark to bring the beer along in case he got thirsty? Why or why not?
5. What vitamin would Mark have in greater amounts in his body after that day?
6. What did Mark do that increased his chance of burns?
7. Why would Mark's skin have looked red within the first few hours of his adventure rather than redness developing hours and days later as a result of "sunburn"?

Image Credit: Photo of the view southwest from Palm Canyon by John Crossley, The American Southwest (http://www.americansouthwest.net/). Used with permission.

Date Posted: 06/08/02 nas

MAFES Dawg Tracks

August 8, 2007 ***Water vs. Sports Drinks - What you need to Know***

There has been a discussion as to which is better for rehydration, sports drinks, like Gatorade, Powerade, Propel, or water. Research has been and continues to be performed on the advantages of both. There are several schools on the subject. I have researched several links of studies, reports and opinions on the advantages of one over the other. I shall review in summary the findings that I discovered and will add the links that I referred to so that you can refer to these for in-depth details.

Using the link, www.dailylobo.com, which is the University of New Mexico's Web page, Dr. Robert Robergs, a UNM exercise physiologist, has done extensive research on the subject. I shall summarize his findings and you may refer to this link to get deeper details. Dr. Robergs has spent from 1999 thru 2004 researching Gatorade's claims that it is superior to water in its ability to rehydrate the body. He states that there is nothing magical about Gatorade that hydrates the body better. You put water and Gatorade in front of an athlete, and they prefer to drink Gatorade just because it tastes better. He further stated that weighing a person before and after the drinks have been consumed will test body hydration. If the weights are the same, it is obvious that Gatorade isn't retained any better than water.

The reason that Gatorade is thought to rehydrate better is because of the carbohydrates in the drink, which aids the small intestine in absorbing water in the body. The body absorbs water seven times faster with carbohydrates, but Dr. Robergs says that there is no more evidence that the body is able to retain that water. After the research subjects drank the Gatorade and water, they had to run to the bathroom just as fast.

The research showed that Gatorade provides athletes with carbohydrates needed during exercise, but unless a person is going to exercise for at least 90 minutes, consuming carbohydrates is self-defeating. He also added that that there is no need for people to ingest a drink that is basically sugar water. You can make the same drink out of table sugar and Kool-Aid, then add some table salt. It is effectively the same, but one-fifth the cost.

Gatorade's Sports Science Institute's Web site states that water quenches thirst, but is not an effective hydrator because it prematurely satisfies thirst. The research showed that most people don't drink enough water during exercise, and the fluids in their bodies are constantly being depleted through urination. The salt in the Gatorade maintains their desire to keep drinking it. Dr Robergs says that the same argument against water used by the company also applies to its sports drink. The argument is valid for both water and Gatorade. Dr. Robergs surmises that we (exercise scientists) are improving the integrity and accuracy of science.

Mr. Peter Liu, representing the soko.com health and fitness link states that sweating is the body's mechanism for cooling down, which is triggered by heavy activity and heat. The higher sweat production occurs during exercise. As sweat rises to the skin, large amounts of water, sodium, chloride and potassium are brought to the surface. The loss of these electrolytes decreases the athletic effectiveness, since the loss of sodium, chloride and water dehydrates the body. The most important thing to know is that the amount of sweat produced is equally proportionate to the amount of energy used up. It is when the body loses fluids that the debate between water and sports drinks comes to the fore.

Gatorade and PowerAde are the same drink with different flavors. Other variations contain fewer carbohydrates, more vitamins, more electrolytes and caffeine. Both drinks boast that they help the body to work harder and more effectively during exercise by replacing electrolytes as you lose them and enabling your body to drink more liquid. Drinking more liquid quickens rehydration. Gatorade claims that its drink does it better than water. The real truth is that sports drinks are most effective if you're planning to take part in an extreme exercise event for long periods of time, like a triathlon or marathon runs.

WATER FACTS: Water contains minerals and electrolytes as Gatorade and PowerAde does. However, water contains calcium, nitrates, sulphates and zinc, in addition to electrolytes. One of the selling points that sports drinks have against water is that water has no taste. Sugar and flavoring added to sports drinks increases their appeal. They also boast that people soon tire of drinking water because of the lack of taste. Water does not contain the calories of sports drinks. This may be one reason why they released newer versions with fewer calories.

FITNESS WATER: Gatorade released its line of Propel Fitness Water in the year of 2000. It has the same ingredients as Gatorade, but also included more vitamins and fewer calories. The selling points are the same as Gatorade. The lightly flavored water is supposed to make you drink more, while helping you to stay active. The fact is that water does the same job.

THE VERDICT: While Gatorade, PowerAde and Propel, and all of their off-shoots, boast superiority to water in some way or other, drinks that contain electrolytes are only at their most effective during extended periods of intensive exercise. Water is a much better substitute for normal periods of exercise. If you normally exercise for an hour or more, you can easily replenish and rehydrate your muscles with water. If your body mostly consists of water in the first place, why replace that water with some foreign liquid?

KNOWING IS HALF THE BATTLE: Athletes and workers will have their own preference as to what they want to drink while they exercise or work, and the debate of which is best will continue. It is just best to know the facts, no matter which drink you like better.

The University of California, San Francisco, Department of Nutrition on their web (www.ucsf.edu/sfshare/nutrition.html) answers the question, "ISN'T GATORADE THE BEST DRINK FOR PLAYING SPORTS AND QUENCHING THIRST?" ***No, Gatorade is not as bad as other drinks like soda, but when you are playing sports, water is probably the best. Gatorade has sugar in it, which makes it harder for your body to absorb the fluid you need while playing sports. But as long as you have a healthy diet and aren't running marathons, water will provide the needed electrolytes and is probably your best option.***

All the articles that I read use the basis of exercise and sports for their research. However, we can relay this message to our work related activities. Excessive work, over long periods of time, may qualify the use of sports drinks, but in normal fieldwork, where breaks are taken periodically, water seems to be the better fit. No article that I read completely favors sports drinks totally over water.

Ted Gordon-Risk Mgmt. / Loss Control Mgr 8/8/2007
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Sources: www.soko.com
www.dailylobo.com/media/storage/paper344
www.ucsf.edu/sfshare/nutrition.html

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