You're not bonking. You're dehydrated!

by Dr. Stacy Sims

Picture this: last 10 km of a race. You're in a break, you are part of the rotation and all is going your way… then you feel it. You feel your legs getting heavy, and that dreaded flatness creeping in. "Uh-oh" you think to yourself, "I haven't eaten enough! I need something quickly!" You reach into your pocket for a gel, slurp it down and follow it with your sports drink. 3 minutes later you feel a rush, but then 4 minutes later, your legs still feel flat and dead. The finish line is getting closer and you are beginning to think of damage control. You sit in trying to find a bit of recovery, you wait until 4km to go and hit another gel, hoping for a lift to get that last bit of power for your kick and sprint. You're reading the break and BAM attack off the front. 500m to go, you try to kick it up, but your legs just don't respond… Yet again, you finish 6th (or 7th or 10th.. anywhere but where you'd like to be).

Where did you go wrong? You thought you were eating and drinking enough, but the fatigue and border line cramping came into play again.

What if I were to tell you, it's a relatively easy fix? It's not a calorie thing, but a blood volume thing. Basically, you're dehydrated.

"What? How is that possible? I drank at least a bottle an hour!"

Perhaps, but two things here… 1) Did you drink according to body weight and environmental conditions (minimum 0.18 ounces per pound of body weight in temperatures 75'F and below, or 0.2oz per pound of body weight in temperatures above 80'F)?? And 2) what was in your bottle?

In my experience working with athletes, they are so focused on calories that they don't pay attention to the fact that what they are drinking contributes to FUELING, not HYDRATION.

Let me explain.

In science speak: During prolonged exercise, fluid and salt losses through sweating reduce plasma volume which leads to heart rate drift in association with hyperthermia and reductions in performance. Oral rehydration with water reduces the loss of plasma volume and lessens heart rate drift and hyperthermia. Moreover, the inclusion of sodium in the rehydration solution to levels that double those in sweat (i.e., around 90 mmol/l Na^+) restores plasma volume when ingested during exercise, and expands plasma volume if ingested pre-exercise.

In real person speak: During exercise you lose water and salt through sweat. When you lose this water and salt, the watery part of your blood also drops. With less water in your blood, the blood is more viscous, thus you end up with a higher heart rate, lower power production, and a greater rise in core temperature->all leading to fatigue, reduced performance, and the dreaded power decline when it counts the most: at the end of a race.

There is a competition within the body when you start to exercise: Your muscles and your skin fight for your blood. Blood goes to the muscles for metabolic function. Blood goes to the skin to get rid of the heat produced by the working muscles. As body water drops, this competition becomes more fierce, and the skin blood flow will win out- Primarily because heat is a greater threat to the body than keeping the muscles working (which produces heat..).

The fatigue you experience is that drop in blood flow to the muscle- basically you have less metabolism functioning plus protein denaturing (the contractile proteins denature, aka stop working, in muscle temperatures >~39'C).

"Ok" you say, "But I'm drinking so I should be able to circumvent this blood volume problem."

BUT here is where things go south. It's what you're drinking that's making you dehydrated.

The mass market out there has the message that when you drink a 4-8% carbohydrate solution with sodium (~220mg sodium per liter) you are taking care of your hydration and fueling needs. The focus is always on carbohydrate availability and calories. (If you do a literature search on hydration and carbohydrate for endurance exercise you will find the hydration research is really carbohydrate availability in the form of liquid calories.)

I'm here to tell you, as a physiologist that specializes in hydration, thermoregulation, and performance; this is a misleading and incorrect message.

Let's look at two key factors needed to pull fluid into the body's fluid spaces:

1) You need what you are drinking to have an osmolality below that of blood. (osmolality is the amount of solutes in a solution. The more active solutes in a fluid, the higher the osmolality. Blood sits ~285mOsm)

2) You want what you are drinking to meet the physiological needs of fluid absorption- this means that you want your fluid to have fluid co-transporters: the intestinal cell membranes use sucrose, glucose, and sodium (Na+) as facilitators to get fluid across the cells into the water spaces of the body.

Now let's look at the nutritional aspects of a typical sports drink:

- 5-6% carbohydrate solution (5-6 grams of carb per 100ml)

- Osmolality of ~300-305mOsm

- Sugars: maltodextrin, fructose, sucrose

- Sodium: 220mg per liter

With the higher osmolality than blood, the physiological response is to pull water from within the vascular spaces of the body to "dilute" higher osmolality. This creates a net gradient of water leaving the body into the digestive system. Problem: effective dehydration and GI distress.

The 5-6% solution provides exogenous carbohydrate but not in the levels needed to sustain longer term endurance exercise without energy fluctuations (you want 4-6 calories per pound of body weight of mixed macronutrient food- different rates of oxidation/breakdown means a greater time and titration of fuel to the body)

The maltodextrin and fructose are notorious for causing GI distress and the oxidation/breakdown of these molecules increase heat storage (meaning a faster rate at which your core temperature rises).

Sodium and sucrose- these are the only two potential "helpers" in fluid absorption, BUT by the nature of the osmolality, the net gradient of fluid is to come from within the body into the gut, thus the sodium and sucrose work with this gradient to facilitate fluid movement through the intestinal cell membranes into the GI tract.

Let's go back to the initial scenario:

You're in a break, you're legs are starting to feel a bit heavy, you drink a drink with low osmolality, comprised of sucrose and glucose, sodium, magnesium, and potassium (all which work with physiology to pull fluid across the intestinal membrane into the body's water spaces). Then BAM… you attack, you push the power, and BAM you finish where you want to be… on the podium.

Here's the bottom line:

- Hydration in the bottle. This fluid is designed to work WITH physiology, not against it.

- Food in the pocket. Mixed macronutrient. Designed to keep GI distress at bay and energy levels constant.

Here's the finish line: You. Strong. Happy.

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For more information about Osmo Nutrition, go to OsmoNutrition.com.

About the author

Dr. Stacy Sims, MSc, PhD served as an exercise physiologist and nutrition scientist at Stanford University from 2007-2012 where she worked as an environmental exercise physiologist and nutrition scientist specializing in recovery, and nutritional adaptations for health, body composition, and maximizing performance. During the past decade Stacy has worked as an environmental physiologist and nutrition specialist for for professional athletes and teams including Andy Schleck, ultraswimmer Jamie Patrick, the Garmin/Slipstream Pro Cycling Team, USA Cycling Olympic Team (BMX and women's track cycling), Team Tibco, Flying Lizard Motorsports, and Team Leopard-Trek, among others. Stacy earned a BA from Purdue University, an MSc from Springfield College, a doctorate from University of Otago, and was a postdoctoral research fellow in cardiovascular disease prevention, thermoregulation, and women's health at Stanford University. Stacy raced crew as an undergraduate at Purdue University and competes as a Cat 1 road cyclist and elite XTerra triathlete.