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Confronting the Drinking Problem

What if almost everything you know about hydration and sports is wrong?

By Hilary Achauer **February 2015**

Melissa Lin/CrossFit Journal

"Thirst is going to save you from dehydration and hyponatremia." —Dr. Tamara Hew-Butler

Dr. Tamara Hew-Butler, a devoted marathon runner and sports-medicine podiatrist, was working in the medical tent at the 2000 Houston Marathon in Houston, Texas.

"It was hot that day," Hew-Butler said, "and all these runners came (into the tent) and collapsed."

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Hew-Butler and her colleagues knew exactly what to do. Assuming dehydration, the medical aides started IVs for the collapsed runners.

Then something strange happened.

Instead of getting better, many of the runners got sicker. The medical workers continued to administer intravenous fluids.

"We were giving more IVs until four runners had seizures. They were taken to the hospital and were in comas for a week. They almost died," Hew-Butler said.

The runners all suffered from exercise-associated hyponatremia (EAH). Hyponatremia occurs when sodium levels in the blood fall below 135 milliequivalents per liter (mEq/L; in international units, this is expressed as millimoles per liter, or mmol/L). A normal blood-sodium range is between 135 and 145 mEq/L (mmol/L).

Hyponatremia can cause mild symptoms such as irritability and fatigue or more extreme symptoms including nausea, vomiting, seizures and comas. Brain swelling—exercise-associated hyponatremic encephalopathy (EAHE)—can cause death.

"Back then, we didn't know what (hyponatremia) was or what caused it," Hew-Butler said.

"I was a big part of that running community, and so that hit me really hard. I wanted to find out why these runners almost died," she said.

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Most of the current hydration guidelines—including pre-hydration and drinking 8 oz. of fluids every 20 minutes while exercising—are not only unnecessary but can also be life threatening for some people. In its official position paper on exercise and fluid replacement, the American College of Sports Medicine (ACSM) recommends pre-hydrating. It also suggests athletes consume beverages containing electrolytes and carbohydrates, saying they "provide benefits over water alone under certain circumstances."

Courtesy of Tamara Hew-Butler

Dr. Tamara Hew-Butler

In "Waterlogged: The Serious Problem of Overhydration in Endurance Sports," Dr. Tim Noakes examined the problem in detail over 429 pages. He graphed over 1,600 cases of EAH and EAHE from 1981 to 2009, including a dozen fatalities. Noakes believes these conditions are entirely preventable. The solution: Athletes should drink only to thirst. But instead athletes followed hydration guidelines that either put them in the hospital or the grave.

For example, in 1998, Kelly Barrett, a 43-year-old pediatric dentist and mother of three young children, died of EAHE after drinking too much during the 1998 Chicago Marathon. Upon death, her blood-sodium concentration was 121 mEq/L. Hilary Bellamy, a 35-year-old mother of two, collapsed at the 20.5-mile mark of the 2002 Marine

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Courtesy of Sandra Fowkes Godek

Sandra Fowkes Godek, Ph.D.

Corps Marathon in Washington, D.C. She later died of EAHE; her blood-sodium concentration was 123 mEq/L.

The endurance community is not the only group that's suffered losses.

In August 2008, Patrick Allen, a football player on the Bakersfield Christian High School team in California, died of EAHE caused by drinking too much water, according to the autopsy. In August 2014, two high-school football players, Zyrees Oliver and Walker Wilbanks, consumed excessive amounts of fluid—including Gatorade—and both died from EAHE.

Their deaths—and others—inspired CrossFit to take action.

On Feb. 20, 2015, CrossFit is hosting The 2015 CrossFit Conference on Exercise-Associated Hyponatremia, organized by the HEAT Institute. The world's foremost researchers on hydration and hyponatremia will gather in Carlsbad, California, to set the record straight on hydration and hopefully save lives.

What Is Exercise-Associated Hyponatremia?

Sandra Fowkes Godek, Ph.D., is the director of the Heat Illness Evaluation Avoidance and Treatment (HEAT) Institute at West Chester University in Pennsylvania, which provides athletes with independent and unbiased information about thermoregulation and fluid and electrolyte balance.

Fowkes Godek started working with the Philadelphia Eagles football team 12 years ago, following them and studying their sweat rates, sweat-sodium concentrations and blood-electrolyte levels.

"When the two young men died this past August of hyponatremia, I pay very close attention to those things. It's my area of research," Fowkes Godek said.

"The thing in football players—I don't know if this was a compounding factor in the boys that died—is that they typically a lot of times do have low blood-sodium levels simply because (of) consecutive days of sweating," she said.

It's possible Oliver and Wilbanks depleted their sodium after consecutive days of practice and started out the day at 135 mEq/L (the low end of normal). It wouldn't take much for them to dilute their blood sodium to dangerous levels and become hyponatremic if they then drank too much liquid, Fowkes Godek said.

Why can drinking too much fluid while exercising dilute the body's blood sodium?

Hew-Butler explained sodium stays outside the cells, while potassium stays inside the cells. Water moves freely between the cells.

"When you have low sodium, or hyponatremia, that drives water inside the cells, and the cells will swell," Hew-Butler said.

This, in turn, can cause the lungs to fill with fluid, possibly leading to pulmonary edema. The worst outcome, however, is swelling in the brain. The brain is encased in a hard skull, so if it swells even 5 percent, the brain stem can get pushed out of the skull.

"And that's how people die," Hew-Butler said.

At the 2000 Houston Marathon, Hew-Butler found out the people who ended up in her medical tent had consumed between 80 and 100 cups of water by the time they reached her.

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They were following well-established hydration guidelines.

"They were told to (drink)! 'You gotta drink, don't get dehydrated!'" Hew-Butler said. "These are like healthy people who just had bad advice."

If drinking too much water can be potentially fatal, why isn't it dangerous to sit at home and drink glass after glass of water? Why aren't sedentary people getting hyponatremia?

During exercise, the body goes into fluid-protection mode because of the possibility of losing fluids through sweat. An antidiuretic hormone called vasopressin helps the body hold onto the extra fluids—which can have disastrous results if the person exercising continues to drink even after his or her thirst is satiated, or if he or she drinks before thirst, as is usually instructed.

As a leader in health and fitness worldwide, CrossFit believes it's important to spread the word about hydration myths and avoid more preventable deaths.

Why We Over-hydrate

In 2002, 28-year-old Cynthia Lucero ran the Boston Marathon to celebrate the completion of her dissertation and to raise money for the Massachusetts chapter of the Leukemia and Lymphoma Society. Lucero's family had traveled to Boston from Ecuador and was waiting for her at the finish line.

She never made it.

By all accounts, Lucero ran well for the first 19 miles. Then, between miles 19 and 20, Lucero started stumbling. A friend jumped onto the course and began running with her.

"Lucero told the friend that she felt dehydrated and rubber-legged," Stephen Smith wrote in the Boston Globe.

"Lucero tumbled to the pavement. When she reached Brigham and Women's, she was comatose," Smith wrote, referring to the Boston hospital.

Lucero died soon after.

She wasn't dehydrated. In fact, Lucero died of hyponatremic encephalopathy.

Lucero died from drinking too much.

"The major risk factor (for EAH) seems to be overhydration or excessive fluid consumption during activity," Dr. Mitchell

Michael Brian/CrossFit Journal

Many athletes have been told to drink before they're thirsty, but doing so can have tragic consequences.

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Rosner and Dr. Justin Kirven wrote in "Exercise-Associated Hyponatremia," published online in 2006 in the Clinical Journal of the American Society of Nephrology.

EAH deaths are a relatively recent phenomenon, and they are a result of athletes and trainers following widely accepted guidelines for hydration and avoiding dehydration.

"The rule of thumb is to drink 8 ounces of a sport drink or water possibly every 20 minutes," sports-medicine expert Dr. Lewis G. Maharam told the popular health website WebMD. "If you are exercising less than 40 minutes, water is fine, but for anything over 40 minutes, you want a sports drink that has sugar or salt in it because this helps you increase the fluid that goes into the body."

In 2012, Oliver Thring wrote an article in The Guardian titled "Do Sports and Hydration Theory Hold any Water?" In it, Thring references an analysis from the BMJ (formerly the British Medical Journal) of the science behind commonly accepted hydration guidelines.

"The BMJ recently published a lengthy analysis of the science behind these claims, and the findings are important. They show how the hydration fanaticism which has gripped the sports industry since the 1980s has been established in large part through studies funded by (GlaxoSmithKline), Coca-Cola and PepsiCo, which owns Gatorade," Thring wrote.

"It's (obvious) the water-bottling companies and the sports-drink companies have been largely behind propagating what really are a lot of myths," Fowkes Godek said.

"Like dehydration causes heat stroke—that's just a myth. That's a scare tactic that Gatorade used for many years, particularly in the area where I am, which is athletic trainers. The athletic trainers now still will rank dehydration as one of the main reasons why someone gets exertional heat stroke. It's not true. I beat my head against the wall so many times. It's a very minor factor when you look at all the other things that predispose somebody to exertional heat stroke," Fowkes Godek said.

Michael Brian/CrossFit Journal

Dr. Mitchell Rosner refutes the idea that athletes are already dehydrated by the time they feel thirsty.

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Rosner, co-author of "Exercise-Associated Hyponatremia" (cited above), is a nephrologist who is the Henry B. Mulholland professor of medicine and chairman for the Department of Medicine at the University of Virginia. He hopes the Feb. 20 conference will start a broader discussion of water consumption during exercise.

"(At the conference) I'm going to go over the mythology that people need to drink eight glasses of water a day. There's no data to support that," he said.

He'd also like to dispel the myth that a person is already dehydrated by the time thirst kicks in.

"Humans have a very sensitive thirst mechanism that has evolved over time to prevent dehydration," Rosner said.

Michael Brian/CrossFit Journal

Athletes have been told sports drinks can help replace sodium, but Fowkes Godek says the salt in sports drinks is ultimately "irrelevant" when it comes to maintaining proper levels of sodium in the blood.

Rosner doesn't think the hydration misinformation was started deliberately, but he said he thinks soft-drink companies have perpetuated the myths.

Dehydration is the process of losing body fluid, Fowkes Godek said. It's not an illness or a worrisome condition.

"Now people think (dehydration) is an illness, which it really isn't," Fowkes Godek said. "It's just the process of going from one state of hydration to another.

"If you start very well hydrated, you can lose 2 to 3 percent of your body weight and still be in a normal range of hydration. You have technically dehydrated, because you've lost body fluid, but you can still be in normal hydration."

How Much to Drink?

If hyponatremia is caused by low blood sodium, why don't sports drinks with sodium correct the imbalance?

They just aren't salty enough.

Hyponatremia occurs when the blood-sodium levels are diluted. Adding more fluids, even if they contain sodium, only compounds the problem. For instance, Gatorade's sodium content is 19 mEq/L, while human blood is around 140 mEq/L. Therefore, Gatorade can do nothing but dilute blood sodium.

"Unless you drank something that was (as salty as normal blood sodium), you would not be maintaining your blood-sodium levels—because you are adding way too much water," Fowkes Godek said.

"For these big, heavy, salty sweaters (like football players), drinking Gatorade is just like drinking water. The salt that's in that is irrelevant to putting back what they need, particularly on a chronic basis," Fowkes Godek explained.

Contrast that statement to this one from "SSE #88: Hyponatremia in Athletes" from the Gatorade Sports Science Institute:

"The risk of hyponatremia can be reduced by making certain that fluid intake does not exceed sweat loss and by ingesting sodium containing beverages or foods to help replace the sodium lost in sweat."

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Cheryl Boatman/CrossFit Journal

Weight lost during a training session can be safely replaced with fluid, according to Dr. Mitchell Rosner. Replacing more than is lost can put athletes at risk of hyponatremia.

"You would need to drink 30 L of Gatorade to put the salt back, and if you did drink 30 L, you would die from hyponatremia," Fowkes Godek said. "Once you start doing the calculations, you realize that the amount of salt that's in any kind of sport drink is irrelevant. The bottom line from stopping someone from getting EAH is for them not to drink."

To maintain their proper blood-sodium levels, Fowkes Godek gives Philadelphia Eagles players beverages that are five times as salty as Gatorade. On top of that, she gives them salty foods like soups.

Given the confusing and conflicting information, what's an athlete to do?

"We need to make sure that we explain the body's needs and how we should hydrate individually," Fowkes Godek said.

Rosner recommends all habitual exercisers get a sense for how much water they lose during an average training session. The best way to determine this is to weigh yourself before and after a training session. Any weight lost in that short time period can be attributed to water loss.

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Courtesy of Mitchell Rosner

Dr. Mitchell Rosner

"If you know you sweat one kilo, then drinking one kilo of water is safe," Rosner said.

The second way to ensure you don't over-hydrate is to drink to thirst. Don't pre-hydrate or drink if you are not thirsty.

"Your body is really well adapted," Hew-Butler said. "For us, thirst is like your real-time calculator for everybody. Thirst is going to save you from dehydration and hyponatremia. It's the best thing that's going to keep you in the middle."

Raising Awareness and Preventing Deaths

The goal of the 2015 CrossFit Conference on Exercise-Associated Hyponatremia is to get the fitness community—especially trainers and coaches—thinking about hydration and the pervasive misinformation surrounding it.

Misinformation appears in health publications, beauty magazines and commercials. Endurance athletes and casual fitness enthusiasts alike are encouraged to drink fluids before, after and during racing or exercising, all because doing so will supposedly improve performance.

The truth is young men and women are not dying from dehydration on the marathon course or the football field. They are dying from drinking too much.

"Everyone who comes to this conference is passionate about this. They've seen people die. And if you've seen people almost die, it hits you hard," Hew-Butler said.

Rosner said his goal for the conference goes beyond raising awareness.

"No one should ever die from EAH again," Rosner said. "It's completely preventable."

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About the Author

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