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Water Wise

Top scientists bust hydration myths at the 2015 CrossFit Conference on Exercise-Associated Hyponatremia.

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All photos: Dave Re / CrossFit Journal

In 1998, Dr. Dale Benjamin Speedy stood in front of Ironman competitors in Auckland, New Zealand, and prepared to make an announcement he knew was going to be unpopular.

As medical director of the race since 1995, Speedy was tasked with protecting the athletes. In 1997, he'd seen athletes collapse and watched some of them fall into comas. With the health of the competitors in mind, Speedy made his race-day announcement:

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Dr. Dale Benjamin Speedy and his colleagues succeeded in reducing EAH incidence in triathletes in the late '90s, yet overhydration is still an issue due to misinformation.

He told the athletes he was reducing the number of hydration stations throughout the race, which was made up of a 2.4-mile swim, 112-mile bicycle ride and 26.2-mile run.

"People freaked out," said Speedy, a sports- and exercise-medicine physician. The competitors couldn't figure out why he'd put them at risk of dehydration.

Speedy, however, knew something the athletes and most medical professionals at the time did not: It was more dangerous for the competitors to drink too much water than too little. Speedy had seen it happen.

During the 1997 New Zealand Ironman, the number of cases of exercise-associated hyponatremia (EAH) almost triggered a state of emergency in the region. Athletes were in the hospital, some in comas. According to "Hyponatremia in Ultradistance Triathletes," published by Speedy et al. in 1999 in *Medicine and Science in Sports and Exercise*, 58 of 330 race finishers studied were classified as hyponatremic. Eighteen of those sought medical care, and 11 were severely hyponatremic.

EAH occurs when blood-sodium levels become diluted and fall below 135 milliequivalents per liter (mEq/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.

Of note, in 1996, the American College of Sports Medicine introduced the following hydration guidelines in the article "American College of Sports Medicine Position Stand. Exercise and Fluid Replacement": "During exercise, athletes should start drinking early and at regular intervals in an attempt to consume fluids at a rate sufficient to replace all the water lost through sweating (i.e., body weight loss), or consume the maximal amount that can be tolerated."

In 1998, Speedy implemented a simple prevention and education program, which included fewer aid stations and telling workers at those stations not to force liquids on the athletes. The result was a reduction in the percentage of race starters who received medical care

for hyponatremia from 3.8 in 1997 to 0.6 in 1998. Those findings were published by Speedy and company in the 2000 Clinical Journal of Sports Medicine article [“Diagnosis and Prevention of Hyponatremia at an Ultradistance Triathlon.”](#) More than 15 years after Speedy showed how to reduce the incidence of EAH, people are still dying from a completely preventable condition. In August 2014, two otherwise-healthy 17-year-old high-school football players died from EAH following excessive fluid intake.

On Feb. 20, 2015, scientists and doctors from around the world gathered at the Park Hyatt Aviara resort in Carlsbad, California, for the 2015 CrossFit Conference on Exercise-Associated Hyponatremia, organized by the HEAT Institute. Also in attendance were professional triathletes, athletic trainers, and CrossFit athletes and coaches.

CrossFit Inc. sponsored the conference to share the latest research from top scientists in the field and spread the truth about hydration in hopes of preventing further death and injury.

Fluids and Fallacies

Dr. Mitchell Rosner spoke in the morning and addressed the origins of current hydration guidelines. Rosner is chairman of the department of medicine at the University of Virginia and Henry B. Mulholland Professor of Medicine in the division of nephrology.

Most people have heard it's important to drink, at minimum, eight 8-ounce glasses of water each day. This simple, easy-to-understand guideline is known as “eight by eight.”

According to lay literature, the positive effects of drinking glass after glass of water are significant.

In the July 2000 New York Times article [“Personal Health; For Lifelong Gains, Just Add Water. Repeat.”](#) Jane Brody wrote that drinking water lubricates joints, prevents tissue from sticking and cushions the body from injury.

Rosner said no scientific studies support these claims. The Mayo Clinic agrees, as stated in the article [“Water: How Much Should You Drink Every Day?”](#): “Although the ‘8 by 8’ rule isn’t supported by hard evidence, it remains popular because it’s easy to remember.”

Hydration myths have had a significant impact on behavior.

“There’s been a 25 percent increase in water consumption from the late 1970s to the late 1990s,” Rosner said.

Drinking glass after glass of water while sedentary generally doesn’t have negative health implications. It mostly leads to more trips to the bathroom.

The problem begins when someone drinks excessively while exercising. During exercise, the AVP gene provides instructions for making a hormone called vasopressin, or antidiuretic hormone (ADH). This causes the kidneys to reabsorb more water and make less urine.

The body is exquisitely designed. When it knows it will lose water through sweating, the body holds onto water. When a person drinks excessively while exercising, the body retains the fluid due to the effects of ADH, and if a person keeps drinking, blood sodium can become dangerously diluted, falling well below normal levels of 135-145 mEq/L.



Dr. Mitchell Rosner poked a multitude of holes in “lay literature” recommendations that are not supported by science.



Dr. Jeff Glassman, CrossFit Inc. Chief Scientist, addresses the conference during a lunch lecture.

This interest in hydration in the late 1980s and into the '90s coincided with an explosion in the popularity of marathons. Races such as the Rock 'n' Roll Marathon—which began in 1998 with a record-breaking 18,000 participants—emphasized the fun, all-inclusive aspect of marathon running.

At this time, hydration guidelines were one-size-fits all and didn't take into account body weight or the athlete's pace. For instance, a slower runner would have far more time to drink too much than an elite runner who could finish a marathon in 2 hours, 30 minutes or so.

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What academics, physicians and coaches didn't realize is that telling endurance athletes to pre-hydrate and then drink as much fluid as they can tolerate could lead to potentially fatal EAH. Even worse, because the condition was almost unknown—Speedy and Dr. Tim Noakes first used the term “EAH” in a paper in 2000—overhydrated athletes were given intravenous fluids by well-meaning aid workers and medical staff, making the condition worse.

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. Hilary Bellamy, a 35-year-old mother of two, collapsed at the 20.5-mile mark of the 2002 Marine Corps Marathon in Washington, D.C. She later died of EAHE.

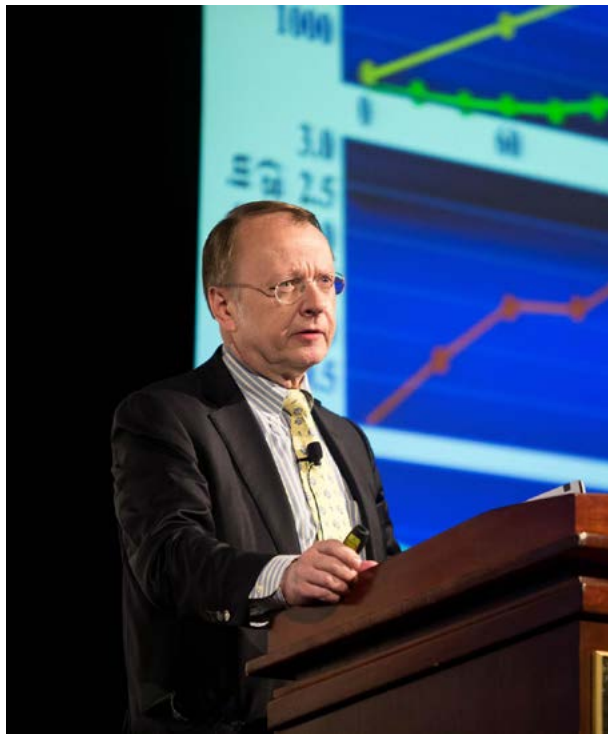
In August 2008, Patrick Allen, a football player on the Bakersfield Christian High School team in California, died of EAHE caused by drinking too much water, according to the autopsy. In August 2014, two high-school football players, Zyrees Oliver of Georgia and Walker Wilbanks of Mississippi, consumed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

From the Scientists to the Community

Troy Aguila and Luke Porter read the CrossFit Journal article "[Confronting the Drinking Problem](#)" about the Feb. 20 conference and decided to attend and learn more. The two are in the process of opening a new affiliate, CrossFit VICE in Playa Vista, California.

After listening to the first five speakers address the causes of EAH, Aguila said he was interested in hearing the scientists debunk conventional wisdom about dehydration.

"Water stations (at races) are sales and marketing opportunities," Aguila said. His point was later supported by



Dr. Joseph Verbalis of Georgetown University explained exactly why sodium supplementation cannot prevent EAH.

Dr. William Roberts, a professor in the department of family medicine and community health at the University of Minnesota Medical School. Roberts is also program director at the University of Minnesota St. John's Hospital Family Medicine Residency in St. Paul, Minnesota.

"The amount of water stations is a money issue because of sponsorship," Roberts said.

"At (one) Houston marathon there were 30 water stops. A woman stopped at each and had three cups of water at each. That's 90 cups of water. Her sodium level was 121," Roberts said. She collapsed but luckily survived.

Aguila and Porter said the information they learned would be useful to their future members.

"This can help the general population," Aguila said. "If they are going to compete in things like Spartan races, this can empower us to give them important knowledge."

"It's very logical," Porter said about what the scientists were saying about EAH and overhydration.

"Why is it being suppressed?" he asked.

Josh Everett, who finished third at the inaugural CrossFit Games in 2007 and second in 2008, was also in attendance. He said he was drawn to the conference by the level of the presenters, and he said he would use what he learned when coaching and in his own training.

"I will be smarter about recommendations for athletes competing in longer events, especially when they are doing double days," said Everett, who is a strength-and-conditioning coach for the U.S. Navy.

"For me personally, it makes me feel less bad about not drinking as much water as I should," he said with a laugh.

Just Add Salt?

If EAH is caused by low levels of blood sodium, it seems logical that salt supplements would solve the problem.

Not so, said Dr. Joseph Verbalis, professor of medicine and physiology and chief of the division of endocrinology and metabolism at Georgetown University.

"Sodium supplementation doesn't help maintenance of body osmolality," Verbalis said. (Osmolality is the measure of dissolved particles in a fluid.)

"Whatever is taken in is excreted," he said.

What's more, Verbalis said recent research indicates sodium could stimulate secretion of AVP, which triggers the antidiuretic hormone (ADH).

"This could be a double whammy for EAH," Verbalis said.

Dr. Martin Hoffman is professor of physical medicine and rehabilitation at the University of California, Davis and chief of physical medicine and rehabilitation at the VA Northern California Health Care System. He is also the director of research for the Western States Endurance Run, the world's oldest and most prestigious 100-mile trail race.

Hoffman has been doing EAH research on Western States runners since 2008, and his efforts helped reduce the rate of EAH at the race from 51 percent in 1998 to about



Dr. Martin Hoffman showed sodium supplements can cause excessive thirst, which then leads to over-consumption of liquids and increased risk of EAH.

7 percent now, based on treated athletes. Hoffman and Kristin Stuemple's "[Sodium Supplementation and Exercise-Associated Hyponatremia During Prolonged Exercise](#)" showed that while supplemental sodium may reduce the decline in blood-sodium concentration, it will not prevent the development of EAH if overdrinking continues.

Although no science supports the idea that hydration prevents or relieves cramping, the myth persists.

In some cases, sodium supplements can cause excessive thirst, motivating the athlete to overhydrate. Hoffman shared the case of a man who ran 100 miles in 18 hours and took 7,000 mg of supplemental sodium. When he collapsed at the end of the race, his blood sodium was 127 mEq/L, well below the normal range.

"He was thirsty because he was taking so much sodium," Hoffman said.

Many athletes also drink regularly during exercise to avoid muscle cramps, and it's common for coaches and trainers to list dehydration as the cause of cramps. Kevin Miller, Ph.D., an associate professor in the athletic-training program at Central Michigan University, specializes in studying exercise-associated muscle cramping.

The problem Miller found with most of the existing literature surrounding exercise-associated muscle cramps is the inability to separate dehydration from fatigue, making it difficult to determine the cause of the cramping. Miller conducted a study that tested hydrated and mildly dehydrated subjects, inducing cramps with electrical shocks after exercise.

"I found no difference between very hydrated and mildly hydrated individuals as far as cramps," Miller said. He then repeated the experiment with subjects who were even more dehydrated. Again, there was no increased cramping among the dehydrated subjects.



Dr. Tamara Hew-Butler was one of 18 experts who lectured at the conference and helped dispel myths about hydration.

Although no science supports the idea that hydration prevents or relieves cramping, the myth persists. Miller suggested the true source of cramps might actually be muscle exhaustion.

Zyrees Oliver, the 17-year-old football player who died of EAHE in August 2014, complained of cramps during football practice. He drank 4 gallons of fluid: 2 gallons of water and 2 gallons of Gatorade. Oliver later collapsed at home and died in the hospital.

Several of Oliver's relatives attended the Feb. 20 conference, including his mother and his aunt, Dr. Tammy Chavis.

"Are you committed to educating communities across the country?" Chavis asked the scientists and conference attendees.

"It can't stop here," Chavis said about the educating and myth-busting that had gone on that day.

"We have to take it from state to state, across the nation."

Spread the Knowledge

Speedy's lengthy campaign of education and prevention has been a huge success in New Zealand and almost completely eliminated EAH in the country.

"In New Zealand, we've managed to debunk the myth of dehydration," Speedy said.

Not so in the United States. Many well-meaning ER doctors and nurses assume a collapsed athlete is dehydrated and administer more fluids, which makes the condition worse.

But the problem could be stopped before an athlete reaches the ER or aid station. Sports scientists need to put out data-driven information that will replace current myths and prevent future injuries and deaths, and athletes, parents and coaches must be aware of the very real danger of overhydrating during exercise.

Water is essential. However, that doesn't mean it makes sense to flood the body with water if you're not thirsty. The assembled experts at the conference proved that in no uncertain terms over 11 hours of lectures, and they pointed out that the body already has a precise mechanism for determining when it needs water—thirst.

Instead of pre-hydrating, drinking according to a schedule or following one-size-fits-all guidelines such as "eight by eight," athletes are now being instructed to follow a simpler rule that will keep them safe: If you're thirsty, drink. If you're not thirsty, don't drink.



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