

BRAIN CRAMPS?

BY HILARY ACHAUER

Despite a wealth of scientific research on hydration and cramping, few athletes and coaches know anything about preventing and treating muscle cramps.





Trent Cole suffered from severe cramps early in his NFL career, and he said staying hydrated did little to remedy the problem.

Trent Cole never knew when they were going to strike. When they did, they brought him to his knees.

Exercise-induced muscle cramps were a serious problem for Cole when the Philadelphia Eagles drafted the University of Cincinnati product in 2005.

No matter what he tried or how much fluid he drank, he couldn't stop the full-body muscle cramps. Once, the cramping got so bad Cole was sent to the hospital, where he was given nine bags of IV fluid.

"I hydrated as much as I could," Cole said, "and I still cramped."

Fortunately, Cole had access to Sandra Fowkes Godek, Ph.D. The director of the Heat Illness Evaluation Avoidance and Treatment (HEAT) Institute at West Chester University in Pennsylvania, Fowkes Godek has been working with the Eagles for 12 years, studying their sweat rates, sweat-sodium concentrations and blood-electrolyte levels.

Fowkes Godek has long known something most athletes and coaches do not: Dehydration does not cause muscle cramps. Scientists have tried—and failed—to link dehydration and muscle cramps.

So Fowkes Godek treated Cole with a mix of vitamins, beta glucan, sodium and chloride.

"My cramps went away," said Cole, who currently plays defensive end for the Indianapolis Colts. He said he hasn't been bothered by cramps in 10 years.

"(Cole is) a very heavy, salty sweater. He's a high-intensity player," Fowkes Godek said. "We basically have fixed his cramps by paying attention to his eating and replacement of the salt that he loses."

SCIENTISTS AGREE ON ONE THING: SPORTS DRINKS DO NOTHING TO RELIEVE CRAMPS.

Scientists still do not know exactly what causes muscle cramps. Some studies point to fatigue, while some scientists believe cramps are a neurologic issue that can be remedied with a salty diet. However, scientists agree on one thing: Sports drinks do nothing to relieve cramps.

Still, the misconceptions persist, and athletes regularly consume fluids in vain attempts to treat cramps. Sometimes, that approach has fatal results.

In August 2014, Zyrees Oliver, a high-school football player in Georgia, passed out after football practice and was taken to the hospital, where he died due to exercise-associated hyponatremic encephalopathy (EAHE). Essentially, excessive fluid intake diluted

his blood sodium to dangerous levels and caused his brain to swell. According to relatives, Oliver cramped in practice and drank at least 2 gallons of water and 2 gallons of Gatorade.

About a week later, another high-school football player, Walker Wilbanks of Mississippi, also cramped during practice, drank too much fluid and died of EAHE.

These deaths were preventable.

Here, we look at the science behind muscle cramps and common hydration practices in all levels of football. Dispelling myths about muscle cramps and detailing the dangers of overhydration can help athletes in all sports, especially those who practice or compete for multiple days in a row.

The Cause of Cramps

Kevin Miller, Ph.D., is an associate professor in the department of Athletic Training at Central Michigan University. He specializes in the causes, treatments and prevention of heat illness, with a specific emphasis on exercise-associated muscle cramping. His research has garnered both national and international media coverage.

At the 2015 CrossFit Conference on Exercise-Associated Hyponatremia, Miller addressed the widespread belief that cramping is caused by dehydration.

"The problem with cramp literature is you can't separate dehydration from fatigue," Miller said on Feb. 20 in Carlsbad, California.

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, dehydrated subjects experienced no increased cramping.

Miller suggested the true source of cramps might actually be muscle exhaustion.

NBA player LeBron James at times suffers from debilitating muscle cramps that often force him out of games, including Game 1 of the 2014 NBA Finals. The New York Times article "[James and Air-Conditioning Are Expected to Return for Game 2](#)" said the star tried to prevent muscle cramping with everything from supplementing with potassium pills and electrolytes to changing his uniform and cutting his warm-up short.

In the article, Miller hypothesizes that the cause of James' cramping might be his intensity during the game.

"He is expected to do almost everything for the Heat—rebound, defend players who are bigger or quicker, run the offense and lead fast breaks," Miller told The New York Times in 2014, when James was still with the Miami Heat.



Cory Boyd (No. 64) is now a coach at Terra Linda High School in San Rafael, California. He said the coaches don't tell their players how much to drink.

Megan Verby



Cole Sager, a tailback at the University of Washington from 2009 to 2012, said players were constantly told to stay hydrated to prevent cramps, though hydration and cramping are not linked by science.

Shaun Cleary/CrossFit Journal

Miller suggested a different reason for James' cramps: "People who tend to cramp go faster and work at a higher intensity," Miller said, citing research on triathletes. "(James) was all over the court."

Fowkes Godek agrees that muscle cramps are not caused by dehydration.

"I think (cramping) still comes down to a neurologic issue. Which means, if you drink and drink and drink and drink, it's never going to stop your muscle cramps. Even if you drink Gatorade. And if you drink tons of Gatorade, it's never going to stop muscle cramps because Gatorade has a very, very low sodium concentration in it," Fowkes Godek said.

Nevertheless, sports drinks are commonly regarded as a cure for cramps or a means of preventing them. In the wake of James' exit from Game 1 in 2014, Gatorade posted since-deleted tweets suggesting its products might have helped James, who endorses rival Powerade. Interestingly, media reports said James actually drinks Gatorade during games due to a sponsorship deal with the NBA ("[Actually, LeBron James Was Drinking Gatorade Last Night](#)").

James himself mentioned hydration and fluids after the game ("[Air Conditioning Goes out in Game 1](#)"), and other athletes including NBA star Kobe Bryant and NFL player Jonathan Martin took to social media to comment on hydration and sports drinks.

"Drink a Gatorade & get out there," Martin posted after James left the game, highlighting common perception.

But science doesn't confirm that sports drinks prevent or remedy cramps. Furthermore, drinking large amounts of sports drinks is just as dangerous as drinking too much water, as evidenced by the deaths of Wilbanks and Oliver, both of whom were trying to stave off cramps.

Salt Supplementation

Football players don't drink large amounts of fluid just to prevent muscle cramps. They also want to be able to endure grueling preseason practices, which often include "two-a-days" in the heat of late summer. However, staying healthy and performing in these conditions is not as simple as flooding the body with fluids.

Still, athletes are told hydration helps performance. On its [website](#), Gatorade presents its G Series beverage with the tagline "Prime. Perform. Recover."

The [website](#) also states, "Significant losses in fluids and electrolytes can negatively impact performance, especially during long bouts of training."

Advertising, of course, highlights the electrolyte content of sports beverages, suggesting they can replace lost sodium.

Athletes who sweat profusely—and whose sweat is particularly salty—certainly have to be aware of their body's sodium levels when practicing or competing multiple days in a row in the heat.

But if they drink too much water or sports beverages—whose sodium content is actually negligible and not enough to maintain or increase blood-sodium concentrations—these salty, heavy sweaters run the risk of upsetting the body's blood-sodium levels. When this balance is upset, it can lead to exercise-associated hyponatremia (EAH). Hyponatremia can cause mild symptoms such as irritability and fatigue or more extreme symptoms including nausea, vomiting, seizures and comas. Brain swelling—EAHE—can cause death.

If the problem is blood sodium, does it make sense to ingest salt as a preventative measure? Scientists are divided on the issue.

Dr. Tim Noakes, the author of "Waterlogged: The Serious Problem of Overhydration in Endurance Sports," believes the average Western diet contains more than enough salt, making it impossible to exhaust your body's stores.

Fowkes Godek disagrees.

"In (Noakes') world, with marathon runners and shorter-distance runners, I think that's true," she said. She said it's also true for the vast majority of athletes, and most team-sports athletes.

However, endurance athletes don't run five marathons in five days. In preseason, football players practice for hours each day, often two times in a day for five days in a row.

"So, the difference comes from, and the difference in the data I see—versus what (Noakes) generally sees and what his calculations show—is that we see (low sodium levels) over consecutive days. We don't see this the first day of two-a-days," Godek said.

"There is a group of athletes that probably do get into a situation where their blood volume goes down below baseline because they ... are not replacing enough sodium. That happens over consecutive days," Fowkes Godek said.

Football players suit up in heavy pads and helmets, practicing for hours at a time, often twice a day in the late summer heat. This combination of heat and sweat can be dangerous.

If this is true, why aren't we seeing EAH deaths at the higher levels of football?

Fowkes Godek says it's because both the NFL and the NCAA regulate the number of practices in preseason and have careful restrictions on what players wear in those early season practices.

The NCAA allows players to start preseason practicing only for a few hours each day. They are required to wear only shorts and helmets—no pads. It's not until the fifth day of practice that they can put on full pads, and two-a-days are only allowed beginning on Day 6. The NFL has similar rules restricting preseason practices, and two-a-days were eliminated as part of the 2011 collective bargaining agreement.



Hydration issues have long been a part of football, from the era when “Bear” Bryant denied players water to the modern period in which sports drinks are thrust upon players at every opportunity.

Fowkes Godek thinks these regulations have helped tremendously.

When players used to wear full pads at the beginning of preseason practice, Fowkes Godek would see players with reduced blood volume and low blood sodium. Fowkes Godek said if she does see these kinds of symptoms now, it’s not until Day 6, 7 or 8.

The regulations on preseason practices have helped college and pro players, but no national governing body regulates the practices of high-school football players.

“There are six or eight states that have the same acclimatization guidelines (for high-school football players) as the NCAA, but not all states are like that,” Fowkes Godek said.

MISINFORMATION ABOUT HOW TO RELIEVE MUSCLE CRAMPS AND INADEQUATE INFORMATION ABOUT THE DANGERS OF OVERHYDRATING FOR HEAVY, SALTY SWEATERS PUT HIGH-SCHOOL FOOTBALL PLAYERS AT RISK FOR EAH.

Misinformation about how to relieve muscle cramps and inadequate information about the dangers of overhydrating for heavy, salty sweaters put high-school football players at risk for EAH.

“It’s not every high-school player, but there certainly is a population of high-school players that are in that situation where they are losing sodium at a high rate on consecutive days, and that’s causing problems,” Fowkes Godek said.

From Coca-Cola to Pickle Juice: Common Football Hydration Practices

Cory Boyd is a CrossFit athlete who coaches football at Terra Linda High School in San Rafael, California. He also teaches middle-school P.E. and plays semi-pro football.

He said he and the other coaches tell the kids to be consistent about hydration but don’t give the young players specific guidelines about how much to drink.

While Paul “Bear” Bryant famously tried to toughen his players by forbidding Texas A&M players to drink during practices in 1954, football has since become inseparably linked to hydration and sports drinks.

In 2013, 100 percent of NFL properties reported having Gatorade as a sponsor. And, of course, Gatorade is a mainstay of college football. The sports drink was invented at the University of Florida in 1965 as a beverage for the school's athletes, the Gators. In 2012, Gatorade was the official drink of 70 Division I athletic teams.

Cole Sager played football at the University of Washington from 2009 to 2012. He placed 17th at the 2014 Reebok CrossFit Games. Gatorade sponsored the University of Washington's football team, Sager said.

"We had a refrigerator in our locker room full of Gatorade, full of chocolate milk. It wasn't full of water. It was full of Gatorade, because Gatorade paid money for that to be in our lockers. Gatorade was providing it," Sager said.

Sager said the coaches wanted athletes to hydrate before and after practice.

"On every urinal and the inside of every stall, there was a poster with different shades of yellow that would go from almost clear to brown and every shade in between. It would tell you how many ounces to drink to try to get up to the yellowy hue. If you're in the brown, you're dehydrated, (and you had to) drink this much water," Sager said.

According to Dr. Mitchell Rosner, a nephrologist and professor of medicine at the University of Virginia, there is no data to support the importance of urine color as it relates to hydration. In 2012, The BMJ published "Mythbusting Sports and Exercise Products," which concluded urine color is not a useful or safe way to determine hydration status.

If a player got a cramp during practice, he'd get massage therapy from the medical team while drinking some type of fluid, Sager said.

"I think it's automatic—"Oh, I'm cramping. I've got to drink something," Sager said.

Marketing propagates these ideas. For instance, Gatorade.com states the Low-Calorie G2 beverage is "our lightest way to replace what you sweat out. G2 hydrates with the same electrolyte formula of Gatorade Thirst Quencher."

Fowkes Godek offered a different perspective in the CrossFit Journal article "Confronting the Drinking Problem."

"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.

She continued: "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.

Still, athletes hear less from Fowkes Godek and more from commercials and magazine ads. They simply don't have the right information and are left to guess about how much they should drink. This is common even at the top levels of football.

**"WE WERE TOLD TO DRINK, DRINK, DRINK AS MUCH AS YOU CAN, WHEN YOU'RE THIRSTY, EVEN WHEN YOU'RE NOT THIRSTY."
—TRISTAN DAVIS**

Tristan Davis played running back in the NFL from 2009 until 2013, suiting up for the Detroit Lions, Miami Dolphins, Minnesota Vikings, Pittsburgh Steelers and Washington Redskins. He's now a high-school football and track coach in Atlanta, Georgia.

Davis has practiced in some of the hottest parts of the country.

"We were told to drink, drink, drink as much as you can, when you're thirsty, even when you're not thirsty. Make sure your mouth is never dry. And there (were) even places where they would give you IVs. A high-cramp-prone athlete would get an IV. Those were drastic situations. I've seen hydration taken that far," Davis said.

Davis said the NFL regularly administers urine tests to evaluate hydration. If a player's urine is too dark, he's put on watch for three or four days and given fluids until his urine color becomes lighter. Again, doctors have stated urine color is not indicative of hydration levels.

Chuck Carswell is a CrossFit Level 1 Certificate Course leader who was with the Miami Dolphins from 1987 to 1991. He remembers salt tablets were available for all the players, and he was told they were supplied to prevent cramping and dehydration. At that time, he said, there were no instructions about the quantity of fluids they should drink, but he does remember one very unusual hydration practice.

"In (college), at halftime, we had Coca-Cola, which I couldn't believe . . . I don't remember having Gatorade. I remember Coca-Cola was on the sidelines. They had Coca-Cola on the rocks," he said, laughing.

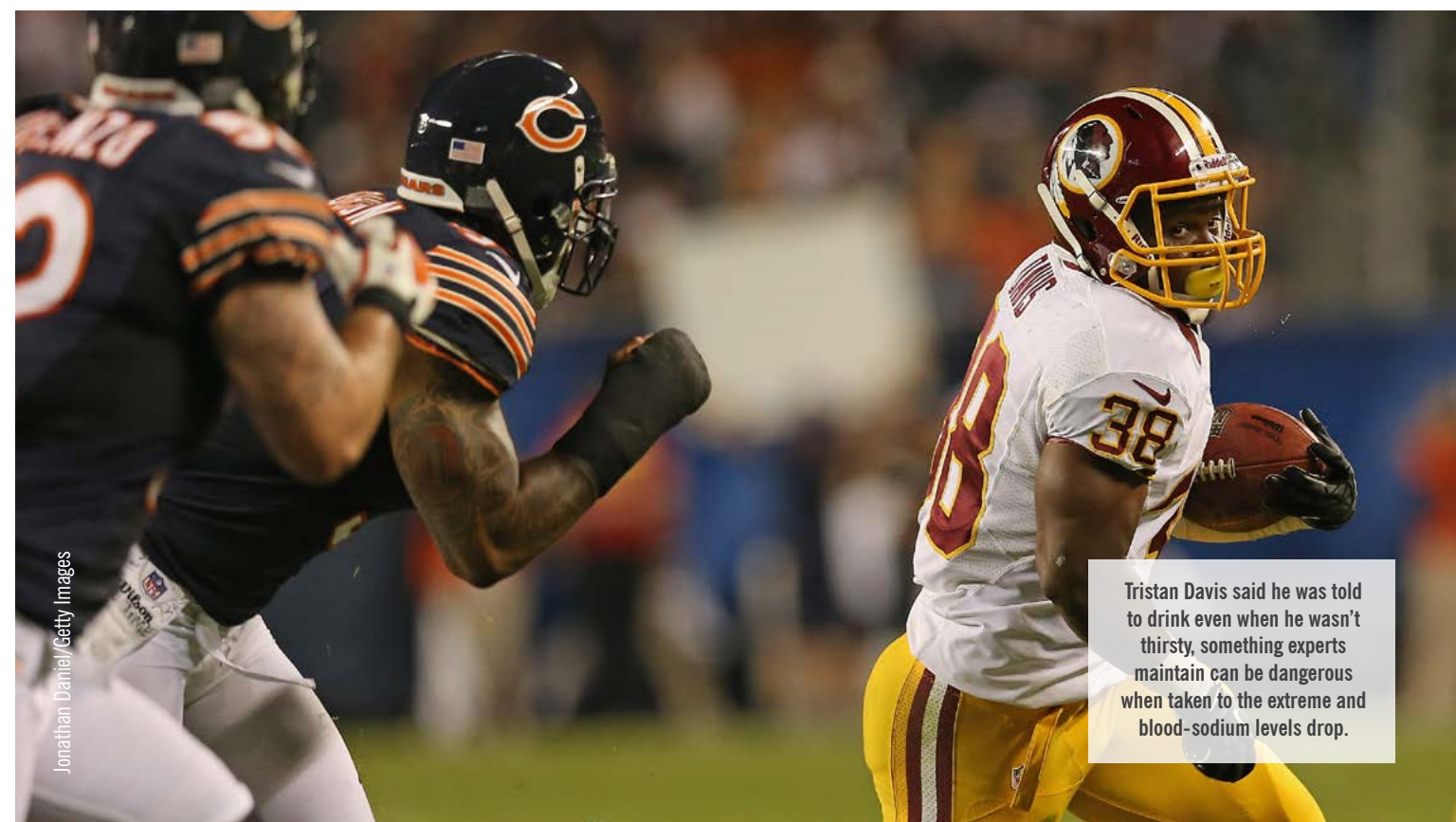
Will Johnson currently plays fullback for the Pittsburgh Steelers. He started doing CrossFit in 2012 and credited the program for helping him reach the NFL in the CrossFit Journal article "CrossFitter Signs With Steelers." He played college ball at West Virginia and is going into his fourth year with the Steelers.

Johnson was surprised to hear there is no scientific link between dehydration and muscle cramps.



Chris Rosa

Sager recalled locker-room posters helping athletes evaluate hydration levels by urine color, though scientists maintain urine color provides little information about an athlete's hydration.



Jonathan Daniel/Getty Images

Tristan Davis said he was told to drink even when he wasn't thirsty, something experts maintain can be dangerous when taken to the extreme and blood-sodium levels drop.



Chuck Carswell played cornerback at the University of Georgia before a stint on the Miami Dolphins development squad. He recalled being served Coke on the sidelines of college games.

Thomas Campitelli/CrossFit Journal

“That’s what we’ve been told all along. That’s crazy,” Johnson said. “We are still told that.”

He continued: “At this level, the NFL, a lot of guys are concerned about soft-tissue injuries. I guess that has a lot to do with—what we’ve been told—being dehydrated. You think about it, these guys are out here fighting for a job, to feed their families, and if you’re not able to go—let’s say you’re sidelined with a soft-tissue injury, like a hamstring pull because you are dehydrated—that will sit you out for at least two weeks, and a lot of guys depend on that for their cut.”

As a result, he said his fellow players are very careful about hydration.

At the high-school level, Johnson said he remembers being told to drink a lot of water the night before practices and games.

“They suggested we follow a simple plan—drink two waters and one Gatorade, and just repeat it throughout the day,” Johnson said.

Now, as a player for the Steelers, he said the trainers and medical staff suggest consuming a lot of potassium to prevent muscle cramps.

“I’ve had plenty of muscle cramps and soft-tissue tears, and I was told that was because of being dehydrated,” Johnson said.

The last time he had a muscle cramp, Johnson said he used a Gatorade electrolyte powder he poured into his water.

“And pickle water,” he said. “That helps with cramps.”

As crazy as pickle water sounds, Miller—one of the foremost experts on muscle cramps—has performed studies that show **pickle juice relieves cramps**. The curious thing about Miller’s findings is that the effect is so rapid there is no way the liquid could have time to leave the stomach and restore lost fluids or electrolytes. This suggests pickle juice might affect nervous-system receptors that disrupt the cramp.

However, these studies are not definitive, and Miller recommends stretching over pickle juice as the best muscle-cramp remedy.

“As far as the muscle strains go, I think if football players are able to recover completely—by rest and replacing lost salt and fluids between practices—then muscle strains are less likely,” Fowkes Godek said via email. “I also think players who are prone to muscle cramping are less likely to get muscle strains as a consequence of the cramping if we can prevent the cramping episodes in the first place.”

Fowkes Godek keeps the Eagles healthy and performing well with significant sodium replacement, primarily at meals. (She said sodium tablets don’t work as well and can cause nausea if taken on an empty stomach.)

“I typically throw out things like soup. People don’t think about drinking soup in July and August, but soup has a tremendous amount of sodium. It’s probably the best way. If you could get football players to drink soup every lunch and dinner, it would help tremendously,” Fowkes Godek said.

NFL teams and Division I schools have access to the best in sports medicine, but many players, coaches and trainers are still unaware of the science of dehydration and cramps. The science is out there, but it’s not reaching the people who need it. And if the pros and top college programs are still uneducated, it’s difficult to expect high-school programs to have the correct information. This can have disastrous consequences.

In August 2008, Patrick Allen came home from his high-school football practice in Bakersfield, California, complaining of muscle cramps. He drank water and Gatorade, and when he started to vomit, his parents called an ambulance. He died two days later after experiencing fluid in his lungs and undergoing surgery to relieve pressure on his brain.

When Patrick Allen’s father, Robert, learned his son had died from EAHE, he was shocked.

“What do you do when you have cramps? You drink lots of water and rehydrate,” he said in the Bakersfield Californian article [“Family in Disbelief That Drinking too Much Water Killed Football Player.”](#)

“You think you are doing everything right and this still happens,” he said. ■

About the Author

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