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LIFE

A New Way to Prevent Muscle Cramps

Nobel Prize winner Rod MacKinnon found that pungent and spicy tastes can hinder neurological misfires that cause cramps

By **MATTHEW FUTTERMAN**

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Could there finally be a way to prevent muscle cramps?

As long as people have played sports, unexpected muscle cramps have been an Achilles' heel for everyone from aspiring Olympians to weekend warriors.

For decades physicians and other experts in sports medicine have theorized that a cramp was the result of a muscle that was dehydrated, or starved of electrolytes, or suffering tears in its micro-fibers and cell membranes. These caused pain and spasms that could only be alleviated with water and electrolytes, conventional wisdom held.

Now, more experts are beginning to believe we may have been thinking wrongly about cramps all along. A shot of spicy liquid—think wasabi or hot chilies—may be a far more effective treatment than an energy drink or a banana. All it took was a Nobel Prize winner experiencing some untimely cramps while sea kayaking a decade ago for people to begin to understand that the causes of muscle cramps may not have much to do with muscles at all.

“The primary origin of the cramp is the nerve, not the muscle,” said Rod MacKinnon, the kayaker and Nobel Prize winning scientist who studies molecular neurobiology and biophysics at Rockefeller University and has led the new thinking on cramps.

With the Olympics scheduled to begin in Rio in a little more than three weeks, the new understanding of cramps couldn't be more timely. Athletes spend four years training for their moment at the Olympics, and few things are more frustrating than a freak event like a cramp that can wipe out years of preparation.

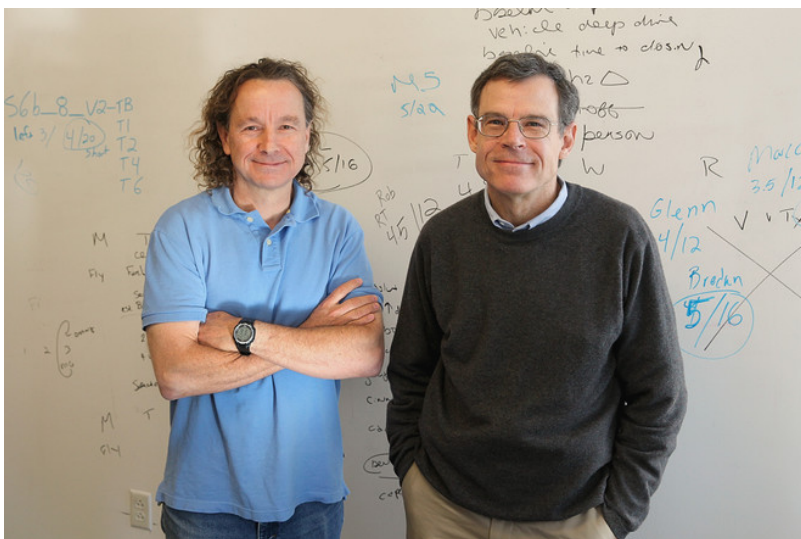
Paula Radcliffe, still the world record holder in the marathon, famously cramped up at



Dr. Rod MacKinnon, left, and friend Jon Sack sea kayak en route from Chappaquiddick, Mass. to Woods Hole, Mass. Cramps in Dr. MacKinnon's arms and hands during a previous kayaking outing led him to study the causes of muscle cramps. PHOTO: BRUCE BEAN

the Athens Olympics in 2004 and failed to finish the race. Earlier this month, tennis player Madison Keys experienced cramps during the third set of her fourth round match at Wimbledon and lost to Simona Halep.

While both Ms. Radcliffe's and Ms. Keys's muscles were indeed taxed, that doesn't necessarily explain why they experienced the pain we associate with cramps. If muscles cramp simply because they are weary and poorly nourished, why do our muscles cramp when we are lying in bed doing nothing? Why would an elite triathlete like Craig Alexander, a former Ironman world champion, occasionally suffer from leg cramps in the first minutes of a race, when he was fully hydrated and the opposite of exhausted?



Nobel Prize winner Dr. Rod MacKinnon, left, studies molecular neurobiology and biophysics, and Dr. Bruce Bean, a neurobiologist at Harvard Medical School. After the pair researched and found that excessive firing of motor neurons causes muscle cramps, they developed a spicy drink that stimulates the nervous system, to hinder the misfires that cause cramps. PHOTO: WENDY MAEDA/GETTY IMAGES

“You feel so helpless when it happens,” Mr. Alexander said, “and the explanation flew in the face of logic.”

Dr. MacKinnon’s hands and arms dangerously cramped up a decade ago when he was kayaking with colleague Bruce Bean, a neurobiologist at Harvard Medical School, roughly 7 miles off Cape Cod in Massachusetts. Hydration and electrolytes weren’t issues in that case either.

After making it back to shore, Dr. MacKinnon and Dr. Bean began hunting for an answer. Rather than focusing on his muscles, Dr. MacKinnon and his friend hypothesized that something might have caused the impulses the nervous system sent to his muscles to misfire and his muscles to cramp. Perhaps, they thought, people might be able to avoid cramps by regulating excessive firing of motor neurons, which they saw as the origin of muscle cramping.

Exercise science isn’t generally an area that winners of the Nobel Prize in chemistry indulge in. Dr. MacKinnon won the Nobel after he and his colleagues provided the first atomic structures of the protein molecules that make electrical signals in living organisms.



LeBron James in June 2014 playing for the Miami Heat. Mr. James has had to exit games due to severe pain caused by muscle cramps. PHOTO: CHRIS TROTMAN/GETTY IMAGES

Nevertheless, cramps were on Dr. MacKinnon’s mind. After perusing the existing research he and Dr. Bean hypothesized that they could modify the nervous system, including the motor neurons controlling muscle, by applying a strong sensory input and by stimulating receptors in the mouth and esophagus—which is how scientists describe ingesting pungent tasting foods. The pungent-taste overloads nerve receptors, producing a kind of numbing effect.

Or, as Dr. MacKinnon explains it, “The strong sensory input causes inhibition of the



U.S. tennis player Madison Keys suffered muscle cramps during the women's singles match she lost to Simona Halep of Romania this month at the Wimbledon Tennis Championships in London. *PHOTO: TIM IRELAND/ASSOCIATED PRESS*

motor output.”

Might this be dangerous? Does the pain from a muscle cramp have a purpose, like the pain that makes us pull our hand away from a hot stove?

After considering this possibility, Dr. MacKinnon concluded there is no benefit to a muscle cramp. The debilitating pain we experience doesn't prevent injury. We experience it not to help us survive but because the human body isn't a perfectly evolved machine.



New Zealand batsman Mark Richardson has cramped up during cricket matches. Here he plays in a match in the northern Indian state of Punjab in 2003. *PHOTO: KAMAL KISHORE/REUTERS*

Using himself as a lab rat, Dr. MacKinnon began concocting spicy drinks in his kitchen with varying amounts of ginger and cinnamon and trying to induce cramps with electrical impulses. Over the course of the next decade, he grew convinced his hunch

was correct. It was harder to induce the cramps after indulging in the spicy concoctions.

A series of randomized, scientific studies followed. The subjects produced results similar to what Dr. MacKinnon had experienced. Those studies were presented last year at meetings of the American Academy of Neurology and the American College of Sports Medicine.

The great irony of all this is athletes for years had already been trying to avoid cramps not simply with water and bananas but also with pungent liquids, such as juice from pickles, beets or sour cherries. They drank the pickle juice believing its high sodium content would replace an important electrolyte, and they drank the beet and cherry juice because they are rich in antioxidants that athletes thought could help prevent cramping.

The idea was to get those ingredients into the bloodstream and muscles. In some cases, the pickle, beet and cherry juice worked, but in the view of Dr. MacKinnon and a growing number of other scientists, not because the nutrients were reaching their muscles since research showed their blood content was largely unchanged.

“We often find in science we are doing the right things but for the wrong reason,” said Philip Skiba, the director of sports medicine at Advocate Lutheran General Hospital in Park Ridge, Ill., who has worked closely with Olympians both in the U.S. and Great Britain to develop training programs. “The sensory experience may have been what was having the effect on the legs.”



Dr. Rod MacKinnon helped develop a spicy drink, Hotshot, which aims to help athletes prevent muscle cramps by stimulating their nervous system. *PHOTO: FLEX INNOVATION GROUP*

Dr. Skiba said he has noticed a significant number of endurance athletes who are indulging in spicy drinks before races now. To try to take advantage of that, Dr. MacKinnon, working with biotech entrepreneur Christoph Westphal, launched the

company Flex Pharma Inc., which went public in 2015.

Earlier this year, the company brought to market Hotshot, a mix of ginger, cinnamon and capsicum—spicy pepper plants—that comes in 1.7 ounce bottles. It is currently available in select stores in Boston, Los Angeles and Boulder, Colo., and can be ordered online.

Dr. Skiba said more testing of Hotshot and other similar products is needed and that the nature of testing the products, or any pungent tasting substance presents an inherent difficulty. Because the taste is so strong, it is very difficult to create a placebo, so subjects invariably know they have ingested something and that can affect whether they experience a cramp.

Even Dr. MacKinnon acknowledges that drinking Hotshot before a stressful workout, especially first thing in the morning, can feel counterintuitive. This isn't ice-cold, citrus-flavored water. The taste is hardly refreshing, and it packs a jolt more commonly experienced around a table covered with South Asian food rather than a training table.

That is the point though. It is about shocking the system, not replenishing it.

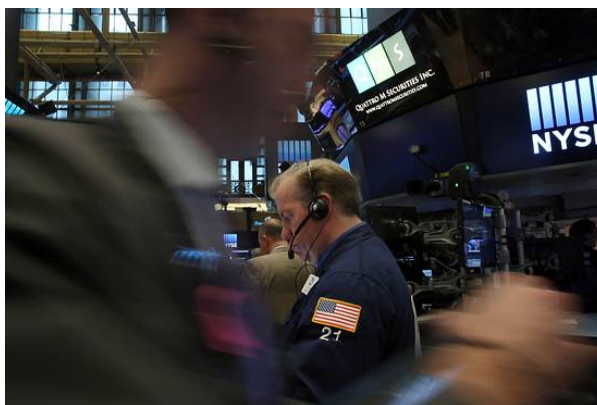
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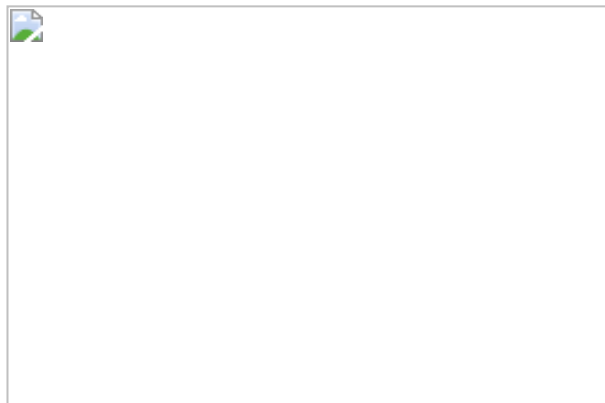
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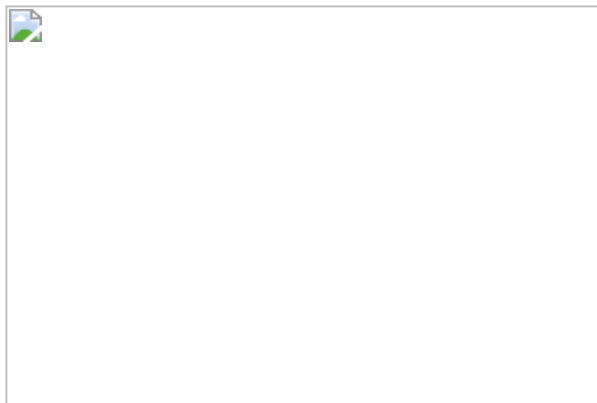
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