Nutrition and Muscle Cramps – What does the science say?

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There are a lot of opinions about why cramping occurs and everyone has their own advice when the topic comes up. Many sports drinks tell you that they key to preventing cramps is magnesium, bike fitters will tell you your saddle is too high, and I've heard dozens of different home remedies. Personally, I've always maintained the belief that cramping is most often caused by extending yourself beyond your fitness abilities (but I have no scientific proof of that). In this post, Alan McCubbin from Next Level Nutrition tells us what the research says about cramping.

The last post on sports supplements generated a lot of interesting comments, and it's great to hear what people use and why. One of the frequent questions to emerge was to look at the scientific evidence for nutrition and cramping. I'll start off by saying that this is one area of sports science where opinion has been very much divided, and only in the last couple of years is a consensus starting to emerge. This is probably for two reasons – firstly there hasn't been much good research out there. Secondly there are probably several types of cramps with different causes, and the solution to one type does not always translate into other types of cramps.

Nutrition treatments for cramping date back to the 1880's. Miners working in hot and humid environments added salt to their beer and milk to try to prevent cramps occurring when working a pick and shovel all day (salted VB anyone?). Despite this history of cramps and physical activity it's amazing how little research has been done in this area in the century that's passed since. Cramps are really difficult to study. They're infrequent, unpredictable and only happen for a few seconds. It's also hard to stick a needle into someone's leg and take a biopsy mid-cramp!

So before we look at the scientific merit of nutrition to treat cramps it's important to understand the different types. Cramps are generally thought of as short, painful muscle contractions. They can occur in a variety of situations: when you're in bed asleep, in pregnant women, in exposure to extreme heat or cold, during extreme physical labor as well as during sport. In exercise the consensus is that there's two types of cramps – whole body cramps (fairly uncommon but extremely distressing to the athlete), and cramping of individual muscle groups (eg. just calves or quads). When cyclists talk about cramping, generally what they're referring to is cramping of individual muscle groups during or immediately after exercise, known as Exercise Associated Muscle Cramps (EAMC).

EAMC are thought to occur because the nervous system's control of muscle contraction and relaxation is somehow lost. Most people will know from experience that stretching a cramped muscle will relax it and relieve the pain – that's because it activates parts of the muscle fiber that regulate relaxation. There's a variety of nutrition supplements and remedies marketed as preventing or treating EAMC by preventing changes in the nervous system's control of muscle contraction and relaxation. But do they actually work?

Let's look at each factor on its own merits. Firstly, does dehydration increase the risk of cramping? There's several ways you can define dehydration – reduced Total Body Water, a change in the concentration of solute particles (osmolality) or specific electrolytes (eg. sodium) in the blood, or a loss of body weight (assumed to be sweat losses) from a well hydrated starting point.

Does loss of body weight or Total Body Water influence risk of cramping? There's a lot of research in this area, but what does exist suggests that it doesn't. As one recent review of the science described: "A careful review of the literature did not identify a single published scientific study showing that athletes with acute EAMC are more dehydrated than control athletes (athletes of the same gender, competing in the same race with similar race finishing times)".

What about increased osmolality or blood sodium levels? This theory has been tested in two ways. In observations of ironman triathletes and ultra-runners during competition, changes in blood osmolality and sodium did not predict cramping risk. There are a couple of studies that suggest an increased risk of cramps in tennis players and American footballers who lost large amounts of sodium from sweat, but these referred to whole body cramps not localized EAMC. Only one study identified that a sports drink delayed the time until calf cramping commenced in comparison to not drinking anything. However in this study both groups cramped eventually, and the sports drink also contained carbohydrate which the other group didn't get (more on that later), so the effect of fluid or sodium may not be the reason for the finding. Finally, one research team have used electrical stimulation to isolate specific factors that influence the chance of cramping. They found that increased plasma osmolality (caused by 3% body weight loss from sweating) made no difference to the risk of cramping when a muscle was electrically stimulated.

As for the other electrolytes such as potassium, calcium and magnesium, evidence comes from a combination of case reports and studies with no control group, all published in the 1920's and 30's. Since 1986 four controlled studies have been published, all showing no relationship between any electrolyte levels and the risk of cramping during exercise. In these studies there was no difference in electrolyte levels at the time of cramping compared to other times (or the athletes who didn't cramp at all). And when cramping resolved there was no change in electrolyte levels that could explain an effect of rehydration or supplementation to relieve the cramping. This is probably not a surprise considering that EAMC's are localized – they occur in a specific muscle group or groups. How would an electrolyte imbalance throughout the whole body cause cramping in only one muscle group?

There are a few other nutrition supplements available, and some sports doctors also recommend quinine. Some of these remedies have had success for non-exercise cramping in specific medical conditions, but in almost all cases these products have simply never been tested for EAMC. There's just no evidence to make a judgement one way or the other.

So if nutritional factors don't seem to play a role in EAMC, what does? Whilst exact biology of what goes on inside the muscle is not yet known, it's thought that some form of muscle fatigue occurs which leads to the onset of EAMC. This appears particularly true when a muscle group is working in a shortened position (eg. calves when pointing your toes in swimming, quads when you get out of the saddle and

fully extend the legs of a bike). This suggests that poor biomechanics may increase muscle fatigue and lead to greater risk of cramping. This is not my area of expertise, but a good bike setup is not a bad idea if you're a frequent cramper. Maximizing carbohydrate consumption during a race may also help reduce cramping risk by maximizing the number of fibers being activated in a muscle group and minimizing fatigue, although this remains a theory as no one's ever studied it.

From some recent observational studies in triathletes a few other distinct risk factors for developing EAMC have emerged:

– Aggressive pacing strategies (trying to go faster than your current personal best over a set distance).

– Racing at a higher intensity then what you normally ride in training

– Riding for longer than you're used to

– Doing another type of exercise you're not used to (eg. a cyclist running a one-off marathon)

Given that most people only cramp during the latter stages of a race, on an epic ride, a monstrous hill climb or after spending time off the bike, these factors are probably not a huge surprise to you. It's also interesting to note that the volume or intensity of training does not predict cramping risk. The difference appears to be that the athletes who are over-ambitious and try to punch above their weight on any given day increase their risk of cramping.

So it doesn't appear that nutrition has much at all to do with localised muscle cramps during exercise. Sadly many sports scientists and dietitians still advocate disproven remedies for preventing EAMC, despite recent scientific evidence to the contrary. However it's unlikely that any of these products are going to be detrimental in any way.

If you do experience whole body cramps than it may be a sodium loss issue, in which case drinking sports drinks that are higher in sodium and even eating foods higher in sodium (eg. Vegemite on bread) may help to reduce this risk. But for the majority of cyclists that's not the case.

To minimise your risk of EAMC make sure you get at least some training sessions in at the intensity that you race at, some long rides (equal or longer than races), and make sure your bike is set up properly for you. Getting adequate carbohydrate during your rides may help but is far from proven (although there are other definite benefits from maximising carb intake during a race). If you do get EAMC in an individual muscle (or the same muscle on both sides of the body) remember that stretching it will usually relieve the pain (if you can afford to stop).