



## Exercise Associated Muscle Cramps

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### Abstract

Muscle cramps associated with exercise are common. Also common are myths about why cramps occur and how to treat them. Medical research has not yet discovered the pathophysiology of these cramps. What is known is what does and does not work to stop them.

Common thinking, even among professionals, is that cramps are caused by dehydration and electrolyte imbalances. Unfortunately these assumptions are incorrect and do not hold up to scientific scrutiny.

Cramps occur in tired muscles. They are successfully treated by stretching the affected muscles. They are also frequently treated successfully by ingesting spicy liquids such as pickle juice. Research into the neurological control of cramps is ongoing and may prove to be the best avenue toward understanding this phenomenon.

### Introduction

Muscle cramping associated with exercise or competition has been a problem for athletes for millennia. Scientific research to understand why cramping occurs and how to prevent or stop it has been a more recent endeavor. The specific cramping that happens during exercise is referred to as Exercise Associated Muscle Cramps (EAMC). Many theories have been formulated to try to explain and treat EAMC, but none has answered all questions.

At the present time, most athletes, coaches and team doctors believe that EAMC are caused by dehydration, electrolyte imbalance or both [1]. The American Academy of Orthopaedic Surgeons information web site currently lists inadequate stretching, poor conditioning, fatigue, age, intense heat, dehydration, and depletion of electrolytes as causes of EAMC [2]. The problem is that many of these hypotheses do not hold up to scientific scrutiny.

It has been noted that muscle fatigue does play a role in EAMC [3]. The cramps do not occur in well-rested muscles. Cramping occurs in certain muscles preferentially. The calves, hamstrings and quadriceps are most common. These are all muscles that cross 2 joints [4]. It has been noted that cramping occurs more often in hot, humid environments. Conversely, EAMC have also occurred in cool or even cold environments. This has led researchers to believe that it is not the heat, but is rather the fatigue, dehydration and increased sweating that occur with heat, but can also occur in cold environments that may be responsible.

It has been shown that athletes who are more prone to heat exhaustion are also more prone to cramping [5]. EAMC occurs in certain athletes more than others indicating a genetic predisposition [6].

### Dehydration

One of the most common beliefs is that cramps occur in athletes who are dehydrated. Since cramping occurs with fatigue, dehydration is always present to some degree. Athletes are encouraged to drink before, during and after practice and games to prevent cramps. The problem with this theory is that it is false. Studies looking at hydrated vs. dehydrated athletes show no difference in rates of cramping [6,7]. Pre-hydrating in hypo hydrated athletes before games does not prevent cramps [8]. Sadly, hyperhydration prior to exercise in order to prevent cramps has led to fatal hyponatremia [9].

### Electrolyte Imbalance

This theory is as common as the dehydration theory. The thinking is that lack of sodium, potassium, calcium and/or magnesium from sweating causes electrophysiologic changes at the muscle leading to cramping. There are several problems with this theory. First, sweating is hypotonic resulting in elevated serum electrolyte levels. Drinking excessive amounts of free water will lower

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serum electrolytes, but neither group has an increased incidence of EAMC [8]. Eating bananas or taking salt pills does not prevent cramping [10,8].

## Pickle Juice

Athletes have been drinking pickle juice to stop and to prevent cramps since the 1950's. Recent studies have shown that for some athletes the practice works. Not only does it work, but the effects are seen within 35 seconds [11]. The fact that it works so fast means that the practice is not changing volume or electrolytes. The salt and volume from the pickle juice are irrelevant (unless the salt is somewhat stimulating to the oral taste receptors) [12]. Anecdotally, coaches and athletes have found that mustard and sour candy have the same effect as pickle juice.

## Stretching

The most common treatment for acute cramping is to stretch the involved muscle [13]. Coaches, trainers and teammates can be seen on the sidelines bending the ankle into dorsiflexion for calf cramps or elevating the leg to stretch the hamstrings when those muscles spasm. This is painful, but typically results in resolution of the cramp. The theory here is that the golgi tendon nerve receptors are stimulated to shut down the cramp signal [14].

## Electrophysiology

The most recent advance in treating EAMC has been to try to amplify the pickle juice effect. Roderick MacKinnon, a Nobel-prize winning neurophysiologist is an avid kayaker in his off time. Even in very cold weather, his arms and hands would cramp while kayaking. His professional skills and desire to prevent this led him to try to understand EAMC. He continues to try to understand the pathophysiology of cramps and has not yet solved that puzzle. He has discovered the mechanism by which pickle juice works. It turns out that two types of taste receptors in the mouth respond to pickle juice. These are the TRPV1 and TRPA receptors [15]. When these taste receptors are stimulated, a signal is sent to the brain which in turn sends a signal that somehow shuts down the cramp signal. The only way this is possible to work in 35 seconds is as a neurostimulant [15].

He then set out to see what else would stimulate these receptors strongly. Food versions of these stimulants turned out to be cinnamon, capsaicin, weak acid and ginger. He mixed them together to get a more predictable stimulant [15]. He has now formed a company selling "Hotshot" as a cramp preventer. The potion has not been in use long enough to say with certainty that it is effective.

## Discussion

Trying to put this all together we know several demonstrated facts and several myths. The facts are that EAMC occurs more often in less well-trained athletes. It is more common in some families and in those susceptible to heat illnesses. It is more common in men than in women. It most commonly occurs in fatigued calf, hamstring and quadriceps muscles. Dehydration does not cause muscle cramping in athletes. Sweating does not cause decreased electrolyte levels and does

not cause cramping. Increased hydration does not prevent cramping and can cause lethal hyponatremia. Eating bananas does not prevent cramping. Stretching the affected muscles will stop cramping and had no relationship to hydration or electrolyte levels. Drinking pickle juice can stop cramps in 35 seconds. Additional oral stimulants may increase the "pickle juice effect".

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