



UNLOCKING PERFORMANCE IN THE HEAT:

WHY EVERY ATHLETE SHOULD KNOW THEIR PRECISE HYDRATION NEEDS

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Every athlete who has trained and competed in Texas during the hot summer months has likely experienced a painful muscle cramp. You sprint off the line only to pull up short grabbing your hamstring, a knot of misfiring motor neurons stopping you in your tracks. While there is a lot of debate in scientific circles about what exactly causes muscle cramps, most scientists agree that it boils down to two main causes. The first cause is that when muscles are tired and are asked to do a movement beyond their ability it leads to a misfire in the nerves leading to the muscles (Behringer et al., 2017). The second cause is that dehydration can reduce that amount of sodium (a common electrolyte found in table salt) in the body, which affects muscle contraction (Maughan & Shirreffs, 2019). We know that fatigue plays a role because of studies performed in the early 1900s on telegraphists – people who used their hands to repeatedly tap out messages in morse code – because of the frequency of cramping common to this profession. These telegraphists were likely not dehydrated when they experienced a cramp; therefore, the spasm was

likely due to overuse and fatigue causing the brain to misfire the nerves leading to their hand muscles.

Spicy, acidic foods such as pickle juice are thought to decrease the duration of the cramp by “distracting” the brain’s firing of motor neurons (Behringer et al., 2017). Since pickle juice works instantly, and does not have time to increase sodium levels in the body, it supports the idea that electrolyte imbalance is not the only cause of cramping. On the other hand, large scale studies on industrial workers performing hours of grueling work in hot conditions has shown that when these workers were given sodium in their drinks, the rate of cramping decreased (Moss, 1923). Clearly dehydration and electrolyte imbalance played a role in the performance of this population. Since both fatigue and dehydration play a role in cramping, it is essential that athletes understand their personal hydration needs.

The amount of sweat produced is different from person to person. On the low end, someone might sweat as little as 0.5 liters per hour, whereas on the high end,

individuals might sweat more than 3 liters per hour. Sweat rates of several popular sports are as follows:

- Basketball – 1.37 L/hr
- Football – 2.14 L/hr
- Soccer – 1.46 L/hr
- Tennis – 2.6 L/hr
- Swimming – 0.7 L/hr

Importantly, dehydration of greater than 2% body weight can lead to significant drops in performance and negatively affect the body's ability to regulate heat (Sawka et al., 2007). Equally as important, the amount of sodium lost per hour can range from 0.2 grams to more than 5 grams per hour in some extreme cases (Sawka et al., 2007). College football players who cramp frequently are more likely to have higher sweat sodium losses than players who don't cramp frequently (Stofan et al., 2005). Genetics, body composition, training status, and how much you have been training in the heat all impact your sweat physiology. Generally, smaller individuals and females tend to sweat less, whereas larger individuals and males tend to sweat more. Athletes that have been training regularly in the heat also tend to sweat more, but their sweat is less salty, reducing the amount of sodium they lose per unit of sweat. Such wide variability in sweat rates and sweat sodium concentrations means that there is no one-size-fits all recommendation for athletes.

I have a personal connection to why it is critical to understand your unique sweat physiology. In 2002, my dad was competing in his first Ironman World Championship race, and midway through the 26.2 mile run he experienced full body muscle spasms. Forced to stop moving in the middle of the "Energy Lab" – a stretch of road surrounded by lava fields with heat radiating off of the black rocks – he thought his race was over. This was well before online athlete tracking was widely available, so my family waited at the finish line as his goal time slipped past, not knowing where he was or what had happened. When we finally saw him jogging towards the finish line, well past when we had expected to see him, we were very relieved he was okay. Later, we learned that he had only been able to start running again after a teammate of his caught up to him and gave him some salt tablets. The electrolytes replenished his body, and his motor neurons returned to normal.

In what would turn out to be a very big coincidence, my dad had signed up to participate in a sweat sodium research study on Ironman athletes, being conducted by a team of exercise physiology researchers from the University of Texas at Austin. Led by world-renowned physiologist Dr. Ed Coyle and his doctoral student Mathew Pahnke, they were investigating the range of sweat rates and sweat sodium losses experienced in the world's most

physically demanding one-day race. Fast forward nearly two decades and the results of that study were displayed in front of me on a lecture screen in a Sports Nutrition course at UT Austin taught by Dr. Coyle, now my doctoral degree advisor. The graph showed the wide range of sweat rates observed in the race, and the dot to the far right of the graph was most likely my dad. The results were a striking reminder that everyone's physiology is slightly different, and some athletes face a much greater challenge when it comes to hydration. After receiving the results from the UT sweat study, my dad learned that he would need to consume substantially more sodium than that provided in the electrolyte mix available on the course. He used the data to guide his hydration protocol and went on to compete in the Ironman World Championships again without further muscle spasms.

Learning your personal sweat profile is essential for ensuring you can train and perform at your best in the heat. As Lead Sports Scientist for Ascension Texas Sports Performance, my role is to provide the same physiological testing used by professional athletes to athletes of all abilities. I use strict data collection protocols to ensure that I provide athletes scientifically sound results for all hydration testing. One of my favorite aspects of my job is to empower athletes with knowledge to help them reach their goals. If you feel like you struggle to maintain your hydration while training or racing this time of year, or if you are a coach who thinks your team would benefit from a group testing session, email me at Jakob.Allen@ascension.org to learn more about how you can optimize your performance in the heat.

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