Find out how to beat the sweat!

**Study Title:** High-sweat Na+ in cystic fibrosis and healthy individuals does not diminish thirst during exercise in the heat

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INTRODUCTION

What will I learn?

• You will get an insight into the one of the most common genetic conditions in the world - Cystic Fibrosis (CF), of which Ireland has the highest prevalence.

• You will learn how the genetic polymorphisms (mutations) can result in CF patients having sweat electrolyte losses 3 times higher than normal individuals.

• You will learn why the above point is an issue, especially for performance, and how it can be managed.

What piece of the puzzle is this?

• This article will give you an insight into how certain conditions can dramatically alter nutrient requirements, and give testament to the notion that a ‘one size fits all’ approach isn’t feasible

• You will see an area of nutritional research that lacks solid background and concrete guidelines, and how to cope with this fact from a management point of view

THE STUDY

A little preface

Cystic fibrosis is the world’s most common genetic polymorphism, which has an umbrella effect on how the Cystic fibrosis transmembrane conductance regulator (CTFR) gene works. This membrane has numerous effects on multiple parts of the body. The CTFR gene has a role in some protein kinase pathways, but it’s main job is the help our bodies transport chloride in and out of cells. When this cannot happen properly organs and tissues where chloride transport is vitally important such as the lungs and GI tract, are effected with a large mucus build-up. In addition, the body’s ability to moderate and re-absorb some sweat electrolytes can go out the window, leading to huge losses.

With CF, there are five different main mutation types, each with distinctive effect, which vary from inability to make the genetic protein for CTFR, issues with the genetic code effecting CTFR function and issues with chloride transport. A list of common side effects of cystic fibrosis includes decreased lung function due to mucus build-up, low sodium and chloride levels, pancreatic insufficiency (inability to make insulin & enzymes due to mucus blockage leading to fat build-up & subsequent fibrosis), liver dysfunction (leading to a drop in bile & digestive enzymes, for the same reason as the pancreas). The last two factors can result in
majorly poor absorption of key fat-soluble vitamins, as fat cannot be broken down. And from reading previous posts, you should be well aware of the importance of vitamin D (fat soluble vitamin) and why low levels may not be ideal for anybody, particularly active individuals.

Let’s start to link into exercise now! One major thing that needs to be factored in with a cystic fibrosis patient who is heavily involved in sport, is the loss of electrolytes that can build up. One standard test for CF is a sweat test for chloride levels. Normal people have chloride sweat levels below 30mmol/L, while in CF patients the chloride levels will be above 60mmol/L. You will typically have a similar level of sodium in your sweat, as they are found in similar concentrations in sweat, plasma etc. From the get-go we can see that CF patients will lose at least twice the amount of sodium during exercise, and so general recommendations for salt intake to be around 3 to 4 times that of healthy populations. It is important to be aware of the relevance of all of this - during exercise, as we sweat, we lose both fluid mass and build up a percentage loss in water weight, whilst losing electrolytes the whole time. It has not been established whether or not CF athletes have higher sweat volumes compared to non-CF athletes.

A typical CF athlete sweats sodium and chloride concentrations of 60-90mmol/L (this can be much higher). This will result in salt losses of between 1-2g/hr based on an average sweat rate of 500ml/hr, and leaves CF athletes at a much higher risk of developing muscle cramps, altered blood pressure and severe exercise-induced hyponatraemia than an otherwise healthy person will be. The latter can be potentially serious as our body sodium levels drop (CF is an issue with chloride metabolism, however in sweat, sodium and chloride levels tend to be the same) causing issues with heart rhythms, blood pressure and confusion.

The study we are looking at here was one of the very few to even consider CF athletes in relation to sports performance.

**What did they do?**

This study took a group of healthy athletes and a group of athletes with CF, had them exercise in heat (32-33 Celsius) and measured their sweat composition in an attempt to see if the larger electrolyte losses lead to a different thirst response in the CF athletes. The athletes cycled continuously until they reached 3% dehydration, in bouts of 20mins @ 50% VO2max with 5-minute breaks. This study broke the athletes into three separate groups:

- Healthy subjects with high sodium sweat concentrations (91.0mmol/L average)
- Control subjects with normal sodium sweat concentrations (43.7mmol/L average)
- CF patients with very high sweat concentrations (132.6mmol/L average)

The study assessed serum sodium levels repeatedly, serum osmolality and rates of fluid restoration during the cycle. VO2 and respiratory exchange ratios were measured in each of the 20-minute phases. Athletes were asked to perceive their rates of effort and subjectively estimate their thirst levels.

In healthy individuals as we lose fluid through sweat, the concentration (osmolality) of our blood ramps up, this kicks off hypovolemic (lower overall amounts of body water stores) and hyperosmotic (higher blood concentration due to loss of water) triggers which release angiotensin & vasopressin, stimulating thirst and our kidneys to reabsorb water into our bodies.
In those with CF, maintaining normal sodium and chloride levels is difficult, and it has been observed that these mechanistic feedback loops don’t work as well in those with CF, making them, again, more likely to hit states of dehydration. The supposed mechanism here is due to the vast amounts of electrolyte losses, that hyperosmotic state is never reached when the body loses a lot of water through sweat, there is simply a lower amount of overall plasma present, but it’s concentration is relatively unaffected.

Subjects had to abstain from both alcohol and coffee for the 24-hour period pre-test, due to their mild diuretic effects, and had a standardized meal regimen to ensure equal sodium intakes prior to testing. They also consumed 12ml/kg of water the night before and morning of the event to ensure adequate hydration and abstained from exercise.

What did they find?

This study used a one-way ANOVA to assess before for various factors (because we know with sweating that electrolyte levels don’t increase) 2 way is used when you are unsure of what the outcome will be) followed by Tukey testing for any significant links.

Sweat Rates

These were looked at in absolute values, and here’s how they broke down on average:

- CF athletes had average rates of 0.7L/hr
- Healthy heavy sweaters had average rates of 1L/hr
- Control subjects had average rates of 0.9L/hr

Electrolytes

Sweat electrolyte levels were significantly higher in CF athletes compared to all others (p < 0.001), the differences are vast & stark:

- CF athletes had sodium levels of 132.6mmol/L, potassium levels of 7.4mmol/L and chloride levels of 127mmol/L on average
- Healthy heavy sweaters had sodium levels of 91mmol/L, potassium levels of 4.4mmol/L and chloride levels of 84.1mmol/L on average
- Control subjects had sodium levels of 43.7mmol/L, potassium levels of 4.7mmol/L and chloride levels of 41.9mmol/L on average

CF athletes had the smallest rises in blood concentration during the test and had equal but major losses on overall plasma volume during exercise sitting around 17-18% - this can cause a type of shock called hypovolemic shock which occurs if people get large bleeds for example and lose lots of blood (plasma) too.

Interestingly enough, there was a similar relationship between all groups for thirst responses with dehydration, though this only signifies that everyone got thirstier as they got more dehydrated, let’s actually see the difference.
Why do we need this:

This is useful to know, for those of you that work as sports nutrition practitioners, dietitians as well as those that have CF or are heavy sweaters (not too dissimilar), as you can be proactive about managing the problem.

1. Set up good baseline hydration tactics, getting around 35-40ml per kg on any given day is a good start to have you in a baseline state of hydration.

2. Do a sweat test, weigh yourself before and after a session, i.e 60mins easy running, whatever the weight loss is, this is your hourly sweat rate (this is a crude way of testing, a lab works better...), you would look to try replace this value per hour of training.

3. If you have CF, set yourself intervals to drink at, forget your thirst cues, in training, practice taking on mouthfuls every 8-10mins if possible, looking to put back approx. 500-600ml per hour on average.

4. If you are a salty sweater (you will have salt deposits on your clothes after exercising) or have CF, drinking water only will dilute your electrolytes and exacerbate your risk of developing low levels, you need isotonic drinks (6-8% carbs with 45-70mg sodium per 100ml) to help replenish both fluid levels AND electrolyte stores.

5. Post exercise, weigh yourself and aim to consume 1.5 times your weight lost within 90 minutes to rehydrate properly, do this with an isotonic or sports drink.

6. For CF athletes specifically, taking on isotonic drinks and adding in an electrolyte tablet may be warranted to stave off hyponatraemia, depending on sweat levels.

7. For CF athletes, you can calculate your sodium losses from the CF sweat test, 1mmol/L = 23mg sodium, this makes for easy maths.

8. Thirst is not always the best metric to work off of, at best it is a delayed alarm telling you that you are dehydrated, it’s like using an alarm that goes off 30 minutes after a meeting started. Pre-empt your thirst.