



THE
CrossFit JOURNAL

WHY SOME SWEAT MORE

Hilary Achauer investigates the science of sweat and busts the myth that fitness alone determines liquid loss.

BY HILARY ACHAUER



Gender and sweat: While females have more sweat glands than men, they produce less sweat from each gland.

At the end of your next CrossFit class, look around.

You'll see some people soaked in sweat, a telltale puddle under the bar. Others who just completed the same workout in the same environment are almost completely dry.

Everyone sweats, but why do some people sweat so much more than others? Do heavy sweaters need to hydrate more than those who merely glisten?

We tend to associate perspiration with fitness, and it's not entirely wrong to do so. Exert yourself for an extended period of time, and it's likely you'll sweat. From the 1980s through 2014, a number of studies showed fit people sweat sooner and more than their sedentary counterparts.

Recently, scientists have taken a closer look at these studies and discovered although exercise and sweat are correlated, improving your fitness will not make you sweat sooner, more efficiently or in greater quantities. And for heavy, salty sweaters, flooding the body with liquid, including sports drinks, is not the best way to replace lost electrolytes.

Understanding Sweat

At the most basic level, sweat is our body's cooling system.

When a body heats up, it produces sweat, which is mostly water with some salts. The salt content of sweat varies from person to person. When the body starts to heat up and converts glucose into energy, sweat is produced to keep the body temperature between 98 and 103 F. A body temperature over 103 can lead to heat exhaustion as well as a significant decline in performance and function.

The body has two types of sweat glands: eccrine and apocrine. Eccrine glands are all over the body, are active from birth, and produce a sweat that's free of proteins and fatty acids. Apocrine glands are in the armpits and anal-genital area and usually end in hair follicles instead of pores.

On its own, sweat doesn't smell. The odor is created when the bacteria on our skin metabolize the proteins and fatty acids in sweat from the apocrine glands. That's why we use deodorant under our arms instead of rubbing it over the entire body like lotion.

Sweat cools us down through the **process of evaporation**. When liquid on the body changes to gas, it draws heat from the liquid, which in turn removes heat from the body.

Who Sweats More—and Why?

If we all sweat the same way and for the same reasons, why do some people sweat sooner and more than others?

Putting aside extrinsic factors such as heat and the amount of clothing or equipment the athlete is wearing, size and gender are the biggest physiological factors that influence sweat rates.

Women have more sweat glands than men but produce less sweat from each gland, which is why **women tend to sweat less than men**. Body mass might also play a role in sweat quantity, likely because it takes **more work to move around more mass**.

The sweat question gets murkier when considering the role fitness plays in how soon and how much a person sweats.

Multiple studies from the **1980s** to the **1990s** seemed to show fit people sweat sooner. According to **one study**, sweating occurred sooner in the trained group than the untrained group: "Physical training improves the secretory activity of the human sweat gland."

A more recent **study** from 2010 concluded "training improved the sweating response."

The idea that fit people sweat sooner and more became conventional wisdom, repeated in publications from **Time** to **The Washington Post**. In this 2015 **Greatist article**, Tony Musto, exercise physiologist and director of fitness at the University of Miami, stated definitively, "The more fit you are, the more efficiently your body sweats."

Not so fast, say some scientists.

The Naked Scientists is a BBC-produced science podcast based at Cambridge University. **In 2013**, scientist Ginny Smith responded to the question, "Who is more fit: the person who starts sweating as soon as they begin to exercise, or the person who barely breaks a sweat?"

The fit people were working harder
so they got hotter.

Smith analyzed studies that took groups of fit and unfit people, asked them to exert themselves equally, and discovered the fit people sweated more.





Fit athletes sweat more in part because they are able to work harder and generate more heat.

The problem, Smith discovered, is the studies determined exertion using VO_2 max—a measure of the maximum volume of oxygen an athlete uses, or the point at which oxygen consumption plateaus. A fit person will have a higher VO_2 max than a sedentary person, though VO_2 max is no longer considered the gold standard of fitness.

Each of the groups in these studies—the fit and the sedentary—worked to the same percentage of VO_2 max, but the fit people had to work quite a bit harder to reach the same VO_2 max level as their sedentary counterparts. That means if you're a distance runner, you will have to run much faster to reach 60 percent of your VO_2 max than someone who has never run more than a mile.

The fit people were working harder so they got hotter.

“You don't get any more efficient at running without producing heat,” Smith said on the podcast.

“When they did the experiment but they controlled for the heat that the people were producing—so they made the unfit people and the fit people run to produce the same amount of heat—they didn't find much difference in their sweat apart from their foreheads,” Smith said. “In fact, the unfit people seem to sweat more on their forehead, which is a bit surprising and unusual.”

A 2014 blog post on [Runner's World](#) cited a 2014 [study](#) from South Korea that found “sweat rate, activated sweat glands, sweat output per gland, skin temperature and VO_2 max were significantly higher in the trained runners than in the sedentary controls.”

After reading the article, Matthew Cramer, a researcher at the Thermal Ergonomics Lab at the University of Ottawa, wrote to [Runner's World](#), pointing out the same issue Smith noted in her assessment of the problem.

Cramer linked to [2010](#) and [2011](#) studies that concluded a person with a higher VO_2 max will sweat more because he or she is running or cycling faster than a less-fit person to reach the same percentage of VO_2 max, thus generating more heat. This led to a correction and an update to the article.

A closer look at these studies shows fit people sweat more not just because they are fit but because they have the capacity to work harder and get hotter, which prompts the body to start the cooling process. Individual sweat rates have less to do with fitness and more to do with gender, size and genetics.

Sweat and Hydration

Temperature and clothing or gear are other factors that play an important role in sweat production.

A person going for a 3-mile run wearing shorts and a T-shirt in 65-degree weather will sweat less than that same person wearing layers of clothing and running the same distance in 95-degree weather.

If you've ever traveled to a much warmer climate and found working out is suddenly much more difficult, you're not alone. Exerting yourself in the heat is a shock to the body if you're not accustomed to it. Thankfully, the body adjusts quickly.

[Sandra Fowkes Godek](#) is the director of the Heat Illness Evaluation Avoidance and Treatment (HEAT) Institute at West Chester University in Pennsylvania. The institute provides athletes with independent and unbiased information about thermoregulation and fluid and electrolyte balance. Fowkes Godek studies athletes and sweating, and her research on thermoregulation, hydration and electrolyte replacement in football players has attracted national attention.

After about 10 days of exercising in the heat, “You will start to sweat sooner and you will sweat over a larger portion of your body,” Fowkes Godek said.

“Typically when you are not acclimatized you will sweat on your torso, but when you become acclimatized, your sweat glands do kick in sooner so your onset of sweating is faster and you will sweat over a larger portion of your body,” she explained.

A benefit of training in the heat, Fowkes Godek said, is the heat stress causes the body to produce more plasma.

“(With) increasing plasma volume ... your cardiovascular system works better,” she said, “and then the other change is that your sweat electrolyte concentration goes down.”

The primary electrolyte in sweat is sodium, so this means a heat-acclimatized athlete will lose less salt in his or her sweat than an athlete unaccustomed to exercising in the heat.

This explains the strategy of CrossFit Games athletes from cooler climates who have traveled to California in advance of the Games to get used to the heat.

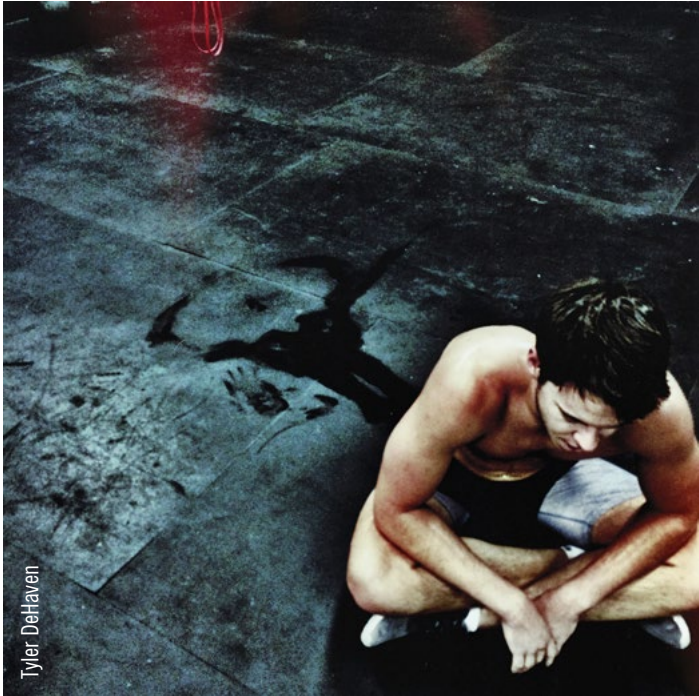
“Your sweat actually comes from filtered blood plasma,” Fowkes Godek said, “so more plasma means you are better able to tolerate the heat. But that is probably more related to the acclima-

tization process than the actual fitness, although fit people do tolerate exercise in the heat better because their cardiovascular system is far more efficient.”

Once you’ve started sweating, what’s the best way to help your body recover? Despite marketing to the contrary, Fowkes Godek said it’s not downing a sports drink like Gatorade, especially if you are a heavy, salty sweater.

Just as people sweat different amounts, sweat sodium concentration varies drastically from person to person. One person might have a sweat sodium concentration of 10 millimoles per liter (mmol/L), and another might have a sweat sodium concentration 10 times that amount.

“The people who are heavy, salty sweaters are losing a tremendous amount of salt, or sodium chloride. Whereas people who don’t sweat that heavily, and their sweat electrolytes concentration is not very high, ... (those) people don’t really need to drink anything or eat any extra electrolytes other than what they get in their food. But other people need a tremendous amount to replace after they have a heavy workout in the heat,” Fowkes Godek said.



Sweat angels might make for great photos, but they say little about the fitness of the person who left them on the rubber.



Bottom line, “if you are peeing clear, you are overhydrated,” Fowkes Godek said.

“You should not have clear urine. That’s just not normal. Your body is working really hard to get rid of that.”

On average, men can only filter and get rid of 1 L of water an hour; for women it’s about 800 ml.

“So if you are drinking twice that, if you are drinking a 2-liter bottle when you exercise for an hour, your kidneys can’t even get rid of that. You are going to hold onto that water; you aren’t going to excrete that. That’s why people gain weight. It’s horrible to exercise and gain weight,” Fowkes Godek said.

Sweat Sense

If you are on the sweatier end of the spectrum, a **headband** can help keep the sweat out of your eyes, and sweatbands on the wrists are a good way to prevent your hands from slipping on the barbell. Perhaps keep a towel nearby to dry off before lightly dusting with chalk to absorb the remaining moisture.

If you’re a high-volume, salty sweater, perhaps consider supplementing with sodium while ensuring you aren’t overhydrating.

But don’t compare sweat with your rivals. The size of the sweat angel is not an accurate measure of fitness. Some people just sweat more than others. ■

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For most people, drinking to thirst and eating a healthy, balanced diet will provide all the necessary hydration and electrolytes.

For most people, drinking to thirst and eating a healthy, balanced diet will provide all the necessary hydration and electrolytes. If you are a heavy, salty sweater—or if you exert yourself in heavy gear or in very hot temperatures for a long period of time—don’t rely on sports drinks for sodium replacement.

You can buy a salt supplement or even **add salt** to a sports drink, but the amount of salt would likely make the beverage unpalatable. If you add too little, you’re actually making the problem worse: It’s critical to replace the salt without drinking so much fluid that you dilute your blood sodium, which can cause injury or death.

Hyponatremia occurs when sodium levels in the blood fall below 135 mmol/L. Mild symptoms of hyponatremia are irritability and

fatigue. More extreme symptoms including nausea, vomiting, seizures and comas. Brain swelling—exercise-associated hyponatremic encephalopathy (EAHE)—can cause death. At least 18 people have died from EAHE since 1993.

Sports drinks such as Gatorade contain only a small amount of sodium, as well as significant amounts of sugar.

“Gatorade was never designed to be a sodium-replacement drink. It was designed to be a fluid-replacement drink. It was formulated to facilitate water uptake,” Fowkes Godek said.

Some of the football interior lineman Fowkes Godek has studied lose 30 g of sodium during a day of practice, and sports drinks can’t even make a dent in that number in safe volumes.

“Amazingly, replacing 30 g of sodium with the average sports drink would require nearly 65L; this is not only impractical, but it would add 13742 kcal and 3848 g of sugar and would cause hyponatremia,” she reported in the Journal of Athletic Training paper **“Sweat Rates, Sweat Sodium Concentrations, and Sodium Losses in 3 Groups of Professional Football Players.”** The study noted that heavy, salty sweaters would likely require “dry sodium supplementation” with tablets or capsules.

Fowkes Godek said diet and genetics play a role in how salty your sweat is. There is some thought that people who are cystic

fibrosis carriers have differences in sodium and chloride channels in their skin, so they tend to lose more sodium through sweat.

The only exact way to figure out your sweat sodium concentration is to get it tested, but you can get a rough idea by looking at your T-shirt once it dries after a particularly sweaty workout session.

“If you get a ring around your shirt, or if you are able to shake your dry shirt and you notice salt coming off of it, then you are typically a salty sweater,” Fowkes Godek said, “but you still don’t know if your sweat concentration is 65 or 100.”

Balancing these two needs—staying hydrated by avoiding overhydration—sounds complicated, and marketing is rife with pseudo-science that clouds the issue. In reality, the guidelines for appropriate hydration are remarkably simple:

“We still go back to ... drink to thirst. If water is sloshing around in your stomach, if you gain weight during exercise, you are over-drinking,” Fowkes Godek said.

She said even if you stay the same weight before and after an hour or more of strenuous exercise, you’re drinking too much. People taking nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen should also be cautious because NSAIDs cause water retention.