

Heat, Sweat and the “Hydration Deficit”

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When you run, you sweat. When you sweat, you lose water. Like everyone else, you rehydrate with water, sports drinks, and recovery drinks.

But can you drink enough *during* exercise on hot, humid days to maintain hydration? Probably not.

Running in the heat and humidity results in fluid loss at a rate that exceeds what can be replaced during and for several hours after exercise. That is the “hydration deficit.” The longer you exercise, the greater the deficit - no matter how much you drink before or during exercise.

In order to appreciate how this hydration deficit affects your running performance, it helps to understand what happens to your body when you run in the heat and humidity.

Heat Dispersion and Decreased Blood Volume

During exercise, heat dispersion is your body’s way of keeping you cool by increasing blood flow to the skin for conductive cooling. Meanwhile, your muscles are like small furnaces that produce heat when you convert fuel to energy while running. The hypothalamus in your brain detects this rise in body temperature, and triggers your body’s sweat glands. The water that helps cool you down - sweat - comes mostly from the blood, so the end result is decreased blood volume as you dehydrate. In lay, non-medical terms, the loss of water results in “thicker” blood.

At the same time, your muscles need more oxygen to keep working. The need for more oxygen means a need for more blood to the muscles.

Putting all this together, what you end up with is a situation where your blood is getting “thicker” as you sweat, meaning it is less efficient at flowing to the skin and muscles. Your body is less able to cool itself by conductive cooling, and is less efficient at delivering oxygen to the working muscles.

So how do heat and humidity affect all of this? A warm day triggers more sweating. A humid day means your evaporative cooling system is not working very efficiently, because moisture in the air suppresses the evaporation of sweat on your skin. You are left with a situation where your body finds it harder to meet the demands being placed upon it. Your muscles need oxygen-filled blood in order to keep you running; your skin needs blood to help keep the body cool; and in the meantime dehydration from sweating means your blood is less and less capable of performing both tasks.

Furthermore, your body responds to decreased blood volume by decreasing blood flow and suppressing sweat in order to conserve bodily fluids. In turn, your muscles simply cannot perform without adequate oxygen, your sweating declines, and your body temperature can rise to dangerous levels. You might even get chills on a hot day. When that happens, you must stop running.

Rate of Water Loss: More Than You Can Replace (“Hydration Deficit”)

On very hot, humid days, it is not unusual for a runner to lose anywhere from 2-5 pounds of water in just one hour. Some of that water loss is replaced by drinking during exercise. However, your stomach can absorb only 6-7 ounces of water every fifteen minutes. At that rate, you can replace about 24-28 ounces per hour – less than 2 pounds. If you are losing more than 28 ounces of water every hour (and you usually are during warm months), you are experiencing “hydration deficit.”

The longer you exercise, the greater the deficit. Assume that on a hot day you lose 3 pounds of sweat (48 ounces) every hour. Even if you drink a quart of water (32 ounces) per hour, your stomach can only absorb about 28 of those ounces every hour (and the rest will just slosh around in your stomach while you run). Thus, your deficit is 20 ounces per hour. Over the course of two hours, you will experience a deficit of 40 ounces (or more if you don’t drink enough). At that rate, a four-hour marathon in the heat means 80 ounces of deficit...that’s 5 pounds!

Hydration Deficit Equals Decreased Performance

Research on the effects of dehydration on athletic performance indicates that for every 1% loss in your body weight from dehydration, you will slow down about 2%.

Thus, a 125-pound woman who sweats 3 pounds per hour will lose 6 pounds in two hours, which is almost 5% of her body weight. That 5% loss of body weight equals a 10% loss in performance. If she is running 8 minutes per mile, a slowdown of 10% means she will run about 45-50 seconds per mile *slower* after 2 hours.

True, some of that water loss can be replaced during running. Our 125-pound woman who is sweating 48 ounces every hour (3 pounds) can replace 28 ounces per hour, so her net loss is only 20 ounces every hour. Still, that equals 60 ounces over a 3-hour period, or almost 4% of her body weight. A 4% loss of body weight means 8% drop in performance. Her 8-minute miles become 8:40 miles.

Prehydration and Rehydration

Remember: “dehydration” simply means “water loss.” It’s going to happen when you run. The important thing to remember is that no matter how much you drink, you cannot keep up with the amount of lost fluid.

But you can counter the effects of the hydration deficit by “prehydrating” before you run, and rehydrating during and after your run.

Before exercise, “prehydrating” is the specific act of preparing yourself for exercise and the hydration deficit that accompanies exercise. At a minimum, drink 8-12 cups of water throughout the day, especially during warm months. At least one hour before exercise, drink 16 ounces of water.

During exercise, drink 6-8 ounces every 15 minutes, even if you are not thirsty.

After exercise, it can take anywhere from 24-48 hours to completely rehydrate. Remember that your body is only going to absorb 24-28 ounces of water every hour after exercise. If you have lost 3, 4, 5 or more pounds, it will take several hours just to absorb that much water, assuming that you drink enough to catch up. Even then, you will begin to lose some of that fluid in your urine, so you’ve got to continue drinking regularly for many hours after exercise.