

Physiology of Exercising in the Heat

It has been well documented that as air temperature increases, endurance performance decreases. When we exercise, we convert stored calories (fat and carbohydrates) into energy that is then translated into movement. However, humans are not 100 percent efficient in this conversion, leaving about 70-80 percent of this energy lost as heat production. This is the primary reason that we heat up while exercising. With every muscle contraction, we are also generating heat.

This production of heat is typically not a problem when exercising in cooler environments as the body is able to maintain a stable core temperature. However this accumulation of heat becomes more difficult for the body to manage when exercising in hot conditions. There are a few different mechanisms through which our body cools itself, however, the major mechanisms we are all familiar with is sweating. Sweating works to dissipate heat from the body through evaporation. As our core temperature increases, blood flow to the skin increases, allowing sweat to form and, upon evaporation, heat releases from the body. This process of heat loss is magnified when exercising in hot weather, which is why we sweat more and are at a greater risk of dehydration.

During prolonged endurance exercise in the heat, the importance of maintaining adequate hydration becomes crucial as dehydration of as little as 2 percent has been shown to affect performance. Once dehydration begins to set in, heart rate and perceived exertion climb higher for the same given exercise intensity due to more blood flow being directed to the skin and away from the muscles. This impact on the body becomes nearly impossible to counteract. The following are signs of dehydration to be aware of when exercising in the heat.

Signs and symptoms of dehydration:

- Dizziness, confusion, lightheadedness
- Dry lips, mouth, skin
- Physical and mental fatigue
- Decreased pace and performance
- Darkened urine (one of the first indicators)
- Increased body temperature, heart rate and perceived effort

Although exercising in the heat imposes a huge demand on the body, there are ways to manage this challenge. Adequate hydration before, during and after exercise sessions is crucial for maintaining performance in the heat.

Monitoring Hydration Status

The first step in maintaining adequate hydration is to remain hydrated throughout the day. The easiest way of doing so is by checking the color of your urine, ideally first thing each morning. A pale yellow, or lemonade-like color, is indicative of adequate hydration. A darker, strong-smelling urine probably means that you are slightly dehydrated (see the chart below as a guide).



Hydration Recommendations

It is difficult to provide recommendations for fluid intake throughout the day as everyone has different fluid needs based on sweat rate, exercise habits, body weight and environmental conditions.¹ However, drinking enough water throughout the day so that your urine is a pale yellow color (see chart in the above section) is a good place to start. Remaining adequately hydrated throughout the day contributes to success in training sessions throughout the day.

Providing fluid recommendations during exercise is also difficult as fluid needs are dependent on sweat rate and environmental conditions. The table below, however, provides some general guidelines that provide a great place to start.

“It is also important to consider that sweat contains electrolytes: sodium, potassium, chloride and small amounts of minerals (iron, calcium and magnesium),” explains Registered Dietitian [Susan Kitchen](#). “Of all these, sodium takes the biggest hit from sweat loss, thus it’s the most important to replace. Generally speaking, most athletes lose about 500 milligrams sodium per pound of sweat loss, and heavy sweaters can lose in excess of 1,000 mg sodium/hour. So, it’s best to keep up with the increased loss of fluid.”

Hydration Recommendations

Timing	Hydration Strategy
Pre-Exercise	- Drink sufficiently between exercise sessions and throughout each day so that urine is pale yellow
During Exercise	
<i>Sessions < 1 hour</i>	- 24-30 oz of plain water
<i>Sessions > 1 hour</i>	- 24-30 oz/hour of plain water or carbohydrate/electrolyte drink - Don’t rely on thirst as an indicator to drink fluids; aim to avoid the sensation of thirst in hot conditions
Post-Exercise	- 20-24 oz water or carbohydrate/electrolyte drink — depending on duration of training session