

# What causes Muscle Fatigue?

Want to keep your performance high? Here's what causes muscle fatigue and how to avoid it

To understand what causes muscle fatigue, it's worth looking at what exactly muscle fatigue is. If you exercise regularly, you may be familiar with the sensation of a dull ache in your muscles or experienced a feeling of tiredness or lack of energy that makes it hard to complete your usual daily tasks. But it's not just exercise that can cause muscle fatigue, several health conditions also list muscle fatigue as a common symptom.

A study in the [Journal of Physiology](#) defines muscle fatigue as a transient or temporary decrease in the capacity to perform physical actions. More specifically, 'muscle fatigue' describes any reduction in the force or power that the muscles can produce, which develops soon after the onset of physical activity.

You will surely have experienced this in your own life - whether in a reduction in your running speed, your strength when lifting weights, or simply in that you find it more difficult to sustain the same level of performance. Not only can it be frustrating struggling to maintain a given level of output, but fatigue-induced decreases in performance can lead to worse training adaptations, as shown by a study from the [International Journal of Sports Physiology and Performance](#).

In order to get the most out of your training, let's look at how to best prevent muscle fatigue. There are a handful of options (some of which are simpler than others), from training at submaximal intensities to simply drinking more water.



## WHAT IS MUSCLE FATIGUE?

As we've already discussed, muscle fatigue is a decrease in the force or power that muscles and [muscle fiber types](#) involved in a given task can produce. In real terms, this manifests as being able to lift less weight or do fewer reps, not run/cycle as fast or for as long, or the same performance feeling more difficult. For muscle fatigue, we're only considering reductions in performance for the same muscles, and primarily within the same workout, or workouts in close proximity to each other; e.g. being able to perform fewer reps on bench press as you do more sets, or finding it more difficult to maintain a given pace during a 5k run or runs on subsequent days.

Fatigue induced over the course of a longer time period or with different muscle groups is more likely to be a systemic, Central Nervous System-oriented sense of fatigue, as illustrated in research into caffeine in the [American Journal of Physiology](#).

## CAUSES OF MUSCLE FATIGUE

Before we start discussing what causes muscle fatigue, we first need to understand what allows muscles to contract and work. At the most fundamental level, muscle contracts by individual fibers (called actin and myosin) sliding over each other, and forming cross-bridges. A chemical called Adenosine Triphosphate (ATP) is essential to allow this to occur, and can be thought of as muscle currency - the more you have, the more your muscles can work, as outlined in [Progress in Biophysics and Molecular Biology](#). Phosphocreatine (PCr for short) is a high-energy chemical that acts as a reserve of phosphates to create more ATP.

One of the reasons ATP is so important is that it allows for the release of calcium from within muscle cells to allow contractions to take place, and an important by-product of creating ATP is a build-up of Hydrogen Ions. Hydrogen Ions induce fatigue by creating a more acidic environment in the muscle.

According to research findings published in [Sports Medicine](#), muscular work can cause decreases in ATP and PCr and an accumulation of Hydrogen Ions and Magnesium ions, which inhibit the release of calcium. These effects can hamper cross-bridging and calcium release, and the result of this is decreased muscular force production.

A huge factor that causes muscles to fatigue is the increase in heat experienced by the body when exercising. Exercise-induced heat can cause physiological strain as discussed above, according to a 2015 review in [Scandinavian Journal of Medicine & Science in Sports](#), and can also lead to dehydration through sweat as the body attempts to maintain a consistent and safe temperature.

Dehydration is one of the main contributors to fatigue according to a 2011 paper in the [Journal of Sports Sciences](#), and sweating can lead to significant losses of essential minerals such as sodium, magnesium and calcium, which can lead to greater muscle fatigue.

### HOW TO PREVENT MUSCLE FATIGUE

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Now that we know what causes muscle fatigue at a cellular and more general level, there are some well-established, practical steps we can take to help reduce muscle fatigue. First of all, eating some carbohydrates within a few hours of exercise can significantly improve exercise performance, largely because carbohydrates play a vital role in glycolysis, a primary pathway for ATP production.

Secondly, there are a number of tactics you can use post-workout to reduce the fatigue experienced from a workout session. A 2018 study in [Frontiers in Physiology](#) found that water immersion at any temperature below body temperature was highly effective at reducing fatigue and post-workout muscle soreness.

Finally, a piece of research from 2019 in the [Journal of Strength and Conditioning Research](#) found that cooling strategies were one of the most effective ways to maintain performance during a workout, in other words, preventing too high a core temperature helps prevent fatigue. One highly effective way to help maintain a relatively low temperature is by drinking cold water, a question investigated in a 2015 meta-analysis in the [Scandinavian Journal of Medicine and Science in Sports](#), and 10 out of the 14 studies compiled showed a reduction in body temperature by drinking cold water.

### TAKE-HOME POINTS AND PRACTICAL STEPS

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Some degree of muscle fatigue is inevitable when exercising, as hopefully you can see now. However, there are some practical steps we can take to reduce the effect, now that we know what causes muscle fatigue. Eating some [carbohydrate](#) before training can help maintain muscular performance, and below-body temperature water immersion can be useful as well. Most people are already drinking water when exercising, but ensuring that it's cold will have a large effect on protecting against muscle fatigue and allowing you to get the most out of your workouts.