

Why are my muscles sore after exercise? Hint: It's nothing to do with lactic acid

January 8 2024, by Robert Andrew Robergs and Samuel L. Torrens



Credit: Ketut Subiyanto from Pexels

As many of us hit the gym or go for a run to recover from the silly season, you might notice a bit of extra muscle soreness.

This is especially true if it has been a while between workouts.

A common misunderstanding is that such soreness is due to [lactic acid](#) build-up in the muscles.

Research, however, shows lactic [acid](#) has [nothing to do with it](#). The truth is far more interesting, but also a bit more complex.

It's not lactic acid

We've known for decades that lactic acid has [nothing to do with muscle soreness](#) after [exercise](#).

In fact, as one of us (Robert Andrew Robergs) has long [argued](#), cells produce [lactate](#), not lactic acid. This process actually [opposes](#) not causes the build-up of acid in the muscles and bloodstream.

Unfortunately, historical inertia means people still use the term "lactic acid" in relation to exercise.

Lactate [doesn't cause major problems](#) for the muscles you use when you exercise. You'd probably be [worse off](#) without it due to other benefits to your working muscles.

Lactate isn't the reason you're sore a few days after upping your weights or exercising after a long break.

So, if it's not lactic acid and it's not lactate, what is causing all that [muscle](#) soreness?

Muscle pain during and after exercise

When you exercise, a lot of [chemical reactions](#) occur in your [muscle cells](#). All these chemical reactions accumulate products and by-products which cause water to enter into the cells.

That causes the pressure inside and between muscle cells to increase.

This pressure, combined with the movement of molecules from the muscle cells can stimulate nerve endings and cause [discomfort](#) during exercise.

The pain and discomfort you sometimes feel hours to days after an unfamiliar type or amount of exercise has a different list of causes.

If you exercise beyond your usual level or routine, you can cause microscopic damage to your muscles and their connections to tendons.

Such damage causes the release of ions and other molecules from the muscles, causing localized swelling and stimulation of nerve endings.

This is sometimes known as "[delayed onset muscle soreness](#)" or DOMS.

While the damage occurs during the exercise, the resulting response to the injury builds over the next one to two days (longer if the damage is severe). This can sometimes cause pain and difficulty with normal movement.

The upshot

Research is clear; the discomfort from delayed onset muscle soreness has nothing to do with [lactate](#) or [lactic acid](#).

The good news, though, is that your muscles adapt rapidly to the activity that would initially cause delayed onset muscle soreness.

So, assuming you don't wait too long (more than roughly two weeks) before being active again, the next time you do the same activity there will be much less damage and discomfort.

If you have an exercise goal (such as doing a particular hike or completing a half-marathon), ensure it is realistic and that you can work up to it by training over several months.

Such training will gradually build the muscle adaptations necessary to prevent delayed onset muscle soreness. And being less wrecked by exercise makes it more enjoyable and more easy to stick to a routine or habit.

Finally, remove "lactic acid" from your exercise vocabulary. Its supposed role in muscle soreness is a myth that's hung around far too long already.

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