

How Exercise Keeps Your DNA Young

By Alice Park, Time Magazine, July 27, 2016

A new study reveals how exercise may be another way to combat aging

To stay young, you have to keep your cells young, and what dictates a cell's age is its DNA. Too many cycles of dividing can trigger the aging process, until eventually the cell peters out and stops dividing altogether.

But now researchers have found that exercise can help keep DNA healthy and young. In a small [study published in the journal *Science Advances*](#), Anabelle Decottignies, from the de Duve Institute at the Catholic University of Louvain in Brussels, and her colleagues found that just moderate-intensity physical activity helps hold back cell aging.

They studied a specific part of DNA that keeps track of how many times a cell has divided. Each time a cell divides, it copies its DNA (which is packed into chromosomes) and this section of the chromosomes, called [telomeres](#), gets shorter. In the study, Decottignies identified a molecule that's responsible for directing this telomere-shortening. Until this work, not much was known about how the chromosomes controlled this DNA snipping process. Decottignies recruited 10 healthy people to ride stationary bicycles for 45 minutes and took a muscle biopsy from each of their legs before and after the cycling session. She also measured blood levels of muscle function with lactate, which muscle cells produce when stressed.

Based on analysis of these samples, the researchers found that a compound called nuclear respiratory factor 1 (NRF1) regulates the production of a factor that in turn controls the shortening of the telomeres. Exercise boosts levels of NRF1, which protects the telomeres from being snipped away. "Think about NRF1 like varnish on nails," says Decottignies. "You cannot change the nail, but you can change the

varnish again and again. What you're doing is refreshing and replacing the old section with new protective molecules at the telomeres."

With each bout of moderate exercise, she says, the protection to the telomeres is refreshed, thus helping the DNA, and in turn the cells, to remain "younger" and hold off the aging process. "The protection is constantly renewed upon exercise," says Decottignies.

Other evidence supports the connection between exercise and its effect on telomeres. NRF1 is also part of the pathway that's activated during starvation; some studies have indeed hinted that a fasting diet may help cells stay biologically young and not divide as frequently.

In the study, the team didn't actually measure whether the 45 minutes led to longer telomeres, but that's a focus of future studies. For now, the findings provide strong support for a way that exercise may keep us young by keeping our DNA young.

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Seven Amazing Things That Happen to a Body in Motion.

Excerpt from the Mandy Oaklaner article in the 9/12/16 Time Magazine Article, titled “The New Science of Exercises

1. Exercise is great for your brain.

It's linked to less depression, better memory and quicker learning. Studies also suggest that exercise is, as of now, the best way to prevent or delay the onset of Alzheimer's disease, a major fear for many Americans.

Scientists don't know exactly why exercise changes the structure and function of the brain, but it's an area of active research. So far, they've found that exercise improves blood flow to the brain, feeding the growth of new blood vessels and even new brain cells, thanks to the protein BDNF (brain-derived neurotrophic factor). BDNF triggers the growth of new neurons and helps repair and protect brain cells from degeneration. It may also [help people focus](#), according to recent research.

2. You might get happier.

Countless studies show that many types of exercise, from walking to cycling, make people feel better and can even relieve symptoms of depression. Exercise triggers the release of chemicals in the brain—serotonin, norepinephrine, endorphins, dopamine—that dull pain, lighten mood and relieve stress. “For years we focused almost exclusively on the physical benefits of exercise and really have ignored the psychological and emotional benefits of being regularly active,” says Cedric Bryant, chief science officer of the American Council on Exercise.

3. It might make you age slower.

Exercise has been shown to lengthen lifespan by as much as five years. A [small new study](#) suggests that moderate-intensity exercise may slow down the aging of cells. As humans get older and their cells divide over and over again, their telomeres—the protective caps on the end of chromosomes—get shorter. To see how exercise affects telomeres, researchers took a muscle biopsy and blood samples from 10 healthy people before and after a 45-minute ride on a stationary bicycle. They found that exercise increased levels of a molecule that protects telomeres, ultimately slowing how quickly they shorten over time. Exercise, then, appears to slow aging at the cellular level.

4. It'll make your skin look better.

Aerobic exercise revs up blood flow to the skin, delivering oxygen and nutrients that improve skin health and even help wounds heal faster. “That's why when people have injuries, they should get moving as quickly as possible—not only to make sure the muscle doesn't atrophy, but to make sure there's good blood flow to the skin,” says Anthony Hackney, an exercise physiologist at the University of North Carolina at Chapel Hill. Train long enough, and you'll add more blood vessels and tiny capillaries to the skin, too.

The skin also serves as a release point for heat. (See “[Why Does My Face Turn Red When I Exercise?](#)” for more on that.) When you exercise, your muscles generate a lot of heat, which you have to give up to the environment so your body temperature doesn't get too high, Hackney says. The heat in the muscle transfers to the blood, which shuttles it to the skin; it can then escape into the atmosphere.

5. Amazing things can happen in just a few minutes.

Emerging research suggests that it doesn't take much movement to get the benefits. "We've been interested in the question of, How low can you go?" says Martin Gibala, an exercise physiologist at McMaster University in Ontario. He wanted to test how effective a 10-minute workout could be, compared to the typical 50-minute bout. The micro-workout he devised consists of three exhausting 20-second intervals of all-out, hard-as-you-can exercise, followed by brief recoveries. In a three-month study, he pitted the short workout against the standard one to see which was better. To his amazement, the workouts resulted in identical improvements in heart function and blood-sugar control, even though one workout was five times longer than the other. "If you're willing and able to push hard, you can get away with surprisingly little exercise," Gibala says. (For more on the [1-minute workout read this.](#))

6. It can help you recover from a major illness.

Even very vigorous exercise—like the interval workouts Gibala is studying—can, in fact, be appropriate for people with different chronic conditions, from Type 2 diabetes to heart failure. That's new thinking, because for decades, people with certain diseases were advised not to exercise. Now scientists know that far more people can and should exercise. A recent analysis of more than 300 clinical trials discovered that for people recovering from a stroke, exercise was even more effective at helping them rehabilitate.

Dr. Robert Sallis, a family physician at Kaiser Permanente Fontana Medical Center in California, has prescribed exercise to his patients since the early 1990s in hopes of doling out less medication. "It really worked amazingly, particularly in my very sickest patients," he says. "If I could get them to do it on a regular basis—even just walking, anything that got their heart rate up a bit—I would see dramatic improvements in their chronic disease, not to mention all of these other things like depression, anxiety, mood and energy levels."

7. Your fat cells will shrink.

The body uses both carbohydrates and fats as energy sources. But after consistent aerobic exercise training, the body gets better at burning fat, which requires a lot of oxygen to convert it into energy. "One of the benefits of exercise training is that our cardiovascular system gets stronger and better at delivering oxygen, so we are able to metabolize more fat as an energy source," Hackney says. As a result, your fat cells—which produce the substances responsible for chronic low-grade inflammation—shrink, and so does inflammation.

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Made to Move – How to Reverse Aging

by Dr. Henry S. Lodge

(New research reveals surprising facts about our changing bodies.)

You Can Stop “Normal” Aging.

From your body’s point of view, “normal” aging isn’t normal at all. It’s a choice you make by the way you live your life. The other choice is to tell your cells to grow—to build a strong, vibrant body and mind.

Let’s have a look at standard American aging. Barbara D. had a baby when she was 34, gave up exercise and gained 50 pounds. Exhausted and depressed, Barbara thought youth, energy and optimism were all in her rearview mirror. Jon M., 55, had fallen even farther down the slippery slope. He was stuck in the corporate world of stress, long hours and doughnuts. At 255 pounds, he had knees that hurt and a back that ached. He developed high blood pressure and eventually diabetes. Life was looking grim.

Jon and Barbara weren’t getting old; they had let their bodies decay. Most aging is just the dry rot we program into our cells by sedentary living, junk food and stress. Yes, we do have to get old, and ultimately we do have to die. But our bodies are designed to age slowly and remarkably well. Most of what we see and fear is decay, and decay is only one choice. Growth is the other.

After two years of misery, Barbara started exercising and is now in the best shape of her life. She just finished a sprint triathlon and, at 37, feels like she is 20. Jon started eating better and exercising too—slowly at first, but he stuck with it. He has since lost 50 pounds, the pain in his knees and back has disappeared, and his diabetes is gone. Today, Jon is 60 and living his life in the body of a healthy 30-year-old. He will die one day, but he is likely to live like a young man until he gets there.

The hard reality of our biology is that we are built to move. Exercise is the master signaling system that tells our cells to grow instead of fade. When we exercise, that process of growth spreads throughout every cell in our bodies, making us functionally younger. Not a little bit younger—a lot younger. True biological aging is a surprisingly slow and graceful process. You can live out your life in a powerful, healthy body if you are willing to put in the work.

Let’s take a step back to see how exercise works at the cellular level. Your body is made up of trillions of cells that live mostly for a few weeks or months, die and are replaced by new cells in an endless cycle. For example, your taste buds live only a few hours, white blood cells live 10 days, and your muscle cells live about three months. Even your bones dissolve and are replaced, over and over again. A few key stem cells in each organ and your brain cells are the only ones that stick around for the duration. All of your other cells are in a constant state of renewal.

You replace about 1% of your cells every day. That means 1% of your body is brand-new today, and you will get another 1% tomorrow. Think of it as getting a whole new body every three months. It’s not entirely accurate, but it’s pretty close. Viewed that way, you are walking around in a body that is brand-new since Christmas—new lungs, new liver, new muscles, new skin. Look down at your legs and realize that you are going to have new ones by the Fourth of July. Whether that body is functionally younger or older is a choice you make by how you live.

You choose whether those new cells come in stronger or weaker. You choose whether they grow or decay each day from then on. Your cells don’t care which choice you make. They just follow the directions you send. Exercise, and your cells get stronger; sit down, and they decay.

This whole system evolved over billions of years out in nature, where all animals face two great cellular challenges: The first is to grow strong, fast and fit in the spring, when food abounds and there are calories to fuel hungry muscles, bones and brains. The second is to decay as fast as possible in the winter, when calories disappear and surviving starvation is the key to life. You would think that food is the controlling signal for this, but it's not. Motion controls your system.

Though we've moved indoors and left that life behind, our cells still think we're living out on the savannah, struggling to stay alive each day. There are no microwaves or supermarkets in nature. If you want to eat, you have to hunt or forage every single day. That movement is a signal that it's time to grow. So, when you exercise, your muscles release specific substances that travel throughout your bloodstream, telling your cells to grow. Sedentary muscles, on the other hand, let out a steady trickle of chemicals that whisper to every cell to decay, day after day after day.

Men like Jon, who go from sedentary to fit, cut their risk of dying from a heart attack by 75% over five years. Women cut their risk by 80%—and heart attacks are the largest single killer of women. Both men and women can double their leg strength with three months of exercise, and most of us can double it again in another three months. This is true whether you're in your 30s or your 90s. It's not a miracle or a mystery. It's your biology, and you're in charge.

The other master signal to our cells—equal and, in some respects, even more important than exercise—is emotion. One of the most fascinating revelations of the last decade is that emotions change our cells through the same molecular pathways as exercise. Anger, stress and loneliness are signals for “starvation” and chronic danger. They “melt” our bodies as surely as sedentary living. Optimism, love and community trigger the process of growth, building our bodies, hearts and minds.

Men who have a heart attack and come home to a family are four times less likely to die of a second heart attack. Women battling heart disease or cancer do better in direct proportion to the number of close friends and relatives they have. Babies in the ICU who are touched more often are more likely to survive. Everywhere you look, you see the role of emotion in our biology. Like exercise, it's a choice.

It's hard to exercise every day. And with our busy lives, it's even harder to find the time and energy to maintain relationships and build communities. But it's worth it when you consider the alternative. Go for a walk or a run, and think about it. Deep in our cells, down at the level of molecular genetics, we are wired to exercise and to care. We're beginning to wake up to that as a nation, but you might not want to wait. You might want to join Barbara, Jon and millions of others and change your life. Start today. Your cells are listening.

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