

What Are Sirtuins and How Do They Affect Aging and Longevity?

Analysis by [Dr. Joseph Mercola](#)

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STORY AT-A-GLANCE

- Sirtuins are proteins your body naturally produces that depend on NAD⁺ to regulate cellular energy production, DNA repair, metabolism, and healthy aging, making them central to how well your cells recover from everyday stress
- Your body contains seven different sirtuins, each with a specialized role in different parts of your cells, so healthy aging depends on multiple repair and energy systems working together instead of one "longevity gene"
- Mitochondrial sirtuins help keep your cellular power plants running efficiently by supporting ATP production, balancing metabolism, and helping your cells respond appropriately to normal oxidative stress
- Declining sirtuin activity and falling NAD⁺ levels are linked to reduced mitochondrial function, impaired DNA repair, and greater risk of age-related changes affecting your heart, brain, and muscles
- The most effective way to support healthy sirtuin activity is to strengthen your cellular energy system through consistent lifestyle habits, including adequate healthy carbohydrates, support for NAD⁺ recycling, regular movement, morning sunlight, and protection of mitochondrial health

Sirtuins (SIRTs) are a family of proteins that sit at the intersection of energy, repair, and aging – and understanding how they work may change the way you think about growing older. These enzymes rely on nicotinamide adenine dinucleotide (NAD⁺), and they spend

a little of it every time they act, which is what links your body's moment-to-moment energy status to DNA repair, mitochondrial function, inflammation, and metabolism.¹

How well your sirtuins function helps determine how efficiently your cells adapt, recover, and maintain themselves over a lifetime, which is why researchers have placed them at the center of the science of healthy aging. Sirtuins are enzymes your body produces, not something you obtain directly from food. Different members of the sirtuin family work inside different parts of your cells, and each one performs a specialized job.

That division of labor matters enormously, because these proteins do not all behave the same way or produce the same effects. Together, they help coordinate how your body uses nutrients, responds to physical stress, and maintains healthy tissues over time. That distinction becomes much clearer once you look at how each member of the sirtuin family works inside the body and why researchers continue to study them so closely.

Different Sirtuins Perform Different Jobs

A News Medical article by science writer Chinta Sidharthan summarizes current research on all seven known human sirtuins and explains how each one performs a different job inside your cells rather than acting in the same way.²

It summarizes findings from multiple scientific studies to explain how these enzymes regulate metabolism, DNA repair, inflammation, mitochondrial function, and healthy aging. One of the most important messages is that researchers no longer see "activating sirtuins" as a simple solution because each sirtuin behaves differently depending on the tissue, organ, and biological process involved.

- **Each member of the sirtuin family specializes in a different location inside your cells** — Rather than working everywhere at once, SIRT1, SIRT6, and SIRT7 spend most of their time inside the cell nucleus, where they help regulate genes and preserve DNA stability. SIRT2 works mainly in the cell fluid but moves into the nucleus during certain stages of cell division.

Meanwhile, SIRT3, SIRT4, and SIRT5 operate inside [mitochondria](#), where they oversee many of the chemical reactions that keep your cells supplied with energy.

This means healthy aging depends on many separate repair and energy systems working together instead of relying on one "longevity gene." The review states that these enzymes respond to nutrient availability, environmental stress, metabolic regulation, and circadian rhythms, showing that your daily habits influence the very pathways scientists continue to investigate.

- **Your body's energy factories receive some of the greatest support from mitochondrial sirtuins** — According to the review, SIRT3 serves as the major mitochondrial deacetylase, meaning it removes small chemical tags from proteins so those proteins work more efficiently.

This helps regulate enzymes involved in the electron transport chain and the tricarboxylic acid cycle, often called the TCA or Krebs cycle, the series of reactions that converts nutrients into adenosine triphosphate (ATP), the primary energy currency used by every cell.

The review also explains that SIRT5 regulates parts of the urea cycle, which helps remove excess nitrogen from your body, while also influencing glycolysis, the process that converts glucose into usable energy. SIRT4 works differently by slowing certain metabolic pathways, illustrating that healthy metabolism depends on balance rather than maximum activity.

- **Healthy aging depends on constant maintenance instead of one-time repairs** — The review highlights research showing that sirtuins preserve genomic integrity, meaning they help keep your DNA stable as cells divide throughout life. One example involves SIRT6, which helps repair dangerous double-strand DNA breaks and maintain telomeres, the protective caps at the ends of chromosomes that naturally shorten with age.

Animal research found that deficiency of SIRT6 produced features of premature aging, emphasizing how important continuous DNA maintenance becomes over a lifetime.³ The review also explains that SIRT1 and SIRT3 activate antioxidant defense pathways instead of simply eliminating every reactive oxygen species, or ROS.

These molecules often receive negative attention because excessive amounts damage cells, but moderate ROS also serve as important signals that tell your cells to strengthen their defenses. Researchers describe this as a hormetic response, meaning a small amount of biological stress helps build greater resilience over time.

- **Researchers continue to uncover why declining mitochondrial function accelerates aging** — The review explains what happens when SIRT3 slows down. Because its job is to strip those chemical tags off mitochondrial proteins, falling SIRT3 activity lets the tags accumulate, a state called hyperacetylation, and the tagged proteins gum up and lose efficiency.

As energy production falls, ROS rise, increasing the risk of cardiac fibrosis, neurodegeneration, and skeletal muscle loss during aging. Cardiac fibrosis refers to excessive scar tissue that stiffens the heart and reduces its ability to pump efficiently.

Neurodegeneration describes the gradual loss of nerve cells that contributes to disorders affecting memory and movement. These findings reinforce an important takeaway for your own health: protecting mitochondrial function supports far more than energy levels. It also helps preserve muscle, cardiovascular health, and healthy brain function as you grow older.

- **Scientists remain optimistic, but they also urge caution about future therapies** — One of the strongest themes throughout the review is that researchers have moved beyond the idea that simply increasing sirtuin activity solves every problem.

The article notes that compounds such as [resveratrol](#), the molecule once made famous by [red wine](#), have shown effects resembling calorie restriction, the long-studied practice of eating fewer calories without malnutrition that reliably extends lifespan in laboratory animals and remains the original discovery that launched sirtuin research.

In experimental models, resveratrol appeared to mimic some of those benefits, but its specificity and usefulness in people remain limited. Researchers are also studying [NAD+ precursors](#) because they help restore declining NAD+ levels, yet the evidence in humans remains disease-specific rather than universally consistent.

The review further explains that some sirtuins produce opposite effects depending on the tissue or disease stage, including certain cancers where SIRT1 acts either as a tumor suppressor or as a tumor promoter depending on the biological setting. That growing understanding encourages a practical mindset: supporting your overall cellular health through healthy lifestyle habits makes far more sense than expecting a single supplement or molecule to control the complex biology of aging.

Note: The research summarized here includes laboratory and animal studies as well as human research of varying scope. Findings from cell and animal models may not directly apply to human health.

Support Your Cellular Energy Every Day

Healthy sirtuin activity starts with healthy [cellular energy](#). Sirtuins are one part of a much larger system rather than a single target to activate. Instead of chasing one supplement that promises longevity, build the daily habits that give your cells the fuel and raw materials they need to produce energy, repair damage, and adapt to stress. Those consistent habits also help maintain healthy NAD+ levels, the molecule sirtuins rely on to function.

- 1. Feed your cells enough quality carbohydrates** — Most adults need about 250 grams of carbohydrates daily, adjusting upward if you're very active. Focus on whole fruit, white rice, root vegetables, properly prepared starches, and other minimally processed carbohydrate sources that provide the glucose your cells need for efficient energy production. Your body relies on steady energy availability to support the same metabolic pathways that influence sirtuin activity.

You may have read that fasting or calorie restriction "activates" sirtuins, and in lab models it can. But chronic energy shortage is itself a stressor, and your cells need steady glucose to run the very repair and energy pathways sirtuins depend on. Keeping NAD⁺ recycling healthy matters more than starving your system.

- 2. Support your body's natural NAD⁺ recycling system** — Sirtuins depend on NAD⁺, but **NAD⁺ levels naturally decline** with age and fall more rapidly when your body spends large amounts repairing DNA or responding to chronic inflammation. One important reason is that your body's NAD⁺ recycling process, called the salvage pathway, becomes less efficient over time. I recommend supporting that system with small, consistent amounts of niacinamide instead of large doses.

Niacinamide is a form of vitamin B3, not the same as flush-causing niacin. I recommend about 50 milligrams (mg) three times daily, which provides steady support for NAD⁺ production while avoiding the drawbacks associated with **high-dose vitamin B3**. Eating foods naturally rich in B vitamins, including grass fed beef, mushrooms, potatoes, bananas, and leafy green vegetables — if you tolerate them — also helps supply the nutrients your mitochondria need to produce energy efficiently.

- 3. Protect your mitochondria every day** — Your mitochondria produce the ATP that powers nearly every process inside your body. Help them work efficiently by avoiding **seed oils**, choosing traditional fats such as grass fed butter, ghee, or tallow instead, getting regular movement, and eating enough protein.

Aim for about 0.6 to 0.8 grams per pound (or 1.32 to 1.76 grams per kilogram) of ideal body weight, with one-third coming from [collagen-rich sources](#) like slow-cooked meats or bone broth. Those building blocks support the repair and maintenance processes that healthy cells perform continuously.

- 4. Support your natural daily rhythm** — Your cells follow an internal clock, and sirtuins are wired directly into it. SIRT1 helps run the molecular machinery that keeps your circadian rhythm on time, and that rhythm in turn governs the daily rise and fall of NAD+. Spend time outdoors in morning sunlight to set that clock, then reduce bright artificial light after sunset.

If you still consume significant amounts of seed oils and other sources of [linoleic acid](#) (LA), avoid intense midday sun exposure (10 a.m. to 4 p.m.) until you have reduced those foods for at least six months. This is because LA is a polyunsaturated fat that oxidizes easily, builds up in your skin, and increases your risk of skin damage. Healthy light exposure supports cellular energy production and helps reinforce many of the biological pathways that interact with metabolism and healthy aging.

Just as important, protect your sleep itself: aim for high-quality sleep on a consistent schedule. Deep sleep is when much of your cellular repair and mitochondrial housekeeping happens, and it's when your NAD+ recycling system does its most important work.

- 5. Build resilience through consistent movement instead of longevity shortcuts** — If you're mostly sedentary, begin with daily walking and gradually add resistance training twice a week that matches your fitness level. Exercise encourages your cells to become stronger and more efficient over time. Rather than depending on one "anti-aging" product, make consistency your goal.

Every healthy meal, every walk, every workout, and every good night's sleep helps create the environment your sirtuins, mitochondria, and NAD+ recycling system need to support healthy aging.

FAQs About Sirtuins, Aging, and Longevity

Q: What are sirtuins, and why are they important?

A: Sirtuins are a family of proteins your body naturally produces that help regulate how your cells create energy, repair DNA, respond to stress, and maintain healthy tissues. Because they rely on NAD⁺ to function, they connect your body's energy status with many of the biological processes that influence healthy aging.

Q: Do all sirtuins perform the same job?

A: No. Humans have seven different sirtuins, and each one has specialized responsibilities. Some help maintain your DNA, while others work inside your mitochondria to support energy production or regulate metabolism. Scientists now recognize that healthy aging depends on all of these systems working together rather than on one "longevity protein."

Q: Why does NAD⁺ matter for healthy aging?

A: NAD⁺ serves as the fuel that allows sirtuins to work. As you grow older, NAD⁺ levels naturally decline and are depleted more quickly when your body repairs DNA or responds to chronic inflammation. Supporting your body's ability to recycle NAD⁺ helps maintain the cellular processes that promote healthy aging.

Q: What daily habits help support healthy sirtuin activity?

A: The most effective approach focuses on strengthening your cellular energy system. Eating enough minimally processed carbohydrates, protecting your mitochondria, maintaining regular physical activity, getting morning sunlight, and

supporting healthy NAD⁺ production all create an environment where sirtuins function more efficiently.

Q: Are longevity supplements enough to activate sirtuins?

A: No. Current research shows that healthy aging is far more complex than taking a single supplement. While scientists continue to study NAD⁺ precursors and other compounds, the strongest foundation remains healthy lifestyle habits that support cellular energy production, mitochondrial function, and your body's natural repair systems.

This article is for informational purposes only and does not constitute medical advice. Sirtuins, NAD⁺ precursors, and related supplements are not a treatment for any disease. Consult a qualified health care provider before making changes to your health regimen.

Sources and References

- ^{1, 2} [News Medical May 12, 2026](#)
- ³ [Aging 5\(3\); 144-150](#)