**Headline:** Can You Reset Your Biological Age to Live a Longer, Healthier Life?

**Teaser:** Biological age may really just be a number.

By Leslie Alan Horvitz

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**[Article Body:]**

Biological (or epigenetic) age is arguably more important than chronological age. But what happens if your cells are aging faster than the calendar says? Can you reset your biological age and live a longer, healthier life? Science may offer the answers.

We are not necessarily as old as we look. That’s because many scientists don’t measure “age” chronologically. Our cells may age at a slower or faster rate than our age as marked by the calendar. Chronological age refers to the actual time a person has been alive. Biological age is a more amorphous concept that considers an individual’s physical health, functionality, and molecular profiling, which can be influenced by genetics, lifestyle, and diet. However, as measured by biological or [epigenetic clocks](https://clockfoundation.org/science/), age may have a much more significant role in governing how long we live and how healthy we remain as the years pass.

Our [epigenetic clocks](https://clockfoundation.org/science/) begin ticking before we emerge from the womb. They appear soon after the embryonic stem cell stage and continue uninterrupted until the day we die. The clock ticks faster or slower, depending on the wear and tear we experience. “Aging is [an unintended consequence of processes](https://clockfoundation.org/science/) necessary for the development of the organism and tissue homeostasis thereafter,” according to the Clock Foundation, a nonprofit working to speed the availability of treatments that help improve health and life expectancy. That concept implies that while we can tinker around the edges (don’t smoke—or quit smoking if you’ve picked up this harmful habit), aging is an irrevocable part of being human, and there’s not much you can do about it. Other experts beg to differ, claiming that aging can be considered a disease.

Is aging a disease? Or is it a risk factor for what is usually referred to as [age-related diseases](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6779524/)? The World Health Organization (WHO) now [recognizes](https://www.kumc.edu/communications/about/publications/kansas-medicine-and-science/fall-winter-2024/should-aging-be-a-disease.html) aging as a disease. We’re not just talking about semantics. How we regard a disease—separate from or integral to aging—will guide scientists searching for new therapies to address it, such as preventing cancer and heart disease. We must be careful here, though. Many diseases are caused by factors other than age, and it becomes more difficult to correlate a particular disease with biological age.

**Environmental Health Factors**

Since the advent of antibiotics, vaccinations, and significant advancements in public hygiene, the primary determinants of morbidity and mortality have shifted toward age and sustained exposure to environmental elements—like [pollutants](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10472068/)—often interacting with genetic predispositions. With the [average lifespan on the rise](https://www.cdc.gov/nchs/pressroom/nchs_press_releases/2023/20231129.htm), chronic illnesses, notably neurological disorders, are burgeoning alongside associated costs.

Unlike the acute impact of infectious diseases or accidents, the detrimental consequences of aging and environmental hazards manifest gradually over extended periods. An intriguing theory posits that [environmental influences might expedite biological aging](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8023055/), a notion bolstered by findings showing that dietary restrictions, known to prolong “[health span](https://publichealth.wustl.edu/heatlhspan-is-more-important-than-lifespan-so-why-dont-more-people-know-about-it/)” (the period of your life when you’re healthy), can mitigate the adverse effects of environmental stressors.

“[B]oth age and environmental risk factors are associated with the accumulation of somatic mutations in mitotic cells and epigenetic modifications that are a measure of ‘biological age,’ a better predictor of age-related morbidity and mortality than chronological age,” wrote Pablo Knobel, Rachel Litke, and Charles V. Mobbs, scientists at the Icahn School of Medicine at Mount Sinai in New York, in a 2022 [study](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9813958/) about how environmental risk factors impact neurological conditions.

The researchers delved into the notion that environmental hazards like smoking and air pollution may exacerbate neurological disorders like Alzheimer’s disease by hastening biological aging through persistent epigenetic changes. Understanding these mechanisms holds promise for devising interventions to stave off the harmful impacts of aging and environmental exposures.

**Epigenetic Clock**

The epigenetic clock has proven fairly reliable as a [predictor of functional decline and age-related diseases](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9373966/). Biological age is associated with a [range of common illnesses](https://www.nm.org/healthbeat/medical-advances/science-and-research/What-is-Your-Actual-Age#:~:text=aging%2Drelated%20diseases.-,Aging%2DRelated%20Diseases,Pulmonary%20fibrosis), including lung disease, chronic bronchitis, pulmonary fibrosis, diabetes, cancer, cardiovascular disease, kidney disease, fatty liver, respiratory function, dementia, and Alzheimer’s disease.

How we age differs from individual to individual. Part of the aging process is genes. Yet, another part of it is epigenetics. That is, it is based on environmental influences: what we eat, how much (or how little) alcohol we consume, whether we smoke or not, what kind of environment we are exposed to (how much pollution is in the air and water, for example), and who we spend time with. Many scientists are optimistic that we will soon see remarkable advances in this field.

Scientists have been studying specific [biomarkers](https://www.feinberg.northwestern.edu/sites/longevity/centers/human-longevity-lab.html) that indicate the rate at which we age or—the functional capability of a person or organ and how they each change with age. Biomarkers aren’t new; scientists have known about them since the 1980s.

These biomarkers (or aging markers) are [divided into two types](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6779524/): histology-based data—histology is the study of microscopic structures—(including chemical changes to DNA, which is called methylation) and clinical biomarkers obtained from blood chemistry, anthropometry (physical measurement), and organ function test measurements.

Still, we aren’t sure about the relationship between chronological and biological age. As much as scientists are learning how epidemiology affects the aging process, they can’t [explain or reveal the underlying mechanism of epigenetic aging](https://clockfoundation.org/science/). That’s another way of saying that we may have to wait a while before we can prescribe a drug that will reset the epigenetic clock and give us more—and healthier—years of life. That’s why such importance is attached to health span.

**DNA Methylation: The Number One Biomarker**

Methylation refers to the vital actions that govern how our genes change when our cells replicate and repair (something they’re doing all the time). [Methylation is a process involved in epigenetics](https://www.nm.org/healthbeat/medical-advances/science-and-research/What-is-Your-Actual-Age#:~:text=DNA%20methylation%20can%20also%20be,Vaughan.)—how the environment and lifestyle affect your genes. DNA methylation turns genes on and off—like a light switch. (More technically, compounds or [chemical tags](https://www.genome.gov/genetics-glossary/Methylation) called [methyl groups](https://www.sciencedirect.com/topics/medicine-and-dentistry/methyl-group) attach to some DNA molecules as we age, turning them on and off).

The higher the proportion of methylated DNA in specific locations in the body (cells, tissues, and organs), the greater the acceleration of the aging process. That’s why methylation is crucial in determining how our cells are aging. Smoking can ramp up methylation. “Tens of thousands of locations gain methylation when you smoke,” [says](https://www.npr.org/sections/health-shots/2024/01/29/1226911278/thrive-age-longevity-lab-healthy-aging-live-better-longer) aging researcher [Steve Horvath](https://people.healthsciences.ucla.edu/institution/personnel?personnel_id=45544), according to a January 2024 article in NPR. He developed the [epigenetic clock](https://clockfoundation.org/?gclid=Cj0KCQiAh8OtBhCQARIsAIkWb69jmAHw8FzkjjFQTQ7MBz1scPce-e6MWeHlDBL0KDrbEcvN0bKHbM4aAm6-EALw_wcB) used as part of the GrimAge test—“[a form of DNA methylation age predictor](https://liveforever.club/blog/clock-foundation-s-grimage-biological-age-test-review).” (Horvath’s GrimAge Test is named after the Grim Reaper. Other tests, like [myDNAge](https://www.mydnage.com/about), are based on Hovarth’s work.) Obesity can also increase methylation.

“Conversely, if you eat vegetables, if you are lean, if you exercise, that slows methylation age,” Horvath [adds](https://www.npr.org/sections/health-shots/2024/01/29/1226911278/thrive-age-longevity-lab-healthy-aging-live-better-longer), [pointing out](https://www.npr.org/sections/health-shots/2024/02/05/1228753141/biological-age-test-dna) that we can “use methylation to measure time in all cells that contain DNA.” However, some changes due to methylation can be positive—especially during pregnancy. Adequate methylation is critical for fertility and the developing embryo and could decrease infertility and pregnancy loss seen in women with endometriosis.

According to Dr. Douglas Vaughan, director of the Potocsnak Longevity Institute at Northwestern Medicine, lifestyle changes can reverse methylation. “You can alter your fate with diet and exercise, for example,” he [says](https://www.nm.org/healthbeat/medical-advances/science-and-research/What-is-Your-Actual-Age). Dr. Vaughan adds that the reversal can occur relatively quickly in experimental animal models and possibly in people. That’s the good news.

Will there be an anti-aging pill or some other magical elixir or treatment that will spare us the need for dieting and exercising? If that occurs, it’s still in the future. The problem is that before we can intervene, we need to know the location of the relevant targets in the body—and we don’t yet.

In short, methylation is a [reliable way to predict lifespan and health span](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6366976/). That’s what makes it such an important biomarker of aging. It is, in fact, the “[first accurate multi-tissue biomarker of aging](https://clockfoundation.org/science/),” which gives us an approximate age for multiple tissues and organs in human beings.

**Telomeres**

Another biomarker is perhaps better known—telomeres. They sit at the ends of the chromosomes—the structures that carry your DNA. (DNA is usually likened to a blueprint for the cells.) The telomeres are groups of molecules called nucleotides that provide a cushion for the chromosomes, preventing them from deterioration.

However, as we age, our cells continue to divide and the telomeres get shorter. The shorter the telomeres, researchers believe, the more likely we are to die early or develop a serious illness. There is a disorder called [short telomere syndromes](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6035054/) (STS), which causes those who have the genetic mutation to age rapidly.

**DNA Damage**

[Research published in Nature Genetics](https://www.pressrundown.com/health/dna-damage-likely-causes-aging) in January 2023 indicates that DNA damage may be a vital factor in aging. Researchers at Erasmus University Medical Center in the Netherlands focused on an enzyme—RNA polymerase II—which transcribes DNA into RNA. This enzyme acts like a diligent secretary, taking dictation from the boss and conveying the message to the employees. If the process stalls, however, as it did in the mice the researchers were studying, it can disrupt gene expression and cellular pathways essential for vital functions that include “nutrient sensing, energy metabolism, immune function, and cellular damage repair, all known to be affected by aging,” [according](https://www.pressrundown.com/) to the Press Rundown.

Accumulated DNA damage is believed to be the culprit responsible for this stalling. Mice that lacked smooth-functioning DNA repair machinery showed signs of premature aging and had significantly shortened lifespans compared to healthy mice. These findings aren’t likely to yield any therapeutic interventions, but they shed light on the link between DNA damage and aging.

**Aging May Depend on Your Zip Code and Health Status**

The epigenetic clock doesn’t just differ from one individual to another. It can also vary from [one community to another](https://www.npr.org/sections/health-shots/2024/01/29/1226911278/thrive-age-longevity-lab-healthy-aging-live-better-longer), even changing through different parts of a city. Northwestern Medicine’s Vaughan, for instance, noted that because of a distinct genetic variant, an Amish population in Indiana had protection against diabetes and cardiovascular disease that was lacking in other people living nearby. In laboratory experiments, Vaughan increased the lifespans of mice nearly fourfold with an engineered protein associated with this variant.

“This was a eureka moment,” Vaughan [tells](https://www.npr.org/sections/health-shots/2024/01/29/1226911278/thrive-age-longevity-lab-healthy-aging-live-better-longer) Allison Aubrey, food and health correspondent for NPR. Meanwhile, in south Chicago, a more impoverished area, life expectancy was 55, whereas, in a wealthier neighborhood closer to Lake Michigan, it was as high as 92.

Other dramatic disparities have been identified in people with HIV, who tend to age at an accelerated rate. A [study](https://news.ki.se/most-accurate-test-to-date-developed-to-measure-biological-aging) conducted by researchers at Sweden’s Karolinska Institute of more than 400 patients with chronic kidney disease examined their blood biomarkers, skin autofluorescence, and epigenetic clocks. They found their biological clocks ticking faster than the average person’s, even after dialysis treatment. Biological clocks did slow down for those who received kidney transplants.

Whether more equality in lifespan can be established may depend on the ability to slow down the rate of aging in disadvantaged or ill populations. “I don’t know exactly what that’s going to be. It might be a drug. It might be a lifestyle intervention; for all I know, it might be gene editing,” Vaughan [says](https://www.npr.org/sections/health-shots/2024/01/29/1226911278/thrive-age-longevity-lab-healthy-aging-live-better-longer).

**Testing to Find Your Biological Age**

Anyone can [order](https://www.npr.org/sections/health-shots/2024/02/05/1228753141/biological-age-test-dna) a test to measure their biological clocks. The only problem is that the results can be unreliable. No definitive test is available as yet. Another issue is what to do with the results once you’ve got them.

Some of these tests assess age-related biomarkers in blood or saliva; others determine the presence of chemicals that affect how genes are expressed; and still others measure telomeres. Some companies offer blood tests to measure cholesterol or hemoglobin A1C, a marker for diabetes. Generally, the number of these markers goes up the older we are. That means a 45-year-old with a cholesterol level closer to an average 50-year-old may have a biological age older than 45.

[Several companies sell tests](https://www.npr.org/sections/health-shots/2024/02/05/1228753141/biological-age-test-dna) ranging from $75 to $500 that analyze blood or saliva and compare changes in your epigenome to population averages. Results from the [at-home tests](https://fortune.com/well/2023/02/09/what-is-my-biological-age/), most often available after two to six weeks, typically include information regarding metabolic health, genetics, and other risk factors for age-related diseases. However, as Fortune wellness reporter L’Oreal Thompson Payton [writes](https://fortune.com/well/2023/02/09/what-is-my-biological-age/), since “the tests aren’t independently evaluated, accuracy may vary across racial and ethnic groups.”

There are many [home tests](https://www.townandcountrymag.com/style/beauty-products/a44304697/biological-age-tests-explained/), including [Tally Health](https://tallyhealth.com/), [Elysium](https://www.elysiumhealth.com/products/index?cjdata=MXxOfDB8WXww&utm_source=cj&utm_medium=p-cpc&utm_campaign), and [Novos](https://novoslabs.com/product/novos-age/). Tally Health, co-founded by Harvard longevity researcher David Sinclair, relies on a cheek swab to assess DNA methylation (the most accurate indicator of biological age) and then recommends an action plan that includes intensifying exercise, taking supplements, and increasing the amount of fruit you should eat.

Tally’s membership program provides users with the option to monitor their progress every three months. Tally’s test shows that women tend to “have an edge.” “Women age more slowly as measured by epigenetic clocks like Tally’s,” [says](https://www.townandcountrymag.com/style/beauty-products/a44304697/biological-age-tests-explained/) Tally Health vice president and head of R&D Dr. Trinna Cuellar, “and we have a longer life expectancy,” [states](https://www.townandcountrymag.com/style/beauty-products/a44304697/biological-age-tests-explained/) an article in Town and Country, quoting Cuellar. TruDiagnostic is one of the most [widely used](https://www.businessinsider.com/biological-age-test-calculation-interpret-results-2024-2#) direct-to-consumer biological age tests, but the cost is high—$500—and its findings are based on dried blood samples.

The [GrimAge test](https://pubmed.ncbi.nlm.nih.gov/30669119/) is among the best-known tests to predict lifespan and health span. However, even the GrimAge test can’t be considered definitive; instead, it is useful only as a predictor of life expectancy based on the individual’s state of health and lifestyle.

These tests have mostly been met with skepticism from researchers. “Next-generation DNA methylation measures of biological aging developed to predict mortality risk and physiological decline are more predictive of morbidity and mortality than the original epigenetic clocks developed to predict chronological age,” [says](https://pubmed.ncbi.nlm.nih.gov/35181865/) Daniel Belsky, an associate professor of epidemiology at Columbia University, who [developed an epigenetic clock](https://elifesciences.org/articles/73420). For his part, Vaughan believes the scores from these tests may be [helpful](https://www.npr.org/sections/health-shots/2024/02/05/1228753141/biological-age-test-dna) when combined with other measurements, such as blood sugar levels.

**Resetting the Clock**

Metformin is the [most prescribed](https://pubmed.ncbi.nlm.nih.gov/28776081) oral hypoglycemic medication for type 2 diabetes worldwide. But it has also been promoted as an [age retardant](https://clockfoundation.org/science/) and a preventative medicine for such age-related diseases as cancer and neurodegenerative diseases like Alzheimer’s.

“In the early 2000s, studies at the National Institutes of Health determined that metformin extends the lifespan and health span in laboratory mice,” states a 2019 [study](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6779524/) published in Trends in Endocrinology and Metabolism. The study also showed that female mice benefited more than males. But metformin was no magic elixir; it failed to extend the longevity of fruit flies or rats.

However, its disparate effects are still being determined, and the dosage has yet to be optimized for each organism to maximize lifespan extension. Moreover, not all those who are prescribed metformin have benefited in terms of aging, and some have experienced side effects.

Before metformin becomes a mainstream therapy for anti-aging, a more granular understanding of its effects on humans is needed. [Research is continuing](https://fortune.com/well/2023/02/09/what-is-my-biological-age/) to explore ways to reverse aging beyond metformin. One [study](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6612014/) of obese African Americans with vitamin D deficiency found that participants were able to reverse their biological age by almost two years in 16 weeks with a supplement regimen.

In an eight-week [clinical trial](https://www.aging-us.com/article/202913/text) conducted with adults between 50 and 72 years, researchers determined that biological age could be reversed over three years by using a treatment that included diet (low glycemic fruits, eggs, and liver), at least seven hours of sleep a night, exercise (30 minutes a day for five days a week), meditation and breathing exercises, and supplemental probiotics and nutrients. Cumin, turmeric, green tea, and mushrooms were also included in the recommended diet. The trial was conducted by Kara Fitzgerald, author of [*Younger You: Reduce Your Bio Age and Live Longer, Better*](https://www.hachettebookgroup.com/titles/kara-n-fitzgerald-nd/younger-you/9780306924859/?lens=hachette-go), and her team.

“Every piece in our intervention [in the clinical trial] was designed based on what favorably influenced DNA methylation [how methyl groups interact with our DNA] and epigenetics,” [says](https://fortune.com/well/2023/02/09/what-is-my-biological-age/) Fitzgerald. “The whole program was built brick by brick to sweet-talk gene expression and turn off bad genes, like genes associated with cancer or even inflammation, and turn on good ones.” She recommends that people begin adopting changes in their diet and lifestyle in their 30s before aging changes really “kick in.”

But whether you’re young or old, current research suggests that when it comes to resetting the biological clock, it’s never too late to start.