Health & Medicine

Can You Slow the Pace of Aging?

A new tool reveals the triggers that drive age-related cellular deterioration, from diet to metal exposure.

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Time is not a friend to the human body. And the true ravages of age, beneath the wrinkles and gray hair, occur at the molecular level, inside our cells, which become progressively less adept at absorbing and processing nutrients, clearing out waste materials, replicating themselves, and preserving the integrity of their DNA as the years march on. Many scientists believe that slowing down the pace of our cellular deterioration is a key to preventing nearly all chronic diseases, from cancer

to heart disease to dementia.

But biology is messy and complex, and there are countless factors that may influence our cellular health. Which are the most important? Daniel Belsky, a Columbia epidemiologist at the Mailman School of Public Health, may have some answers. Belsky is at the forefront of a new type of aging research called "geroscience," and he has created an analytical tool that allows researchers to quickly determine the pace at which a person is aging with just a single blood test.

Recent breakthroughs in molecular biology have revealed that our cells contain chemical signatures that indicate how much wear and tear they have endured. Belsky's tool interprets these signatures, which are made of millions of tiny particles that accumulate on our cells' DNA over time, and generates an easy-to-read, highly accurate assessment of how quickly a person is aging. This has enabled Belsky and other scientists to evaluate how various behavioral and environmental risk factors influence our health at the most fundamental level. "Traditionally, public-health researchers have sought to link risk factors to specific disease outcomes, but it's also important for us to identify factors that affect the basic biology of aging, and hence people's overall susceptibility to disease," says Belsky. "That's always been the holy grail of aging research, but until recently we didn't have the scientific knowledge or technological capabilities to do it."

Belsky's tool, which he developed with colleagues at Duke University and the University of Otago, is based on analysis of physiological data collected from more than one thousand people who have participated for decades in a landmark longitudinal study in Dunedin, New Zealand. It's called DunedinPACE, for "Pace of Aging Calculated from the Epigenome."

Since rolling out the tool in 2022, Belsky and his colleagues have used it to make a number of important discoveries. Their studies have validated past research — confirming that smoking and obesity accelerate aging, for example — while also venturing into new territory. Scientists at other institutions have also adopted DunedinPACE, broadening its impact. Here are some highlights of what they've learned so far.

Low-cal diets pay off

If you're a healthy middle-aged adult and reduce your caloric intake by a whopping 25 percent — with the cuts coming mainly from unhealthy fats, sugars, and processed foods — you can slow the pace at which your body ages by 2 to 3 percent. That translates into a 10 to 15 percent reduction in your risk of dying early, a benefit similar to that of giving up smoking. Belsky, fellow Mailman School researcher Calen Ryan, and other colleagues made the discovery by conducting a randomized controlled trial in which they analyzed blood samples from 220 healthy men and women who had followed a strict diet for two years. The authors acknowledge that the spartan diet isn't for everyone; they say future studies might investigate whether similar benefits are achievable through intermittent fasting or time-restricted eating.

Schooling correlates with lifespan

In another first-of-its-kind study, published earlier this month, Belsky's team found people who stay in school longer tend to age more slowly and live longer. Every additional two years of education, the researchers found, corresponds to a roughly 10 percent lower risk of early death. They suspect that people who stay in school longer may gain access to higher-quality health-care services as a result of professional success. They may also be better educated about healthy lifestyle habits. "Our findings support the hypothesis that interventions to promote educational attainment will slow the pace of biological aging and promote longevity," says Columbia PhD candidate Gloria Huei-Jong Graf, the study's lead author.

Metal exposure accelerates aging

Numerous research groups at Columbia and beyond have used DunedinPACE to examine how environmental hazards harm disadvantaged groups. One of the latest efforts, led by Mailman School professors Allison Kupsco and Ana Navas-Acien, investigated how American Indian populations are affected by exposure to heavy metals like arsenic, cadmium, and selenium, which have previously been shown to contaminate drinking water supplies on many tribal reservations in the southwestern US. The Columbia scientists found that ingesting these metals has significantly

increased tribal members' pace of aging and that it is a main driver of their elevated risk of heart failure.

Kids' bodies wear down too

Children and adolescents who experience racism and other hardships tend to age faster than their peers, according to several studies that have used DunedinPACE. One investigation by researchers at the University of Texas found that Black children who attend highly segregated and impoverished primary schools display more age-related cellular changes than either Black children in more integrated schools or white children. Another study by researchers at Northwestern University showed that adults who had experienced severe emotional or physical abuse as children aged much faster than they would have otherwise. The researchers controlled for many other variables, such as the participants' socioeconomic status, lifestyle, and health choices, to confidently link the past abuse to their accelerated aging.

Healthy food's hidden benefits

A team of Columbia neurologists led by Yian Gu recently teamed up with Belsky to evaluate how the Mediterranean diet affects people's cellular integrity. They confirmed previous studies that have suggested that the popular eating regimen, which limits red meats, dairy, and highly processed foods, makes people age more slowly. Furthermore, the scientists concluded that this reduced pace of aging helps to explain why people who adhere to the vegetable-heavy, whole foods–based diet are less likely to develop Alzheimer's disease.

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