Your DNA Doesn’t Change. Its Instructions Do: 3 Habits to Edit Your Genetic Risks

7 MIN READ

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New research can pinpoint the exact genes that mutate due to smoking and metabolic syndrome. Here's how to protect your DNA.

The way you age, including your disease risk, is largely **written in your DNA**. Some of that story is set in your genetic code from birth, but the ink's not dry on your aging tale. Certain factors are repeatedly rewritten by your habits and environment, and right now, scientists are learning more about that revision process. While you *can't* change your DNA, it turns out you *can* change many of the factors that impact how your DNA behaves.

That behavior is shaped, in part, by a process called DNA methylation. When methylation occurs, and sometimes when it doesn't, your epigenetics — the way your genes are expressed — can change over time. Depending on how and whether your DNA methylates, your genes can be switched on and off, ultimately producing (or *not* producing) proteins that affect aging, inflammation, disease risk, and more.

"Some of it remains very stable, and won't be altered no matter what you do," says Joanne Ryan, PhD, a professor of Monash University in Melbourne, Australia, where she studies the epigenetics of aging. "Other areas do fluctuate, and do change."

Thanks to strides in research, scientists are now better able to pinpoint exactly which gene markers change as a result of our habits and environments: for instance, when we eat certain foods, exercise, or are exposed to certain environmental factors like air pollution or noise.Crucially, **a study** published earlier this month in the *Journal of the American College of Cardiology* (JACC), found that gene expression was especially impacted by cumulative exposure to smoking and cardiometabolic dysregulation, the latter being an umbrella for a handful of risk factors that are also

called “metabolic syndrome.”

Those same researchers identified DNA methylation sites tied to increased atherosclerosis, a chronic arterial condition marked by hardening of the arteriesthat **underlies half of all deaths** in Western society. The finding could someday help scientists move closer to diagnostic tools that say how each of your individual organs, like the heart, are aging.

How does DNA methylation impact you *right now*? To find out why methylation matters, what makes this new finding significant, and what you can do about it — including whether or not you should get your methylation tested — we spoke with Ryan and two other experts:

- **Joanne Ryan, PhD**, a professor of Monash University in Melbourne, Australia, who studies the epigenetics of aging
- **David Furman, PhD**, a professor at the Buck Institute for Research on Aging, who studies the measuring of aging markers
- **Kara Fitzgerald, ND,** a doctor and researcher, who has studied methylation and lifestyle change

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What the New Study Says About DNA Methylation

For the JACC study, scientists looked at blood samples drawn from arteries in the necks, limbs, and hearts of almost 3,700 people. They then checked for methylation markers found in around 768,000 CpG sites on their DNA.

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Certain specific methylation markers kept popping up in people with atherosclerosis, and 90 percent of them were attributable to ordinary cardiovascular risk factors — especially smoking and metabolic syndrome. In the case of smoking, the matches between methylation of a gene marker called AHRR were especially strong.

“This is probably the best evidence we have of an environmental factor that modifies our DNA methylation, and that’s for smoking,” Ryan says. Using this gene marker, “I could take your blood, measure the methylation of this gene, and I could say to you, ‘I know how much you’ve smoked in your lifetime,’” he explains.

When the specific DNA markers tied to atherosclerosis were methylated in a certain pattern, the markers were able to predict — retrospectively — whether the people who were tested had heart attacks or strokes.

“Those changes over a lifetime appear to be captured. That’s what’s suggested in this paper. And what’s incredible is that they’re not just random changes,” Fitzgerald says. “It’s like an archaeological dig into the cardiovascular system that will also likely be able to predict future events.”

What is DNA Methylation, Anyway?

The mechanics of methylation is where things get more advanced. Your DNA is

dotted with groups of molecules made up of three hydrogen atoms and one carbon atom. These are called methyl groups. When one of these groups attaches to certain areas of DNA in your cells, the genes attached to that area can either be expressed or inhibited — that is, the genes are turned "on" or "off." This attachment of the methyl group to the receptor area of the DNA strand is called "DNA methylation." And the "on" or "off" expression of your genes is called epigenetics.

More methylation isn't always good, and less methylation isn't always bad — nor is the reverse true. Instead, specific methylation *patterns* are associated with different disease outcomes, and with aging more generally.

Methylation happens individually in cells, Ryan explains. But when a bunch of the same type of methylation happens in a group of cells in the same area or organ, the percentage of methylation in that area increases, creating a methylation pattern at a specific site. Particular patterns at certain sites **have been linked** with increased risks of certain cancers, arthritis, dementia, or in the case of this new study, atherosclerosis.

How Does DNA Methylation Predict Biological Aging?

These patterns of DNA methylations are what power many of the "biological age" clocks that are available. These clocks, like the **DunedinPACE clock**, **GrimAge clock**, and **Horvath's clock**, use DNA methylation patterns to create a pace of aging measurement, and tell you your "true age."

That said, these clocks have a notable shortcoming: They're not usually able to tell you what caused those patterns, says Furman. "They don't give you immediate understanding of where to intervene, or how to intervene," he says. "You don't know how to change the epigenetic markers in your DNA."

He adds that they also serve as a single snapshot of your methylation patterns, but these patterns are dynamic, often changing throughout the course of a single day.

“Our body is constantly responding to environmental factors. So it makes sense that when we eat something and our gut needs to process that into food, then there are genes that are turned on because we need them at that period of time. And when we stop processing the food, they turn off,” she says. It’s the same for exercise and other acute stressors, too.

3 Ways to Improve Your DNA Methylation Right Now

Someday soon, “age clocks” could become organ- and tissue-specific, Furman says. These will let clinicians know that one of your organs, like your brain, is aging well, but another, like your liver, isn’t. As a result, they’ll have more information about how to combat the aging in that organ.

Right now, this type of organ-specific detail isn’t ready for primetime. But thankfully, you don’t need to know your exact methylation patterns to know if you’ve been smoking, or if you’re suffering from metabolic syndrome. Now knowing that these are significant risk factors, you can go straight to the source and change them. Conveniently, the habits that improve DNA methylation patterns align with familiar guidelines for living well, Fitzgerald says.

Kick tobacco to the curb: Quitting smoking is the single best way to improve your outcomes. **One study** found that smokers were “differentially methylated for more than 10 years after smoking cessation,” but that quitting did in fact reverse the effects. “In ex-smokers who had stopped smoking more than 10 years ago, the degree of methylation for some of the loci was still lower than in study participants who had never smoked,” those researchers wrote.

Get moving: Exercise, too, helps improve methylation patterns. Strength training **has been shown** to improve epigenetic markers in skeletal muscles, and **low-impact exercise** — like tai chi — has been shown to reduce methylation patterns associated with aging.

Eat well: Fitzgerald has conducted studies on methylation-improving diets, and they’re in keeping — for the most part — with diet patterns already associated with

longevity. “Our diet and lifestyle program is very much in alignment with a Mediterranean diet,” she says, recommending less red meat, more whole grains, and leafy green vegetables.

However, Fitzgerald notes that a methylation-targeting diet her team devised includes a greater focus on **polyphenols**, antioxidant compounds found in plants, like leafy greens, that fight inflammation and have been associated with lower risks of chronic diseases such as cancer. The plan includes 3-4 cups of green tea per day, and a shake with 800 mg of polyphenols.

In a 2023 study, people who ate this diet reduced their biological age by 4.7 years in eight weeks, and saw more improvements in epigenetic markers than others who ate the “normal” Mediterranean diet. Fitzgerald says they’ll have more specific data soon: Right now, she and her colleagues have a genome-wide study in peer review that shows specific marker changes.

Bottom Line: Should You Get a DNA Methylation “Aging Clock” Test?

Our experts are mixed on this one, but all agree that the test isn’t a must. And Furman is against these clocks for the common Super Ager.

Besides not telling you what can be done to intervene, “precision is poor,” he says. “So when you test today and you test tomorrow, or you’re suffering from flu or COVID, or someone’s pregnant, or even simply the fact that you’re testing things during the day, you can change your epigenetic age by 10 or 15 years.”

Fitzgerald says that for some people, the clocks can be a helpful add-on option to normal care. If you’re interested, and want to learn more about, for example, cancer risk, she believes the answers can be helpful.

Ryan, who studies these clocks, hasn’t had one done on herself. Like Furman, she says that the fluctuations during the day could leave some skepticism about the “real age” you receive in the results. But for some, she suggests, getting a disappointing “real

age” could be a motivating catalyst to help someone dial in their nutrition or exercise. If you opt for one, she says, the latest versions of the DunedinPACE and GrimAge clocks show the most consistent signals in studies.

But regardless of the data you collect, your best bet for a better outcome is to focus on the known factors that impact methylation: smoking, diet, and exercise. By targeting the factors we know improve health broadly and methylation specifically, you can start taking control of your genetic risks — even if you can’t change your DNA itself.

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