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Too Much Stress May Give Genes Gray Hair

By BENEDICT CAREY

Some stressful events seem to turn a person's hair gray overnight.

Now a team of researchers has found that severe emotional distress - like that caused by divorce, the loss of a job, or caring for an ill child or parent - may speed up the aging of the body's cells at the genetic level.

The findings, being reported today, are the first to link psychological stress so directly to biological age.

The researchers found that blood cells from women who had spent many years caring for a disabled child were, genetically, about a decade older than those from peers who had much less caretaking experience. The study, which appears in Proceedings of the National Academy of Sciences, also suggests that the perception of being stressed can add years to a person's biological age.

Though doctors have linked chronic psychological stress to weakened immune function and an increased risk of catching colds, among other things, they are still trying to understand how tension damages or weakens tissue.

The new research suggests a new way that such damage may occur and opens the possibility that the process can be reversed.

"This is a new and significant finding," said Dr. Bruce McEwen, director of the neuroendocrinology laboratory at Rockefeller University in New York.

He said the research provided some of the clearest evidence yet "of the price in wear and tear on the tissues that everybody pays during a stressful life."

"And we know as we get older," Dr. McEwen continued, "we have a greater tendency to put on fat, to develop heart disease and diabetes."

In the experiment, Dr. Elissa Epel and Dr. Elizabeth Blackburn of the University of California at San Francisco led a team of researchers who analyzed blood samples from 58 young and middle-aged mothers, 39 of them caring for a child with a chronic disorder like autism or cerebral palsy. Using genetic techniques, the doctors examined the DNA of white blood cells, which are central to the body's immune response to infection.

The scientists focused on a piece of DNA, called the telomere, at the very tip of each cell's chromosomes.

Like the head of a split matchstick, the telomere shrinks each time a cell divides and duplicates itself.

Cells may reproduce themselves many times throughout life to repair and strengthen their host organs, to grow or to fight disease.

A chemical called telomerase helps restore a portion of the telomere with each division.

But after 10 to 50 divisions or so - the number varies by tissue type and health, and biologists still do not understand the system well - the telomere gets so short that the cell is effectively retired and no longer able to replicate.

People born with a genetic disease called dyskeratosis congenita, which causes accelerated shortening of telomeres, die young, usually by middle age, most often as a result of complications from weakened immunity.

Change in telomere length over time, in short, is thought to be a rough measure of a cell's age, its vitality.

And when the researchers compared the DNA of mothers caring for disabled children, they found a striking trend: after correcting for the effects of age, they calculated that the longer the women had taken care of their child, the shorter their telomere length, and the lower their telomerase activity.

Some of the more experienced mothers were years older than their chronological age, as measured by their white blood cells.

"When people are under stress, they look haggard, it's like they age before your eyes, and here's something going on at a molecular level" that reflects that impression, said Dr. Blackburn, a professor of biochemistry and biophysics.

The researchers also gave the women a questionnaire, asking them to rate on a three-point scale how overwhelmed they felt by daily life, and how often they were unable to control the important things in their lives. The women who perceived that they were under heavy stress also had significantly shortened telomeres, compared with those who felt more relaxed - whether they were raising a disabled child or not.

"Some of the women who had a lot of objective, real stress also had a low perceived amount of stress, and the next step is trying to understand what it is that promotes this kind of resilience," said Dr. Epel.

She said the group had plans to test the effect of meditation, mindfulness training and yoga on both perceived stress and telomere length.

A form of counseling called cognitive therapy, in which people learn to temper their responses to stress, could also help, psychologists say.

Personality and upbringing almost certainly account for some of this difference, however. In 2003, researchers who followed some 850 New Zealanders from birth to 26 reported that variations in a single gene helped predict which children would later become susceptible to depression, after stressful events like divorce or unemployment.

Researchers at the National Institutes of Health have shown, in monkeys, that warm and attentive rearing of offspring can protect young animals from precisely this genetic variation, promoting resilience in genetically vulnerable individuals. Cold or abusive rearing, psychiatrists say, can have the opposite effect.

"All of these factors intertwine to make up how a person handles stress," said Dr. Ronald Glaser, director of Ohio State University's Institute for Behavioral Medicine Research, who with his wife, Dr. Janice Kiecolt-Glaser, has documented the effect of stress on immune function. "We now have evidence, from a broad range of fields, from studies of wound healing, of inflammation, of vaccines, and now of cell age that really make the case" that stress can cause real harm.

Experts caution that the telomere study needs to be replicated and that no one has yet shown convincingly that psychological stress significantly shortens people's lives. And it is far from clear exactly how fretting over a child's learning disability, say, can cause a parent's telomeres to shorten before their time. Although researchers know that emotional strain of this kind prompts the release of stress hormones, like cortisol, which over time can damage cells, no one knows how these hormones or other stress-related toxins affect telomeres.

"Right now, that is the black box," said Dr. Blackburn, "and that's what we're going to study next."