UC SANTA BARBARA

THE Current

September 21, 2020
Andrea Estrada

How We Age

It is well understood that mortality rates increase with age. Whether you live in Tokyo, rural Tennessee or the forests of Papua, New Guinea, the older you are, the more likely you are to succumb to any number of different ailments.

But how, exactly, do our bodies weather with age, and to what extent do people around the word experience physiological aging differently?

In a paper published in a special issue of the journal Philosophical Transactions of the Royal Society B, a team of anthropologists that includes Michael Gurven, a professor of anthropology at UC Santa Barbara and chair of the campus's Integrative Anthropological Sciences Unit, and Thomas Kraft, a postdoctoral researcher in the same department, construct and compare a composite measure of "physiological dysregulation" among human populations and other species. The themed issue explores the evolution of aging among primates.

Physiological dysregulation refers to the wearing down of the body's ability to bounce back from stress, damage or other adversity. Examples include how one's body might gradually become less able to properly regulate blood sugar, or it might more likely mount an inappropriate immune response that doesn't dissipate when the threat is gone (thereby damaging the body's own cells). This decline in resilience is often considered fundamental to aging.

"We're only now able to start piecing together what physiological aging looks like holistically in subsistence populations of foragers and farmers," said Kraft, the

paper's lead author. "We first built a comprehensive metric of physiological dysregulation in humans, then compared it to other primates. It's not just the case that adult mortality rates are lower in humans; rates of physiological dysregulation are much slower in humans, too."

For nearly two decades, the Tsimane Health and Life History Project has been collecting a large number of measures of health and aging (referred to as biomarkers) among the Tsimane, an indigenous population of forager-horticulturists in the Bolivian Amazon. These range from the typical measures that might be taken during a regular physical exam — blood pressure, cholesterol and blood glucose level — to indicators such as grip strength, various immune markers for inflammation and bone mineral density.

Overall, the current study includes 40 biomarkers among 5,658 adults spread across 22,115 observations. "This makes it one of the only comprehensive longitudinal studies of health in a population living a vastly different lifestyle than the urban, industrialized countries, where most studies occur," said Kraft.

"While any single biomarker gives a snapshot of just one small part of health, what we did was to combine information from many biomarkers simultaneously — both the levels of these markers and the extent to which they are linked together — into a single metric," he continued. "This summary metric gives a holistic portrait of one's 'biological age,' by measuring how 'strange' one's combined biomarkers are relative to a healthy subset of the population."

Noted Gurven, co-director of the Tsimane Health and Life History Project, "In the U.S. and many other countries today, we're more likely to die of heart disease, cancer, diabetes and other 'chronic diseases of aging.' But among the Tsimane and other populations living similar lifestyles, these chronic diseases are rare. Does physiological dysregulation occur at the same rate in this very different context?"

To answer this question, the team compared Tsimane with other human populations. "Where adult mortality rates are high, we might expect that aging of our bodies occurs more quickly, tracking closely the higher increase in mortality with age," Gurven explained. "Another possibility — and a goal for many of us — is to maintain healthy bodies for as long as we can, and then have everything fall apart close to the eventual timing of our demise."

The researchers found that despite a lifestyle vastly different from that of urban, post-industrialized populations such as those in the United States and Italy, and despite higher mortality rates throughout adulthood, Tsimane adults show only marginally higher rates of increase in physiological dysregulation among the Tsimane.

“Our first glimpse suggests a broad species-typical pattern of physical aging across environments and cultures,” said Gurven. “That’s a little surprising because the Tsimane have very low levels of late-age chronic diseases. But the Tsimane are exposed to harsher conditions, including strenuous labor tending fields, tropical diseases and minimal access to health care.”

Added Kraft, “We also found similarities in physiological dysregulation among Tsimane women and men, despite evidence in many populations showing that men typically age faster and are more likely to die than women at most ages.”

As Gurven noted, it’s impossible to understand dysregulation and aging without knowing how different parts of the body function over time. “And to date, we have had little understanding of what that looked like in a population like the Tsimane,” he said. “Yet the conditions we find ourselves in today, where over half of the global population lives in cities, is just a minor blip in the long history of our species. Groups like the Tsimane offer some of the best insight for our understanding of aging prior to industrialization and urbanization.”

All that being said, the researchers are quick to acknowledge that their index is still just a statistical composite. “It’s not a complex network model showing how everything is related to everything else,” Gurven said. What’s amazing, he added, is that our global estimates of physiological dysregulation don’t change much once the information from roughly 15 biomarkers are integrated.

“Additional biomarkers tell you little, and it may not even matter which biomarkers you look at once you hit about 20. That seems to suggest that we're capturing something about the whole system,” he explained. “And any single biomarker is only weakly correlated with our global index. But we’ll learn much more about what it means and how important it might be once we can link dysregulation to useful outcomes, like functional performance, disease states and the likelihood of dying.”

Additional researchers contributing to the study include Angela Garcia of the Integrative Anthropological Sciences Unit at UC Santa Barbara and the Center for

Evolution and Medicine at Arizona State University; Jonathan Stieglitz of the Institute for Advanced Study in Toulouse, France; Benjamin Trumble of the Center for Evolution and Medicine at Arizona State University; and Hillard Kaplan, a professor in the Economic Science Institute at Chapman University. Stieglitz, Trumble and Kaplan also are co-directors of the Tsimane Health and Life History Project.

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.