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Cranial lesions are signs of compromised immune function

When trying to understand the health of long-past populations, sometimes you have to rely on nothing but the bones. In anthropology, porous cranial lesions (PCLs) — areas of pitting on the roof of the eye socket (called *cribra orbitalia*) and on top of the skull (called *cribra cranii*) — have traditionally been considered tell-tale signs of poor childhood health in past populations, but have rarely been tested.

Today, thanks in large part to advances in technology that allow for high-resolution scans of skulls in contemporary populations, scientists are now able to examine these features in living people with known medical histories, allowing a team of international researchers including UC Santa Barbara Distinguished Professor of Anthropology Michael Gurven to find more concrete links between these cranial lesions, their physiological origins and their downstream effects.

In a study published in the journal Science Advances, Gurven and lead author University of Colorado, Boulder anthropologist and UCSB alum Amy Anderson, along with an international group of collaborators examined the cranial tomography scans of adults from the Tsimané tribe, a population of Indigenous farmer-foragers who live in the jungle lowlands of Bolivia. They found evidence that people with cranial lesions show compromised immune function.

“It has been widely assumed that these cranial lesions suggest a childhood of chronic anemia and other indications of lifelong sickness and malnutrition,” said

Gurven. And indeed, countless studies refer to these features to paint a picture of what life and health were like for ancient peoples. “These skeletal lesions are almost never reported by contemporary clinical radiologists,” added Anderson. “So are PCLs just a thing of the past? Are they meaningfully connected to any clinical symptoms? Or might they be an overlooked indicator of poor health even in contemporary populations?”

Bridging past and present

While there is consensus on the idea that cribra orbitalia and cribra cranii develop in childhood, opinion remains divided on their meaning for the medical history or health prospects of adults who have these lesions. Furthermore, investigating historical population health by way of stress markers on bones has its limitations: Skeletal lesions might not be a sign of the severity or prevalence of illness in a population but rather an indication that the individuals have managed to survive these diseases in their lifetimes. Because alternatively, people could die of diseases before lesions could manifest on the bones.

The team’s research finds a way around these obstacles by examining CT scans of the skulls of 375 living Tsimané adults, data that were gathered as part of previous, separate studies of heart and brain health.

“We were able to use those CT scans of living people to see whether they have cranial lesions, and whether those lesions are associated with a wealth of biomarkers we’ve measured over the years,” said Gurven, who also co-leads the Tsimané Health and Life History Project. “That alone was a unique opportunity, bridging the study of the past with the present.”

In addition, according to the researchers, the Tsimané in their sample “lived a largely subsistence-oriented lifestyle in a tropical environment, precisely the setting in which the archaeological literature reports a high prevalence of porous cranial lesions.” Furthermore, the population examined has a high prevalence of respiratory and parasitic infections, in addition to childhood anemia — all of which, the researchers say, “have been correlated with PCLs in radiographic studies.”

The researchers were able to find evidence of cribra orbitalia in about 6% of these individuals. After examining these individuals’ medical diagnoses and health metrics from multiple visits by the Tsimane Health and Life History Project team, they report

that these adults tended to be more likely to have received a diagnosis of tuberculosis in the past 20 years. They also had lower populations of naïve CD4 T cells, which are immune cells that activate when encountering new infections.

Additionally, according to the paper, the evidence of cribra cranii could not be associated with any of the health metrics in the study.

“The Tsimané, who inhabit a food-limited and pathogen-rich environment, do show evidence of having these lesions but they don’t seem to be connected to anemia or respiratory infection in adulthood,” Anderson said. “And while we can’t definitively narrow down their causes from a study of adults, we were able to look at the downstream health profiles of folks with those lesions — and we do see that they show evidence of compromised immune function.”

Porous cranial lesions are still with us, and cribra orbitalia shows promise as a skeletal indicator of health challenges. With the imaging technology to see these skeletal lesions in contemporary populations now available, and confirmation that they are associated with lifelong patterns of health, the researchers say, the way is clear for future studies to identify exactly what causes porous cranial lesions — enabling a better understanding of health in past populations, and in the living.

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