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Genetic adaptations helped East African nomadic pastoralists adapt to constant water stress, but urbanization may present an 'evolutionary mismatch'

Eating a diet of almost exclusively animal products and experiencing relentless, chronic dehydration would lead to serious problems for many of us, but not so for the Turkana of northwest Kenya. The nomadic pastoralists, who have lived for millennia in the hot, dry East African landscape, thrive there thanks to genetic adaptations that allow them to live with the heat, minimal water and high-protein diets. But as urbanization spreads and the people move to cities, the switch to a sedentary lifestyle and changes in diet could present an “evolutionary mismatch” that might cause health problems.

“While adaptations to high altitude are textbook examples of how our genes have changed to improve our survival as we spread around the globe, very little work had ever been done until now on how our bodies have adapted to living in dry, water-scarce environments,” said UC Santa Barbara anthropology professor Michael Gurven, part of a research project studying the Turkana that recently published its findings in the journal Science. The effort is led by Vanderbilt University and UC

Berkeley, and supported by the National Institutes of Health.

Gurven should know. In his work with the nonindustrial Tsimané people of lowland Bolivia, he and colleagues have uncovered the tight relationship between the physiological characteristics of the forest forager-farmers, and the environment in which they have lived, with implications for immunity, metabolism and risks of heart disease and dementia. Similarly, other populations have evolved to suit their environments, say the authors, including Tibetans, who live at extremely high altitudes, and Greenlandic Inuit, who have adapted to a high-fat diet. For the Turkana, their adaptations allow them to function normally at a fraction of the water that most of the rest of us would require.

“Hiking in the Loima hills with a few Turkana guys, I realized I had drunk an entire bottle of water before they had even taken their first sip,” recalled Gurven, an author on the new paper.

According to the paper, the Turkana, who originated in the Nile Valley region and began their nomadic pastoralist practices between 5000 to 8000 years ago, are said to have migrated to the drier rift valley of northwest Kenya 200 to 250 years ago. In their whole genome survey of 367 individuals, the researchers found regions of the genome that appear to have recently been selected for their ability to help kidneys concentrate urine and retain water in response to dehydration, as well as playing a role in metabolizing waste from a protein-rich meat-based diet.

The genomic studies complement years of anthropological work in which the researchers documented the lifestyle of the Turkana community via questionnaires, and their health and physiology through blood and urine analysis. Despite chronic dehydration and protein levels that would in other populations cause gout, the Turkana were generally free from adverse effects.

But what makes them hardy to the effects of dehydration and consistently high protein diets might make them vulnerable to urban sedentary living, which provides significantly more water and carbohydrate-rich (often processed) diets. Kenya is rapidly urbanizing, prompting the researchers’ concern that the new lifestyle may be a shock to Turkana physiology.

“Recent changes in the diet and lifestyle of Turkana who now live in towns puts them at greater risk of hypertension, kidney disease and diabetes,” said Gurven.

Members of the research team have developed a communications and outreach plan in order to both inform the community of the study's findings, and to work collaboratively with local health clinics, elders and area chiefs in an effort to help prevent the emergence of non-communicable diseases.

Many of the questions this research addresses were generated during long meetings with the Turkana community, facilitated by the Turkana Health and Genomics Project , a long-term collaboration between Kenyan and U.S.-based researchers.

"I am deeply inspired by the fact that this work places the Turkana and sub-Saharan Africa at the forefront of genomic research, a field where Indigenous populations have historically been underrepresented," said Charles Miano, one of the study's co-authors and a graduate student at the Kenya Medical Research Institute in Nairobi.

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