Understanding extinct microbes may influence the state of modern human health

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The study of ancient microbes may not seem consequential, but such pioneering research at the University of Oklahoma has implications for the state of modern human health. Cecil Lewis, assistant professor in the Department of Anthropology, says results of this research raise questions about the microbes living on and within people.

A National Institutes of Health initiative is looking at helpful bacteria found on the skin, in the esophagus and in the stomach, by characterizing the microbe's collective genomes as an ecosystem. These collective genomes are referred to as "human microbiomes." Appropriately named, NIH refers to this initiative as the "Human Microbiome Project," analogous to the "Human Genome Project," which published the first human genome in 2000.

The Human Microbiome Project has new challenges. The project is more daunting than sequencing one organism because researchers are sequencing trillions of organisms. There are 10 times as many bacteria cells on and within one's body than there are on human body cells. And these bacteria are important. Within the gut, microbes are known to assist in human digestion, improve energy intake, produce vitamins and even help in the development of a healthy immune system.

The NIH Microbiome Project is searching for the "core" human microbiome. In other words, they are trying to determine if there are certain aspects of the ecology that all humans share. Lewis says ancient DNA research can provide an important perspective on this search.

Lewis is one of the few people in the United States that conducts ancient DNA research. One of his primary interests is ancient human microbiomes. According to Lewis, "We've introduced bacteria into our system through foods from around the world. Fruits imported from various parts of the world contribute to the global microbiomes that now inhabit our bodies." Interestingly, ancient microbiome studies provide a view of these ecosystems prior to the modern world economy.

In living people, the gut microbiome is frequently studied using fecal samples. This gave Lewis and his colleagues an idea. To understand the state of microbiomes before the global world economy, they would compare two ancient coprolites, which are old dry or fossilized feces. The coprolites were 1,300 years old from Central Mexico. Researchers performed genetic testing to determine that the two coprolites were from two different people, and then analyzed the microbiomes within the coprolites.

The researchers retrieved ancient DNA evidence for bacteria species similar to that seen in human microbiomes today. The types of bacteria present were typical of the human gut. Lewis and his collaborators were also able to characterize the functional aspects of these extinct microbiomes. Comparing the two ancient samples, they found them to be very similar to one another.

These findings were compared to human microbiomes today. Lewis and colleagues found that the two ancient microbiomes were more similar to each other functionally than a sample of modern microbiomes. They proposed that prehistoric microbiomes were more geographically structured than those found today—a discovery that, if true, would change the way NIH and others look at human microbiomes.

Geographically structured microbiomes have ramifications for human health. Pioneering work on modern microbiomes has shown that certain

bacteria can impact disease and health states, including diabetes and immune systems disorders. In fact, modern medicine may have caused some of these negative impacts. For example, antibiotic treatment of young children is known to increase their risks of developing allergies later in life because their immune system develops improperly. Understanding ancient microbiomes provides a better picture of microbiomes as they coadapted with our ancestors.

The human microbiome effort is relatively new. Lewis considers his findings preliminary, stating that many new challenges are ahead. But this research will be of interest to many, including medical professionals and biologists and the public. "We should be thinking of ourselves as "superorganisms" harboring microbes from around the world. This is much more complicated than just the cells that make up the body. We have more than just our body to nurture to be in good health," says Lewis.

Lewis says that science needs to be better prepared for the moral and ethical consequences of microbiome research. He and his collaborators started a new project considering these consequences. They will continue their study of ancient microbiomes hoping to obtain a better understanding of exactly how these important ecologies change over time and space.

Source: University of Oklahoma