Oral bacteria create a 'fingerprint' in your mouth

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The bacteria in the human mouth – particularly those nestled under the gums – are as powerful as a fingerprint at identifying a person's ethnicity, new research shows.

Scientists identified a total of almost 400 different species of microbes in the mouths of 100 study participants belonging to four ethnic affiliations: non-Hispanic blacks, whites, Chinese and Latinos.

Only 2 percent of bacterial species were present in all individuals – but in different concentrations according to ethnicity – and 8 percent were detected in 90 percent of the participants. Beyond that, researchers found that each ethnic group in the study was represented by a "signature" of shared microbial communities.

"This is the first time it has been shown that ethnicity is a huge

component in determining what you carry in your mouth. We know that our food and oral hygiene habits determine what bacteria can survive and thrive in our mouths, which is why your dentist stresses brushing and flossing. Can your genetic makeup play a similar role? The answer seems to be yes, it can," said Purnima Kumar, associate professor of periodontology at The Ohio State University and senior author of the study.

"No two people were exactly alike. That's truly a fingerprint."

Kumar used a DNA deep sequencing methodology to obtain an unprecedented in-depth view of these microbial communities in their natural setting.

When the scientists trained a machine to classify each assortment of microbes from under the gums according to ethnicity, a given bacterial community predicted an individual's ethnicity with 62 percent accuracy. The classifier identified African Americans according to their microbial signature correctly 100 percent of the time.

The findings could help explain why people in some ethnic groups, especially African Americans and Latinos, are more susceptible than others to develop gum disease. The research also confirms that one type of dental treatment is not appropriate for all, and could contribute to a more personalized approach to care of the mouth.

"The most important point of this paper is discovering that ethnicity-specific oral microbial communities may predispose individuals to future disease," Kumar said. Though it's too soon to change dental practice based on this work, she said the findings show that "there is huge potential to develop chair-side tools to determine a patient's susceptibility to disease."

The research is published in the Oct 23, 2013, issue of the journal *PLOS ONE*.

Kumar and colleagues collected samples of bacteria from the saliva, tooth surfaces and under the gums of the study participants.

More than 60 percent of bacteria in the human mouth have never been classified, named or studied because they won't grow in a laboratory dish, so the researchers identified the different species – or species-level operational taxonomic units – by sequencing their DNA.

The DNA sequences represented 398 units overall, with an average of about 150 different species per person.

Using only the bacteria found under the gums – which are called subgingival microbes – the classifying machine performed best at positively identifying African Americans according to their microbial communities, followed by positive identifications of Latinos at 67 percent and Caucasians at 50 percent – but with 91 percent specificity, meaning the classifier determined how often a sample did not come from a white person 91 percent of the time.

Kumar and colleagues then expanded the selection of total microbes in all areas of the mouth, and identified surrogate communities of bacteria that were present in at least 80 percent of participants of each ethnic group. These communities showed a prediction likelihood of 65 percent for African Americans, 45 percent for Caucasians, 33 percent for Chinese and 47 percent for Latinos.

"Nature appears to win over nurture in shaping these communities," Kumar noted, because African Americans and whites had distinct microbial signatures despite sharing environmental exposures to nutrition and lifestyle over several generations.

Kumar and her colleagues have embarked on a multistudy investigation of the role the body's microbial communities play in preventing oral disease. The group already has determined that smoking disrupts the healthy bacterial community in the oral cavity, giving disease-causing microbes easier access to the mouth.

Multiple diseases of the mouth are caused by bacterial infections, ranging from cavities to oral cancer.

Bacteria live together in communities called biofilms, and it's within that infrastructure that they communicate with each other and with the immune system. A key to overall human health, Kumar said, is keeping those oral biofilms themselves in good health.

Kumar didn't expect ethnicity to produce significant differences in the bacterial collection in the mouth. But the patterns became clear during the DNA analysis.

"The overarching goal here is to say, 'If you're healthy, are biofilms similar between individuals?' We know, in fact, that they are not similar.

"Among healthy people, there is a core group of species everybody seems to have. But then there is personalization. What factors contribute to this personalization? Gender, age, other parts of genetics?"

It did make sense to Kumar that bacteria below the gums are most closely linked to ethnicity identification because they are the least likely to be disrupted by environmental changes in the mouth, such as food, toothpaste and tobacco.

"Bacteria under the gum line are protected but are also the first opportunity your body gets to be educated about the bacteria that hang out in your mouth," she said.

The power of [bacteria](#) in the body remains misunderstood to some extent. Though many people are inclined to blame disease susceptibility on lifestyle and behavior, this work suggests that humans can be predisposed to certain disease risks solely because of the [microbes](#) that set up shop in their mouths.

"We underestimate these bugs and their power to do good and evil to us. As long as we harness their good side, we're healthy," she said.

Exercise, healthful eating, avoiding smoking, brushing and flossing the teeth, preventing diabetes and obesity – all of these factors are in our control, she explained. But when it comes to genetic factors, Kumar said, "It makes you want to ask: 'Am I in charge or not?'"

Provided by The Ohio State University