Women have more diverse hand bacteria than men

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A new University of Colorado at Boulder study indicates that not only do human hands harbor far higher numbers of bacteria species than previously believed, women have a significantly greater diversity of microbes on their palms than men.

The results have implications for better understanding human bacteria and should help establish a "healthy baseline" to detect microbial community differences on individuals that are associated with a wide variety of human diseases, said CU-Boulder Assistant Professor Noah Fierer, lead study author. A paper on the subject by the CU-Boulder researchers was published online Nov. 3 in the *Proceedings of the National Academy of Sciences.*

Using powerful gene sequencing techniques, the team found a typical hand in the new study had roughly 150 different species of bacteria living on it, said Fierer of CU-Boulder's ecology and evolutionary biology department. While the researchers detected and identified more than 4,700 different bacteria species across 102 human hands in the study, only five species were shared among all 51 participants.

"The sheer number of bacteria species detected on the hands of the study participants was a big surprise, and so was the greater diversity of bacteria we found on the hands of women," said Fierer. The study also showed that the diversity of bacteria on individual hands was not significantly affected by regular hand washing, he said.

The 332,000 gene sequences obtained by the CU team were nearly 100 times greater than those obtained from other studies of skin bacteria also obtained by sampling the entire DNA of microbe communities, known as "metagenomics." The new CU-Boulder study also confirms that standard skin culturing of human skin bacteria, a technique used by many labs, dramatically underestimates the full extent of microbial diversity, Fierer said.

Co-authors on the PNAS study included Micah Hamady of CU-Boulder's computer science department, Christian Lauber of CU-Boulder's Cooperative Institute for Research in Environmental Sciences and CU-Boulder chemistry and biochemistry Assistant Professor Rob Knight. The study was funded primarily by the National Institutes of Health and the National Science Foundation.

Fierer speculated that skin pH may play a role in the higher bacterial diversity on women's hands, since men generally have more acidic skin, and other research has shown microbes are less diverse in more acidic environments. The findings also could be due to differences in sweat and oil gland production between men and women, the frequency of moisturizer or cosmetics applications, skin thickness or hormone production, he said.

The right and left palms of the same individual shared an average of only 17 percent of the same bacteria types, said Knight. Study volunteers, all CU undergraduates, shared an average of only 13 percent of bacteria species with each other, he said.

Although the composition of bacterial communities on dominant and non-dominant hands of subjects was significantly different, diversity levels were similar, Fierer said. The differences found between dominant and non-dominant hands were likely due to environmental conditions like oil production, salinity, moisture or variable

environmental surfaces touched by either hand of an individual, he said.

While some groups of bacteria were less abundant following hand washing, others were more abundant, said Knight, who stressed that regular hand washing with anti-bacterial soap is beneficial. "The vast majority of bacteria are non-pathogenic, and some bacteria even protect against the spread of pathogens," Knight said. "From a public health standpoint, regular hand washing has a very positive effect."

"Although hand washing altered community composition, overall levels of bacterial diversity were unrelated to the time since the last hand washing," wrote the researchers in PNAS. "Either the bacterial colonies rapidly re-establish after hand washing, or washing (as practiced by the students included in this study) does not remove the majority of bacteria taxa found on the skin surface."

The CU-Boulder team used the metagenomic survey to simultaneously analyze all of the bacteria on a given palm surface, said Knight. In simple terms, the effort involved isolating and amplifying tiny bits of microbial DNA, then building complementary DNA strands with a high-powered sequencing machine that allowed the team to identify different families, genera and species of bacteria from the sample.

Knight recently received a $1.1 million NIH grant to develop new computational tools to better understand the composition and dynamics of microbial communities. He has been developing novel methods to tag DNA samples with error-correcting "barcodes" to obtain more accurate sequencing data.

The richness of bacteria types on the palm was three times higher than that found on the forearm and elbow, according to the researchers. The total diversity of hand bacteria appears to match or exceed levels of bacteria colonizing other parts of the body, including the esophagus, the

mouth and lower intestine, Fierer said.

"I view humans as 'continents' of microscopic ecological zones with the kind of diversity comparable to deep oceans or tropical jungles," Fierer said. "Today we have the ability to answer large-scale questions about these complex microbial communities and their implications for human health that we weren't even asking six months or a year ago."

Source: University of Colorado at Boulder