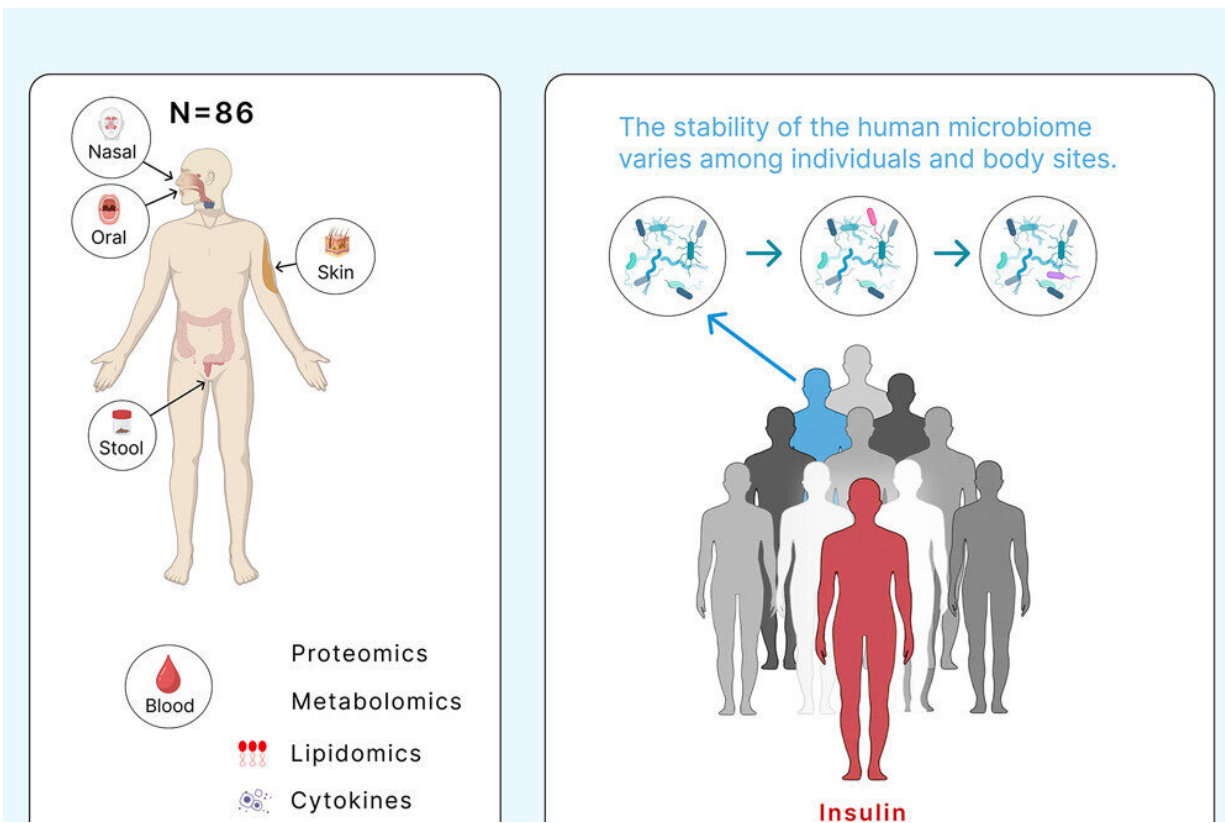


# Our bacteria are more personal than we thought, new study shows

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Credit: *Cell Host & Microbe* (2024). DOI: 10.1016/j.chom.2024.02.012

The trillions of bacteria that call your body home—collectively known as the microbiome—appear to be unique to you, like a fingerprint. That's one conclusion of a detailed study of the gut, mouth, nose and skin

microbiomes of 86 people. Over the course of six years, the bacteria that persisted best in each person's microbiome were those that were most particular to the individual, rather than those shared by the entire population.

"Our results underscore the idea that we each have individualized microbiomes in our bodies that are special to us," said Michael Snyder, Ph.D., the Stanford W. Ascherman, MD, FACS Professor in Genetics and director of the Stanford Center for Genomics and Personalized Medicine. "Your genetics, your diet and your immune system are all shaping this ecosystem."

The new study, led by Snyder in collaboration with Jackson Laboratory biologist George Weinstock, who passed away in 2023, was part of the National Institute of Health's Integrative Human Microbiome Project and is [published](#) online in *Cell Host & Microbe*.

The research also found several correlations between the microbiome and [health](#): For example, people with type 2 diabetes showed a less stable and less diverse microbiome.

"We think that with [insulin resistance](#), the altered lipids, proteins and other metabolites in your blood change what kind of nutrients are available for the microbiome and affect the growth of these bacteria," said Xin Zhou, Ph.D., a postdoctoral scholar in genetics and the lead author of the paper.

## **Long-term tracking**

Scientists have recently gained an appreciation for the role of the human microbiome in health and disease. But the massive size of the microbiome—around 39 trillion microbes in an average person's body—and the fact that it can constantly change make it difficult to

study. Researchers have struggled to determine whether there is one ideal microbiome composition and whether altering someone's microbes can alleviate disease.

Snyder, Zhou and their colleagues set out to track people's microbiomes for up to six years to better understand how the microbes in an individual's body shift with short infections or with the onset of chronic disease. They collected quarterly microbiome samples from the stool, skin, mouth and noses of 86 people ranging in age from 29 to 75 years.

When participants had a respiratory illness, received a vaccination or took an antibiotic, an additional three to seven samples were taken over a five-week period. Each microbiome sample was genetically sequenced to reveal the bacteria it contained.

At the same time, the researchers collected a plethora of other clinical data on the participants' health to study how a variety of factors correlated with changes in the microbiome.

In total, the researchers analyzed 5,432 biological samples and generated 118,124,374 measurements.

"Studying microbes from different body sites over this long a period of time allowed us, for the first time, to look at the entire microbiome as a single, fluid system," Snyder said.

## **Focus on stability**

Confirming what had been found in previous studies, the new research revealed a handful of bacteria that were often found in the microbiomes of healthy people, as well as a pronounced shift in people's microbiomes during infections and other diseases. Far more telling than individual types of bacteria, however, was the stability of the microbiome. In

periods of health, a person's microbiome rarely underwent drastic changes. During an infection, or during the development of diabetes, the bacteria making up the microbiome fluctuated more.

"We found that when you get sick with something like a cold, you have this temporary change in the microbiome; it becomes very dysregulated," Zhou said. "With diabetes, that signature is the same in many ways except that it is long-term rather than temporary."

When the researchers focused on which microbes were most likely to change over the course of years, they were surprised to find that the bacteria most particular to an individual were the most stable.

"A lot of people would suspect that the bacteria shared among us would be the most important and thus the most stable," Snyder said. "We found the complete opposite—the personal microbiome is the most stable. It further suggests that our personal microbiome, different from everyone else's personal microbiome, is pretty integral to our health. This makes sense because all have different healthy baselines."

The data turned up another surprise: The microbiomes in different places in the body were highly correlated. Even though different types of bacteria are present, when the microbiome of one body area changes, the others also shift. If the nasal bacteria change at the onset of a respiratory infection, for instance, the gut, mouth and skin microbes quickly start to change as well. When the gut bacteria shift with diabetes, so do the bacteria on the skin, mouth and nose.

## **Connections to health**

Based on the blood samples taken throughout the study, Snyder's team suspects the [immune system](#) is the common link connecting the microbes in different areas of the body—and connecting overall health within the

microbiome. Levels of certain immune proteins in the blood changed in sync with the microbiome. In addition, lipids—fats in the blood—were also associated with changes in microbiome stability, explaining some of the link to diabetes.

The group pinpointed several environmental factors that played roles in shaping the microbiome: Microbes predictably shifted with the seasons, for instance, likely due to changing humidity and sunlight levels as well as fresh food availability. But these environmental factors, including diet, still didn't explain much of the variability between people.

The new data, the researchers said, closes the door on the idea that there is a gold standard microbiome everyone should be trying to achieve for optimal health.

"Instead, we're moving toward this idea that we have a personal microbiome that is incredibly important for our own metabolic and immune health. Our metabolic and immune health also greatly affect our microbiome—it is all tied together. The [microbiome](#) varies enormously between people," Snyder said. "How you feed it and what it's exposed to probably makes a big impact on your health, and we still have to work that out in many ways."

Researchers from University of Oxford, Ohio State University, uBiome, Oregon Health & Science University, Yale University, Shanghai Jiao Tong University, Zhejiang University, Texas Tech University, Agrosavia, and University of Connecticut were also involved in the study.

**More information:** Xin Zhou et al, Longitudinal profiling of the microbiome at four body sites reveals core stability and individualized

dynamics during health and disease, *Cell Host & Microbe* (2024). DOI: [10.1016/j.chom.2024.02.012](https://doi.org/10.1016/j.chom.2024.02.012)

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