Mouse genetics influences the microbiome more than environment

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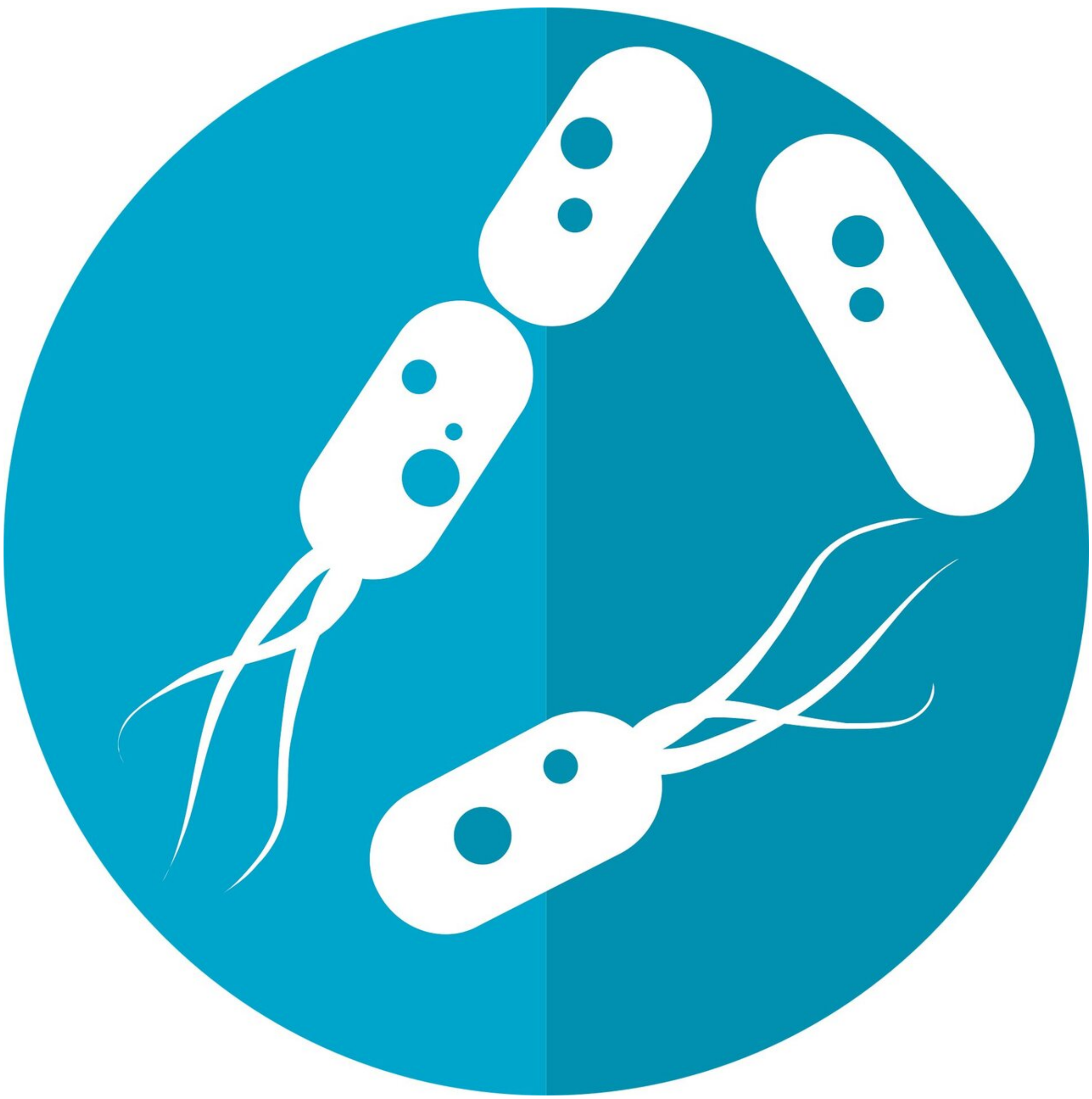

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Genetics has a greater impact on the microbiome than maternal birth environment, at least in mice, according to a study published this week in *Applied and Environmental Microbiology*. Vaginal birth, known to transfer microbiota to a newborn, failed to make a lasting microbial imprint on offspring.

"The powerful effect of genetics, as compared to environment, was surprising," said Yechezkel Kashi, Head of the Applied Genomics and Microbiology Lab, Technion—Israel Institute of Technology. "It was also disappointing since it suggested that the benefits of probiotics might last only as long as one takes them."

In the study, the investigators determined the microbiomes of two different inbred laboratory strains of mice, black mice (C57BL/6J), and white mice (BALB/c). The investigators then crossed the black and white mice. In one set of crosses, the mother was black, while in the other the mother was white. In both cases, the offspring were the same shade of gray, and had similar genetics, regardless of which parent was black and which was white.

The crosses were conducted because in mammals, during birth, mothers transfer microbes from their birth canals to offspring. Thus, during birth, black mothers and white mothers would pass different microbiota to their offspring. The maternal environmental influence on the microbiomes of the offspring turned out to be trivial. The microbiomes of the offspring were similar to each other regardless of whether their mothers were black or white, showing that the maternal seeding during birth didn't take.

A third experiment tested a different environmental influence—food source—on microbiome. In this experiment, black mice and white mice were kept together.

"Mice are coprophages," explained coauthor Hila Korach-Rechtman, Ph.D., Senior Scientist, The Applied Genomics and Microbiology Lab, Technion—Israel Institute of Technology, Haifa. "They eat feces, and in captivity, they eat their cage mates' feces." Since feces contain the microbiome, in this experiment white mice were exposed to black mice' microbes, and vice versa.

This made some difference in the microbiomes, but that difference persisted only as long as the mice occupied the same cages. Once the different strains of mice were separated, their microbiomes reverted to their original composition, said Dr. Korach-Rechtman.

"Obviously, we can't imply that the same model would apply to humans," said Dr. Kashi. Nonetheless, other evidence supports that hypothesis. Studies have found that in both mice and humans, certain genetic loci, or genes correlate with specific microbial species.

Genetic variation could influence the gut microbiome through mechanisms such as "differences in the mucosal gut structure... differences in metabolism such as bile acids secretion... potentially olfactory receptor activity... and antimicrobial peptides and other genetic determinants of the immune system," the investigators wrote.

To analyze the influence of both the mother's strain, and of the coprophagy, the investigators collected feces from the different inbred mouse lines, and analyzed their microbiomes using DNA extraction and sequencing, and bioinformatics analysis of the resulting sequences. The conclusion from both experiments: genetics had major influence on microbiome. Maternal environment and coprophagy had only minor influence.

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