Keeping livestock in the yard just might help your baby's immune system

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Ohio State researchers have found evidence that early exposure to farm animals could lead to robust immune system development. Credit: The Ohio State University

Getting up close—and a little dirty—with farm animals just might help us fend off illness, say researchers who've further demonstrated the benefits of early exposure to a wide variety of environmental bacteria.

Scientists from The Ohio State University found that bacteria and other microbes from rural Amish babies was far more diverse—in a beneficial way—than what was found in urban babies' intestines. And, in a first-of-its-kind experiment, they found evidence of how a healthier gut microbiome might lead to more robust development of the respiratory immune system.

The study was published this month in the journal *Frontiers in Immunology*.

"Good hygiene is important, but from the perspective of our immune systems, a sanitized environment robs our immune systems of the opportunity to be educated by microbes. Too clean is not necessarily a good thing," said the study's co-lead author Zhongtang Yu, a professor of microbiology in Ohio State's Department of Animal Sciences and a member of the university's Food Innovation Center.

The research team collected fecal samples from 10 Ohio babies who were around 6 months to a year old. The five Amish babies all lived in rural homes with farm animals. The other five babies lived in or near Wooster, a midsize Ohio city, and had no known contact with livestock.

The samples revealed important differences—particularly a wide

variation in microbes and an abundance of beneficial bacteria in the Amish babies' guts that wasn't found in their city-dwelling counterparts. The researchers expected this, based on the infants' exposure to the livestock and the fact that the Amish tend to live a relatively less-sanitized lifestyle than most other Americans.

"The priming of the early immune system is much different in Amish babies, compared to city dwellers," said Renukaradhya Gourapura, co-lead author of the study and a professor in Ohio State's College of Food, Agricultural and Environmental Sciences and Food Animal Health Research Program.

What they really wanted to know was how these differences might affect development of the immune system, setting the groundwork for a body's ability to identify and attack diseases and its resistance to allergies and other immune-system problems. Previous studies in the U.S. Amish population and to comparable populations throughout the world have drawn a clear connection between rural life and a decrease in allergies and asthma, Gourapura said.

This connection has led to a theory called the "hygiene hypothesis," which is built on the idea that hyper-clean modern life—think antibacterial soap, ubiquitous hand sanitizer and scrubbed-clean homes and workplaces—has led to an increase in autoimmune and allergic diseases.

Given that the trillions of microbes in the human gut are known to play an important role in health and disease progression, the Ohio State researchers wanted to explore how different gut microbiomes might contribute to immune system development. To do this, they used fecal transplants from the babies in the study to colonize the guts of newborn pigs.

"We wanted to see what happens in early immune system development when newborn pigs with 'germ-free' guts are given the gut microbes from human babies raised in different environments," Gourapura said. "From the day of their birth, these Amish babies were exposed to various microbial species inside and outside of their homes."

The researchers saw a connection between the diverse Amish gut microbes and a more-robust development of immune cells, particularly lymphoid and myeloid cells in the intestines.

"Indeed, there was a big difference in the generation of critical immune cells," Gourapura said.

Previous research into the connection between the microbiome and immunity has been conducted in mice, and this study showed that pigs—which have anatomy, immune systems, genetics and physiology that is more similar to humans—are a viable option for further study, Gourapura said. This is an important step because it opens the door to better exploring details about the microbial links between the gut and the respiratory tract immune system in infants, he said.

"Researchers know that the gut microbiome likely plays a significant role in development of the immune system and in the onset of various metabolic processes and infectious diseases, but we need better models to discover the details of that process so that we can use that information to improve human health," Gourapura said.

For instance, it could be that certain probiotics could improve gut health and immune development, Yu said.

Though the primary difference between the babies in the study was their exposure to a farming environment, the researchers also noted that two of the non-Amish babies were only formula-fed, while all of the Amish

babies in this study were breast-fed. Another important difference that could contribute to gut microbiome differences between the groups is that the Amish families grew and routinely ate their own produce.

More information: Santosh Dhakal et al, Amish (Rural) vs. non-Amish (Urban) Infant Fecal Microbiotas Are Highly Diverse and Their Transplantation Lead to Differences in Mucosal Immune Maturation in a Humanized Germfree Piglet Model, *Frontiers in Immunology* (2019). DOI: 10.3389/fimmu.2019.01509

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