

Breast-fed babies' gut microbes contribute to healthy immune systems

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A new multi-university study reports that differences in bacterial colonization of the infant gut in formula-fed and breast-fed babies lead to changes in the expression of genes involved in the infant's immune system.

The study, published in the April 30 issue of BioMed Central's open access journal [Genome Biology](#), is an Editor's Pick. The research was a joint effort of University of Illinois, Texas A&M University, Miami University, and University of Arkansas scientists.

"This study provides a first insight into the interactions between microbes and the developing infant and how these interactions are affected by diet. It also demonstrates the power of new experimental and analytical approaches that enable the simultaneous analysis of the microbiome and the host response," said Mihai Pop of the University of Maryland in a review of the study for the publishing journal.

There is strong evidence that the colonization of the body by microbes has an important influence on the development of infants' immune systems, he added.

In the study, the researchers compared the [genes](#) expressed in cells from the intestines of three-month-old exclusively breast-fed or formula-fed infants and related this to their gut microbes. The human intestine is lined by epithelial cells that process nutrients and provide the first line of defense against food antigens and pathogens. Approximately one-sixth of the intestinal epithelial cells are shed every day into feces, providing a non-invasive picture of what is going on inside the gut.

The baby's gene expression profile was compared to the genes contained in the microbes in its gut, or the bacterial metagenome. This analysis provides a picture of who the bacteria are and what they are

doing.

The study showed that babies that had been fed only breast milk had a more diverse [bacterial colonization](#) than formula-fed babies. The scientists also found a link between the expression of genes in the bacteria and genes of the [immune system](#) in the baby.

"While we found that the microbiome of breast-fed infants is significantly enriched in genes associated with 'virulence,' including resistance to antibiotics and toxic compounds, we also found a correlation between bacterial pathogenicity and the expression of host genes associated with immune and defense mechanisms," said Robert Chapkin of Texas A&M University.

Iddo Friedberg of Miami University in Ohio said that the differences in virulence genes probably do not reflect an infection. "The breast-fed babies had a larger complement of gram-negative bacteria than the formula-fed [babies](#). Gram-negative bacteria have genes that, although classified as 'virulent,' can activate the immune system but not cause an infection in the process. We are now studying this finding in greater depth," he said.

"The findings show that human milk feeding promotes the beneficial microbe population in the gut and crosstalk between these bacteria and the immune system of the infant and are helping us to define exactly why breast is best," said U of I scientist Sharon Donovan.

Provided by University of Illinois at Urbana-Champaign

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