

9 out of 10 U.S. infants experience gut microbiome deficiency

January 22 2021



Largest study to date benchmarks widespread, underrecognized microbiome-linked risk to infant immune system development, antibiotic resistance, acute conditions such as colic and diaper rash. Credit: Evolve BioSystems, Inc.

A new peer-reviewed study reveals that the vast majority of U.S. infants

may be suffering from a substantial deficiency in an important bacterium key to breast milk digestion and immune system development, as well as protection against gut pathogens linked to common newborn conditions such as colic and diaper rash.

According to the study published today in [Scientific Reports](#), approximately nine out of 10 infants are missing *Bifidobacterium longum* subsp. *infantis* (*B. infantis*) in their gut microbiome, a type of bacteria that plays a critical role in [infant health](#) and development. This specific type of [gut bacteria](#) has been widely [documented](#) as providing the most beneficial impact to infant gut health and possessing the ability to fully unlock the nutritional benefits of breast milk.

The study is the largest to date to benchmark the widespread deficiency in gut bacteria among U.S. infants, and the resulting diminished function of their gut microbiomes.

"The vast majority of infants are deficient in this key gut bacterium from the earliest weeks of life, and this is completely off the radar for most parents and pediatricians alike," said study co-author Karl Sylvester, MD, professor of surgery and pediatrics and associate dean of Maternal Child Health Research, Stanford University. "This study provides the clearest picture to date of just how widespread this issue is and highlights the need to address *B. infantis* deficiency in the infant gut right from the start."

B. infantis had been widely considered one of the most prevalent bacteria in the GI tracts of infants, accordingly its absence from such a wide swath of outwardly healthy infants is surprising. When present, *B. infantis* breaks down carbohydrates in human breast milk called human milk oligosaccharides (HMOs) which are otherwise inaccessible to the infant. In fact, *B. infantis* differs from other *Bifidobacteria* species in its unique adaptation to human breastmilk and specifically in its ability to

break down HMOs into usable nutrients. Perhaps more importantly, *B. infantis* is increasingly linked to the development of the infant immune system, protecting the infant intestinal tract from potentially dangerous bacteria as well as lower incidence of common childhood conditions like colic and diaper rash.

Researchers also discovered that potentially dangerous bacteria comprised, on average, 93 percent of all bacteria in the infant gut microbiome, with the most prevalent bacteria being *Escherichia coli* (*E. coli*), *Klebsiella pneumoniae*, *Salmonella*, *Streptococcus*, *Staphylococcus* and *Clostridium difficile* (*C. diff*). Many of these bacteria are known to harbor genes related to [antibiotic resistance](#). In fact, a total of 325 antibiotic resistant genes were found in the gut bacteria, with more than half (54 percent) of those genes being those that confer bacterial resistance to multiple antibiotics.

"The infant gut is essentially a blank slate at birth, and rapidly acquires bacteria from mom and the environment. We were surprised not only by the extensive lack of good bacteria, but the incredibly high presence of potentially pathogenic bacteria and an environment of antibiotic resistance that appears to be so widespread," said Dr. Sylvester. "The infant [gut microbiome](#) in the U.S. is clearly dysfunctional, and we believe this is a critical factor underpinning many of the infant and childhood ailments we see today across the country."

Study Methodology

Researchers collected fecal samples from 227 infants under six months of age during pediatrician office visits in five different states (CA, GA, OR, PA, SC). The samples were analyzed for bacterial type and amount present, which represents the bacterial composition in the infants' guts. The [fecal samples](#) were assessed for bacterial ability to fully use human breast milk—a hallmark of the presence of health-promoting bacteria, as

well as for the presence of antibiotic resistant genes in the bacteria. The researchers did not include samples from [infants](#) with jaundice, those who were actively undergoing antibiotic treatment, or those diagnosed with problems with absorbing carbohydrates in their intestine, due to the impact such conditions may have on the ability of the infant gut to carry out normal processes.

Newborn Gut and the Impact on Newborn Health

The infant gut requires the presence of thousands of different bacteria to perform different functions—from biological processes to the development of biological structures and systems. Infant gut dysbiosis is marked by a substantial imbalance between beneficial and potentially pathogenic [bacteria](#) in the GI tracts of newborn babies. There has been a strong evidence characterizing a substantial loss of Bifidobacteria in the infant gut over the past 100 years, with research pointing to numerous factors including increased C section delivery, increased use of antibiotics and increased use of infant formula.

As a result of the loss of *B. infantis*, the infant gut is at greater risk for negative consequences, including suboptimal access to the full value of [human breast milk](#), compromised immune system development, an increase in harmful gut pathogens due to increased gut pH, and negative impact on the infant's intestinal wall.

More information: Giorgio Casaburi et al, Metagenomic insights of the infant microbiome community structure and function across multiple sites in the United States, *Scientific Reports* (2021). [DOI: 10.1038/s41598-020-80583-9](https://doi.org/10.1038/s41598-020-80583-9)

Provided by Evolve BioSystems

Citation: 9 out of 10 U.S. infants experience gut microbiome deficiency (2021, January 22)
retrieved 23 April 2024 from
<https://medicalxpress.com/news/2021-01-infants-gut-microbiome-deficiency.html>

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