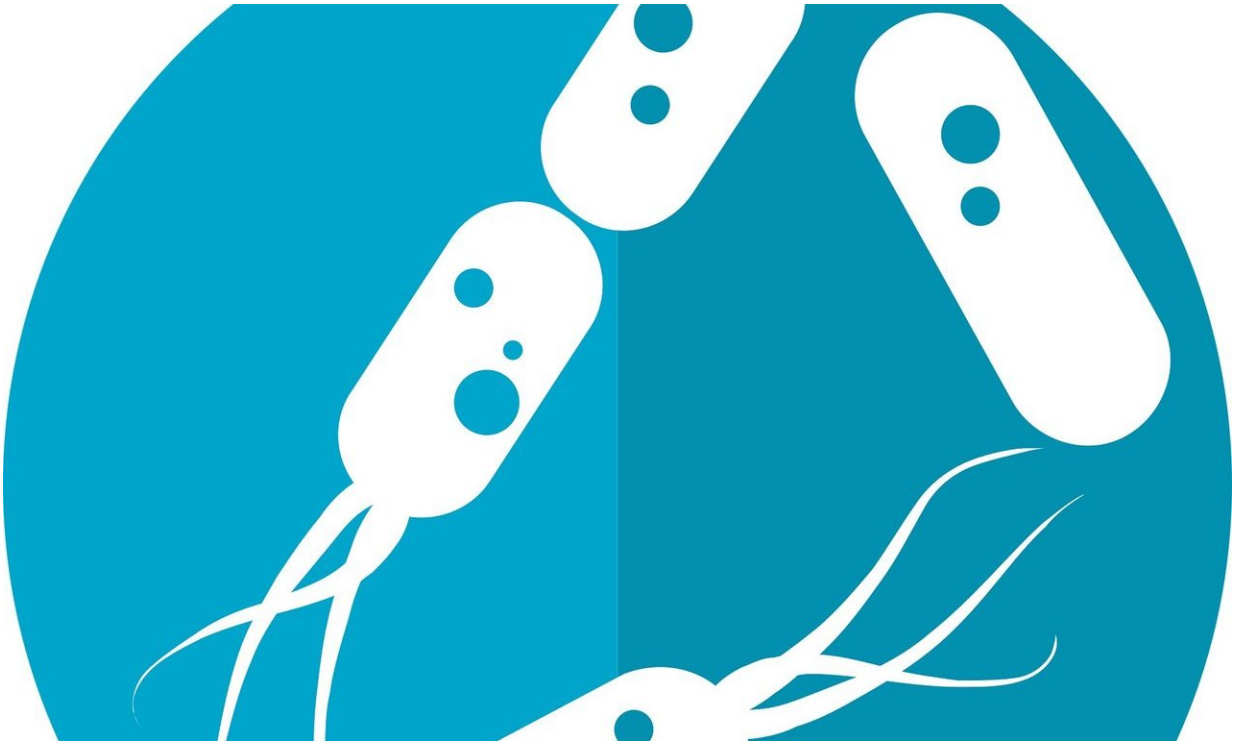
# How the gut microbiota develops in the first five years of life

March 31 2021



Credit: CC0 Public Domain

The human gut microbiota largely reaches an adult-like composition by five years of age, but important differences remain, finds a study published on March 31st in the journal *Cell Host & Microbe*. Several bacterial taxa that have been associated with human health are acquired late in childhood and have not reached their adult abundance by five

years of age.

"We hope to highlight that the gut microbiota continues to develop during childhood," says senior study author Fredrik Bäckhed of the University of Gothenburg. "Our findings underscore the possibility that the microbiota may be particularly sensitive to disturbances during this early establishment, which may have profound effects on health later in life."

Newborns acquire bacteria through transmission from the mother and the environment at delivery. The ecological succession within the gut microbiota is a dynamic process during infancy but stabilizes during childhood. Previous studies have suggested that the microbiota begins to stabilize and evolve toward an adult-like composition two to three years after birth. But how the gut microbiota develops after infancy is still poorly characterized. In particular, the succession by which different bacteria are incorporated into the gut microbiota has not been clear.

"There has been a lot of focus on the gut microbiome in infancy, which is a very important period of development for both the gut microbiome and other physiological and biological processes," says co-first author Josefine Roswall of Hallands Hospital Halmstad. "However, much less is known about the continuing development of the gut microbiome after the first few years."

To address this knowledge gap, the researchers analyzed the microbiota from 471 Swedish children followed from birth to five years of age. The authors used 16S rRNA gene sequencing to profile the microbes present in fecal samples collected at four months, one year, three years, and five years after birth. They also compared the microbiota of children to those of their mothers and an adult Swedish population.

The largest changes in microbiota composition occurred between four

and twelve months of age. Bacteria that are common in adults appeared around the time when the children began to eat solid food. Over the five-year period, different microbial genera followed four main colonization trajectories, increasing in abundance and stabilizing at various time points after birth. Intriguingly, the microbiota of a small number of five-year-old children was mature for their age, whereas some adults had less mature microbiota than expected for their age.

"We find that many of the genera of bacteria which dominate the adult gut microbiota are established at three years," says co-first author Lisa Olsson of the University of Gothenburg. "However, we identify several less abundant bacterial and archaeal genera that are still increasing up to five years of age."

For example, five-year-olds lacked adult levels of microbial community richness, the bacterial genus Methanobrevibacter, and the bacterial family Christensenellaceae. By contrast, the abundance of the bacterial species Ruminococcus gnavus was lower in adults than in five-year-olds.

Both low community richness and high proportions of R. gnavus have been repeatedly linked to diseases such as metabolic syndrome, obesity, cardiovascular disease, and inflammatory bowel disease. By contrast, increased abundance of Methanobrevibacter and certain members of Christensenellaceae has been linked to metabolic health.

Moreover, children with lower weight gain than expected between 12 months and five years had a more immature gut microbiota at 12 months. Similar to malnourished children, the Swedish children with lower weight gain had reduced abundance of Faecalibacterium, which has been linked to metabolic health.

Consistent with previous results, the authors observed a large impact of mode of birth on the gut microbiota early in life. Specifically, caesarean

section was associated with lower microbial diversity at four months, but this normalized at three years as the gut microbiota continued to mature. In addition, 25 genera showed different abundances in five-year-olds born with c-section compare to those born vaginally.

According to the authors, the study provides a reference for the normal establishment and development of the gut microbiota in early childhood. "Although our data is insufficient to make claims about future metabolic conditions, experimental studies have demonstrated that, if the microbiota is disrupted by antibiotics before weaning, mice develop obesity later in life," Bäckhed says. "Future, larger studies are required to identify potential time windows when the gut microbiota may be particular important for the development of diseases in humans."

**More information:** *Cell Host & Microbe*, Roswall et al.: "Developmental trajectory of the healthy human gut microbiota during the first 5 years of life" www.cell.com/cell-host-microbe … 1931-3128(21)00100-1 , DOI: 10.1016/j.chom.2021.02.021

Provided by Cell Press