RESEARCH IMPACT SUMMARY

December 15, 2021

Study Finds a Link Between Gut Bacteria and Healthy Brain Function and Behavior in Infants

Researchers suggest that Bacteroidetes species in the gut microbiome could be beneficial for early brain development in infants

Learning and language disabilities can negatively impact the social and mental well-being of children. Previous studies have suggested a link between certain neurodevelopmental disorders and the type and composition of bacteria in the gastrointestinal tract. However, no study has explored the temporal association between them. Researchers in Canada and China now suggest that during late infancy a specific group of bacteria in the gut, called *Bacteroidetes*, can enhance the cognitive and language abilities of infants.

Gut microbiome is considered vital in establishing the gut-brain connection in children. Bacteria that occupy the human gut shortly after birth may be critical for the growth of human organs, particularly the developing brain. Although previous studies have probed into the brain-gut microbiome interaction, few studies have examined the effects of gut microbiota on neurological development from a temporal perspective.

To address this gap, a team of researchers from Canada and China evaluated and scored the cognitive and language abilities of infants and explored putative links between their gut microbial composition and brain function. Explaining the motivation behind the study, the results of which have been published in *Gut Microbes*, corresponding author Professor Anita L. Kozyrskyj of the University of Alberta in Edmonton explains, "*We aimed to identify microbial clusters and their relation to three objectively-assessed neurodevelopmental domains, using data from the Canadian Healthy Infant Longitudinal Development or the CHILD Cohort Study. The large sample size of our study enabled adjustment for ethnicity and early life covariates, which makes our study robust and objective.*"

The researchers collected fecal samples from 405 infants and identified the microbial clusters present in their gut at age 1 year through 16S rRNA sequencing. Following the identification of specific bacterial groups, the infants were assessed on several neurological parameters, such as visual preference, attention, memory, and communication, using the Bayley Scale of Infant Development at age 2 years. On the basis of the dominant gut microbiota at 1 year of age, the infants could be clustered into three groups: *Proteobacteria*-dominant, *Firmicutes*-dominant, and *Bacteroidetes*-dominant clusters. Interestingly, infants with a *Bacteroidetes*-dominant gut at the age of 1 exhibited superior intellectual and verbal abilities at the age of 2.

The researchers further discovered that *Bacteroidetes* had a higher favorable effect on 2-year-old male infants in terms of the development of early cognitive and language skills, showing a sex-specific association. "*Our study found novel links between neurodevelopment and Bacteroidetes in late infancy. Particularly, we found that the gut-brain axis in boys is likely to be more susceptible to disruptions in the gut microbiome. Our study contributes to growing evidence that neurodevelopmental outcomes are shaped by the gut microbial composition of infants in a sex-dependent manner,*" explains Prof. Kozyrskyj.

Exploring further, the researchers discovered that *Bacteroidetes* in the infants' intestines produced more sphingolipids, a form of short-chain fatty acid. "*Preschool children do better on neurocognitive scales when their sphingolipid levels are higher*," observes Prof. Kozyrskyj, reflecting on the stronger correlation between these bacteria and enhanced cognitive and language scores of the studied infants.

The findings support the theory that *Bacteroidetes* species in late infancy have a positive impact on early brain development. The researchers suggest that this dominance by *Bacteroidetes* species, particularly those under the genus *Bacteroides*, could be a result of less competition from other gut bacteria like *Streptococcus*. Future research is needed to validate these findings and investigate the impact of infant gut bacteria on later stages of brain development.

Reference

Authors	Sukhpreet K Tamana[1], Hein M Tun[1 2], Theodore Konya[3], Radha S Chari[4], Catherine J Field[5], David S Guttman[6], Allan B Becker[7], Theo J Moraes[8], Stuart E Turvey[9], Padmaja Subbarao[8], Malcolm R Sears[10], Jacqueline Pei[11], James A Scott[3], Piush J Mandhane[1], Anita L Kozyrskyj[1]
Title of original paper	Bacteroides-dominant gut microbiome of late infancy is associated with enhanced neurodevelopment
Journal	*Gut Microbes*
DOI	https://doi.org/10.1080/19490976.2021.1930875
Affiliations	[1]Department of Pediatrics, University of Alberta, Edmonton, AB, Canada. [2]HKU-Pasteur Research Pole, School of Public Health, Li Ka Shing Faculty of Medicine, University of Hong Kong, Hong Kong SAR, China. [3]Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada.

[4]Department of Obstetrics and Gynecology, University of Alberta, Edmonton, AB, Canada.
[5]Department of Agricultural, Food & Nutritional Science, University of Alberta, Edmonton, AB, Canada.
[6]Centre for the Analysis of Genome Evolution and Function, University of Toronto, Toronto, ON, Canada.
[7]Department of Pediatrics & Child Health, Children's Hospital Research Institute of Manitoba, University of Manitoba, Winnipeg, MB, Canada.
[8]Department of Pediatrics, Hospital for Sick Children, University of Toronto, Toronto, ON, Canada.
[9]Department of Pediatrics, Child & Family Research Institute, BC Children's Hospital, University of British Columbia, Vancouver, BC, Canada.
[10]Department of Medicine, McMaster University, Hamilton, ON, Canada.
[11]Department of Educational Psychology, University of Alberta, Edmonton, AB, Canada.

Researchers find that gut microbiota dominated by *Bacteroidetes* species have a positive impact on early brain development in infants

Picture courtesy: Pixabay

About Professor Anita L Kozyrskyj

Dr. Anita L Kozyrskyj is a professor at the University of Alberta's Department of Pediatrics. In the year 2000, she obtained her Ph.D. in population health from the University of Manitoba. Her investigations are largely birth cohort studies of the infant gut microbiome. Her current research focuses on how child immune-related and neurodevelopmental outcomes are programmed by the microbiome of early-life. In 2014, she received the Bruce Squires Award from the Canadian Medical Association Journal for the most influential publication of her first infant gut microbiome paper. Since then, her SyMBIOTA research program has generated 40 papers, 2 book chapters and trained many next generation microbiome researchers. Her microbiome papers have been cited by position statements on food allergy and neonatal early-onset bacterial sepsis.