The individual microorganisms that live in our body, the microbiota, and their collective genomes, the microbiome, exert considerable influence over host brain and behaviour

Microbiota and Neurodevelopmental Trajectories: Role of Maternal and Early-Life Nutrition

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Key insights

Pregnancy and early life are characterized by marked changes in the microbial composition of the body. Importantly, these changes coincide with key periods of neurodevelopmental plasticity in the infant, suggesting a complex dialogue between the brain and the microbes that inhabit the gastrointestinal tract. The last decade has uncovered a wealth of fascinating data on the existence of a bidirectional microbial gut-brain axis. These findings have paved the way for understanding the role played by the microbiome in shaping brain health and disease.

Current knowledge

The gut microbiota in human females undergoes dynamic compositional changes during gestation to support the developing fetus. Microbiota composition during pregnancy is affected by a variety of external factors, including diet, drugs, infections, hospitalization and stress. Inadequate intake of micro- and macronutrients, maternal overweight, and high-fat diets have also been associated with poor neurodevelopmental outcomes in the offspring. Emerging data suggests that maternal consumption of prebiotics, probiotics, as well as psychotropic drugs may affect the stability of maternal and infant microbiota and influence offspring behaviour.

Practical implications

The moment of birth provides the first major opportunity for large-scale bacterial colonization of the newborn. Nevertheless, the impact of the mode of delivery on the infant microbiota is only transitory: over time, the microbial population in infants born by C-section evolves to resemble those in vaginally delivered infants. Diet is one of the major drivers of the abundance and diversity of intestinal microbiota. In infants, a key influential parameter is breastfeeding versus formula feeding. Not only do breastfed infants have a distinct gut microbial fingerprint, but breastfed infants also show enhanced verbal and non-verbal cognitive abilities during childhood compared to formula-fed infants. Further research is needed in order to understand how diet and the microbiome shape neurocognitive outcomes in early life.

Recommended reading


Parameter | Effect on the microbiota
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Diet | • High-fibre diets improve gut microbial diversity.  
• Prebiotics stimulate healthy bacterial populations.  
• Probiotics modulate microbiota function, intestinal immunity and responsiveness.
Mode of delivery | • Vaginal delivery is involved in the direct transmission of the maternal microbial signature to the infant.
Breastfeeding | • Breastmilk supports early-life microbial development.
Stress | • Alters the composition of early-life microbiota.
Antibiotics | • Inhibit growth and reduce the stability of the microbiota.

Pre- and post-natal factors that interfere with and support gut microbiota development.