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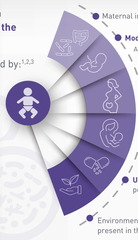
C-section is negatively shaping the gut microbiota

Multiple factors affect early-life intestinal microbiota development

The early life gut microbiome plays an **important role** in the **development of the immune system** and **metabolism**.[1]

Early life gut microbiota can be affected by:[1,2,3]



- Maternal intrauterine microbiome environment
- **Mode of delivery** (vaginal vs. cesarean section)
  A major factor determining the initial colonization.[1] Delivery by C-section is associated with alteration of gut microbial colonization in early life.[1] Children born by C-section showed less richness and diversity.[2]
- Gestational age (term vs. preterm)
- Early dietary feeding (breastfeeding vs. formula, timing of complementary feeding)
- **Use of antibiotics** (during delivery, postnatally, used to fight early life infections)
- Environmental factors (rural/urban environment, at least one sibling present in the household, exposure to pets, daycare attendance)

Early life gut microbiome may affect the risk of chronic diseases (e.g., allergies, obesity, and other chronic immune and metabolic diseases in later life).[1,3]

Gut microbiota	Eubiosis	Health effect
		Immune tolerance Gastrointestinal homeostasis Healthy metabolism
	Dysbiosis	
		Immune disease (allergy, asthma) Gastrointestinal disease (e.g. IBD) Metabolic disease (obesity, diabetes)

IBD: Inflammatory bowel disease

C-section negatively shapes the development of gut microbiota

Gut microbiota disruption is associated with cesarean section (C-section).[4] Infants born by C-section showed **a complete lack of maternal strains** during the first weeks of life.[5]

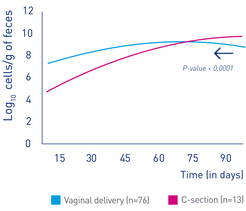
Vaginally-born infants had gut microbiota similar to the maternal vaginal microbiota.[6]

C-section born infants developed a gut microbiota that resembles maternal skin microbiota.[4]

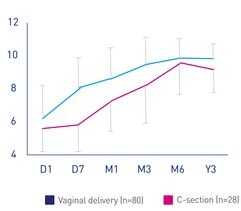
C-section-born infants had **lower colonization rates** of ***Bifidobacterium*** and *Bacteroides*, but they had higher colonization rates of *Clostridium, Lactobacillus, Enterobacter, Enterococcus,* and *Staphylococcus*.[7]

Bifidobacteria are lower in C-section-born infants[8]

Bifidobacterium

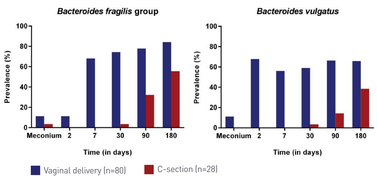


Delay in colonization in first 3 months

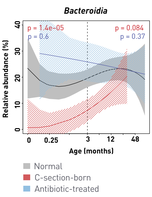


Microbiota differences continue in the first years of life[5,8]

A less diverse Bacteroides (lower/absent) are found up to 1 year of age.[8]



Comparison of the microbiota development in the C-section-born and in the antibiotic-treated children to the normal development[5]



The effect of C-section on gut microbiota is **present at 12 months** of age and **may be normalized in 3–5-years** of age.[9]

Microbial dysbiosis is associated with higher risk of infections in early childhood

Microbial dysbiosis at the **first week** of life plays a crucial role in **susceptibility to respiratory infections** over the first year of age.[9,10]

- There is a **significantly increased risk of infection-related hospitalization** (p<0.001) in early childhood of C-section-born children.[10]
- The increased risk persisted up to **5 years of age**.[10]

Gut microbial dysbiosis impacts the metabolism by increasing the risk of obesity, metabolic syndrome, and asthma[9,11]

- **C-section** can alter colonization of the newborn intestine, which is a critical event **influencing many developmental and physiological processes** and, thereby, the functioning of the immune and neuroendocrine systems, with **long-lasting effects on health**.[12]
- In the **long term**, C-section has been associated with **obesity and asthma** in children.[11]
- **Increased body mass in childhood and adolescence** associated with cesarean delivery was observed in a longitudinal birth cohort study, following subjects **up to 15 years** of age.[12]

References

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