



## Breastfeeding restores microbial shift in the infant's gut microbiota caused by the mode of delivery | 1

Numerous perinatal factors influence the maturation of gut microbiota, including delivery mode, feeding pattern, antibiotic exposure, and gestational age. In this longitudinal study, the Chinese researchers investigated the impact of delivery mode and feeding pattern on the infant's gut microbiota from six weeks to six months after delivery. They also analyzed the correlation between the infant's susceptibility to respiratory infections and changes in the gut microbiota caused by the mode of delivery and feeding pattern.

Recent studies have demonstrated that a major determinant of the gut microbiota during the first weeks of life is delivery mode. Cesarean section disrupts the natural transmission of the gut microbiota from mothers to offspring, resulting in the lack of specific bacterial taxa in infants. This disturbs the maturation of the infant intestine and immune systems. Additionally, a higher incidence of respiratory infections during the first year of life in infants delivered by Cesarean section has been associated with a decrease in health-promoting *Bifidobacterium* and a rise in potentially pathogenic *Enterococcus*, *Staphylococcus*, *Streptococcus*, and *Klebsiella*. This suggests that alterations in the gut microbiota, induced by Cesarean delivery, may have a role in disease susceptibility.

By contrast, the enrichment of *Bifidobacterium*, *Escherichia*, *Bacteroides*, and *Parabacteroides* in vaginally delivered infants can promote the utilization of human milk oligosaccharides and immune stimulation in early life. However, since the effect of the delivery mode gradually decreases by six months of life or earlier, the gut microbiota could recover after the Cesarean section delivery.

Also, it is important to note that the gut microbiota is different in exclusively breastfed and formula-fed infants, even when specific components are added to the formula to promote breastfed-like microbial communities.

### **About the study**

The study included 139 infants followed from six weeks to six months postpartum. 73% (101/139) of them completed the follow-up. The prenatal and perinatal data about the infants, including maternal age, gravidity, pre-pregnancy body mass index, delivery mode, gestational age, infant sex, birth weight, feeding pattern, and the occurrence of respiratory infections during the first six months of age, were obtained from electronic medical records and questionnaire surveys. Stool samples were collected from each infant at six weeks and six months postpartum.

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To examine the presumption that the feeding pattern influences the impact of delivery mode on the infant's gut microbiota, 101 infants at 6 months postpartum were divided into two groups based on their feeding patterns: breastfeeding and mixed-feeding groups. Breastfeeding is defined as exclusively breast milk feeding after birth, while mixed feeding is defined as feeding with a mixture of breast milk and formula milk in varying proportions.



### **Results**

Out of 139 infants, 93 infants (67%) were born by vaginal delivery, and 46 by Cesarean section delivery.

The comparison of gut microbiota composition at six weeks and six months of age demonstrated that the microbial community cluster at six months postpartum was more homogeneous. *Clostridium sensu stricto*<sup>1</sup>, *Klebsiella*, and *Streptococcus* were more abundant at six weeks, whereas *Bifidobacterium*, *Bacteroides*, *Escherichia-Shigella*, and *Veillonella* were enriched at six months of age.

### *Changes in the gut microbiota caused by the mode of delivery*

The analysis of whether and how delivery mode affects the infant's gut microbiota revealed a difference in the composition and structure of the gut microbiota between infants delivered by Cesarean section and infants vaginally delivered at six weeks postpartum. This difference disappeared at six months of age. This confirms that the mode of delivery is a



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major determinant of the gut microbiota during early life, but, the changes in the gut microbiota related to the delivery mode diminish gradually throughout infancy.

A cross-sectional analysis revealed that all vaginally delivered infants were enriched in *Bacteroides* and *Escherichia-Shigella* at six weeks postpartum. However, infants delivered by Cesarean section were depleted of these commensal genera and enriched in *Klebsiella*, *Veillonella*, and *Enterococcus*.

### *The feeding pattern influences the impact of delivery mode on the infant's gut microbiota*

In the mixed feeding group, the stool samples analysis at six weeks postpartum showed a difference in the gut microbiota structure between vaginally delivered infants and infants delivered by Cesarean section. At six months postpartum, in the mixed-feeding group, there was still a difference in relative abundances of specific taxa between those two groups. Infants delivered by Cesarean section had a lower relative abundance of *Bacteroides* and a higher abundance of *Klebsiella*, *Veillonella*, and *Streptococcus*. The relative abundances of *Escherichia-Shigella* were comparable in the two groups.

In the breastfeeding group, there was no difference in the gut microbiota structure between vaginally delivered infants and infants delivered by Cesarean section at six weeks postpartum. At six months postpartum, in the breastfeeding group, the gut microbial profiles in vaginally delivered infants and infants delivered by Cesarean section were still similar. These results confirm that breastfeeding restored the microbial shift in the infant's gut microbiota, induced by Cesarean section.

### *Susceptibility to respiratory infections and changes in the gut microbiota caused by the mode of delivery and feeding pattern*

A correlation analysis demonstrated that changes in the infant's gut microbiota induced by delivery mode correlated with the incidence of respiratory infections. During the first 6 months of the infant's life, the incidence of respiratory infections was significantly higher in infants delivered by Cesarean section (9/71) than in vaginally delivered infants (10/30). Genera associated with Cesarean section delivery (low *Escherichia-Shigella* and high *Klebsiella*) were enriched in infants with respiratory infections.



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### *Conclusion*

This study showed that breastfeeding restored perturbation in the infant's gut microbiota caused by the mode of delivery (Cesarean section), and reduced susceptibility to respiratory infections in the first months of the infant's life.

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### **Journal Reference**

Liu Y, et al. A health-promoting role of exclusive breastfeeding on infants through restoring delivery mode-induced gut microbiota perturbations. *Front. Microbiol.* 2023; 14:1163269. (Open Access) <https://www.frontiersin.org/articles/10.3389/fmicb.2023.1163269>

