



# The Nutrition for improving C-Section delivery children immunity

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- Caesarean section delivery
- Immune system
- Gut microbiome

# Objectives

- Contributed to the continuing medical education
- Increase scientific awareness of children nutrition challenge toward specific problem
- Participant aware that C-Section children are facing challenge in growth & development and require right support

# Caesarean section delivery

- CS is one of the most frequent hospital surgical interventions both in developed and developing countries.
- The World Health Organization (WHO) considers a rate of 10–15% of total deliveries as optimal for caesarean sections.
- The decision to undergo a CS to complete a gestation involves important sanitary and ethical factors due to the consequences that can affect the mother and the neonate in the short-, medium- and long-term.

# Remembered...

The NB has changed at delivery time :

- Blood circuit
- Respiratory system
- Environment
- Colonization microbial



# Neonatal microbial colonization

- Mammal commensal microbes colonize most of their host's surfaces including the skin and the mucosa.
- Neonatal microbial colonization depends on several factors that include, among others, the delivery mode, the environment, feeding, weaning timing, and antibiotic use .
- The exposure of the newborn to microbial antigens facilitates the development and maturation of the immune system.

# Neonatal microbial colonization

- In fact, the ontogenesis of the immune system begins as early as three weeks after conception and this process continues after birth and into childhood
- The mother's microbiotas (vaginal, perineal, and intestinal) are among the initial factors shaping newborn colonization.

# The Immune system

The immune system protects your child's body from outside invaders, such as bacteria, viruses, fungi, and toxins (chemicals produced by microbes). It is made up of different organs, cells, and proteins that work together.



# The Immune system

There are two main parts of the immune system:

- **The innate immune system**, which you are born with.
- **The adaptive immune system**, which you develop when your body is exposed to microbes or chemicals released by microbes.

These two immune systems work together

# Components of the immune system

## Innate immune system

## Adaptive immune system

Response is non-specific

Pathogen and antigen specific response

Exposure leads to immediate maximal response

Lag time between exposure and maximal response

Cell-mediated and humoral components

Cell-mediated and humoral components

No immunological memory

Exposure leads to immunological memory

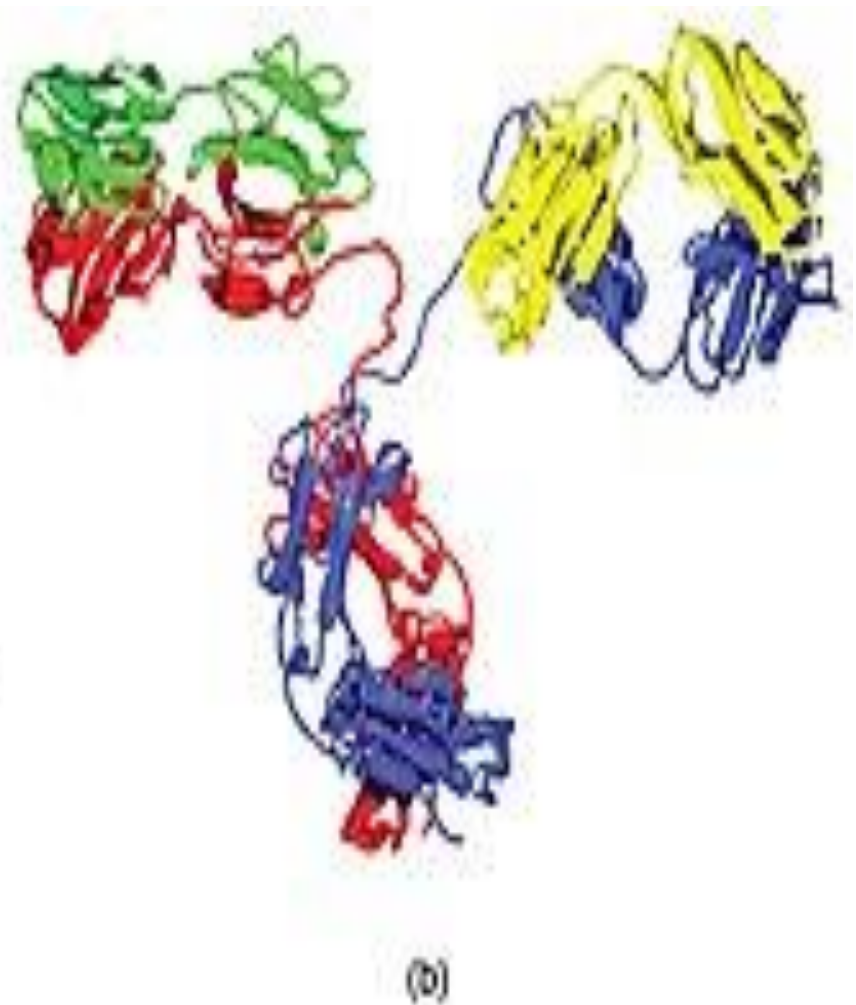
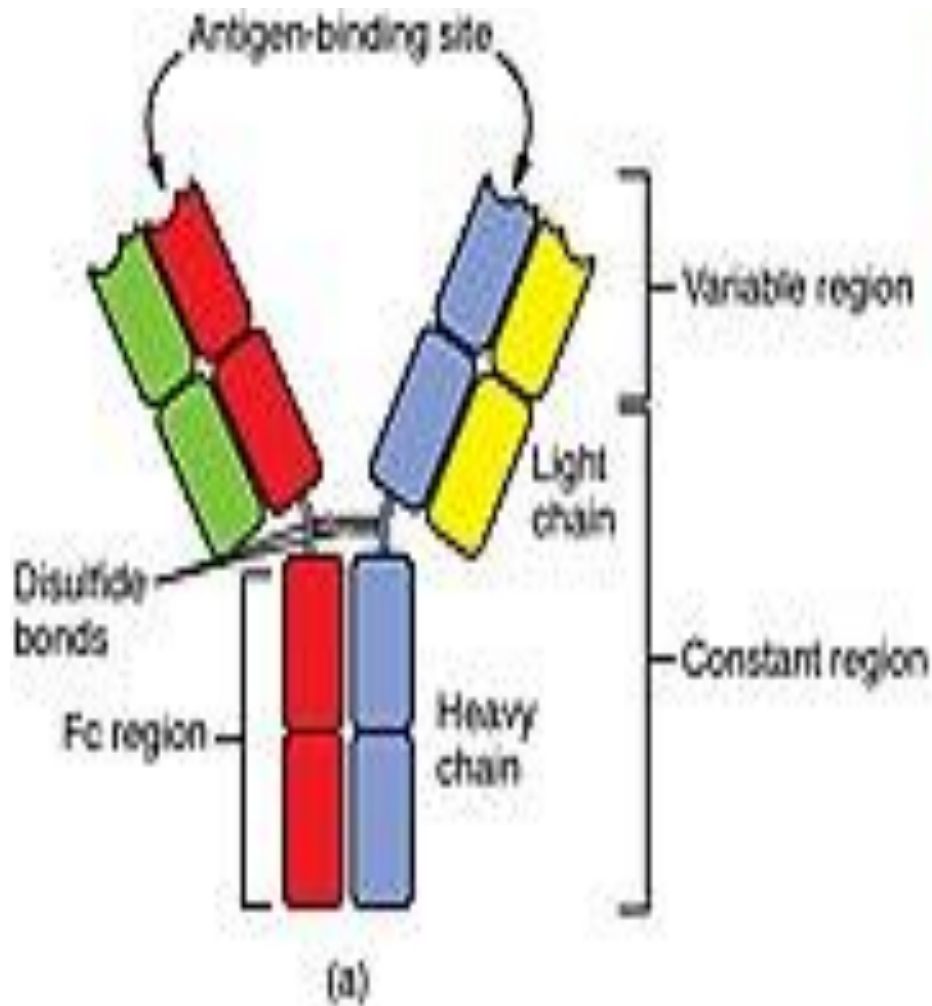
Found in nearly all forms of life

Found only in jawed vertebrates

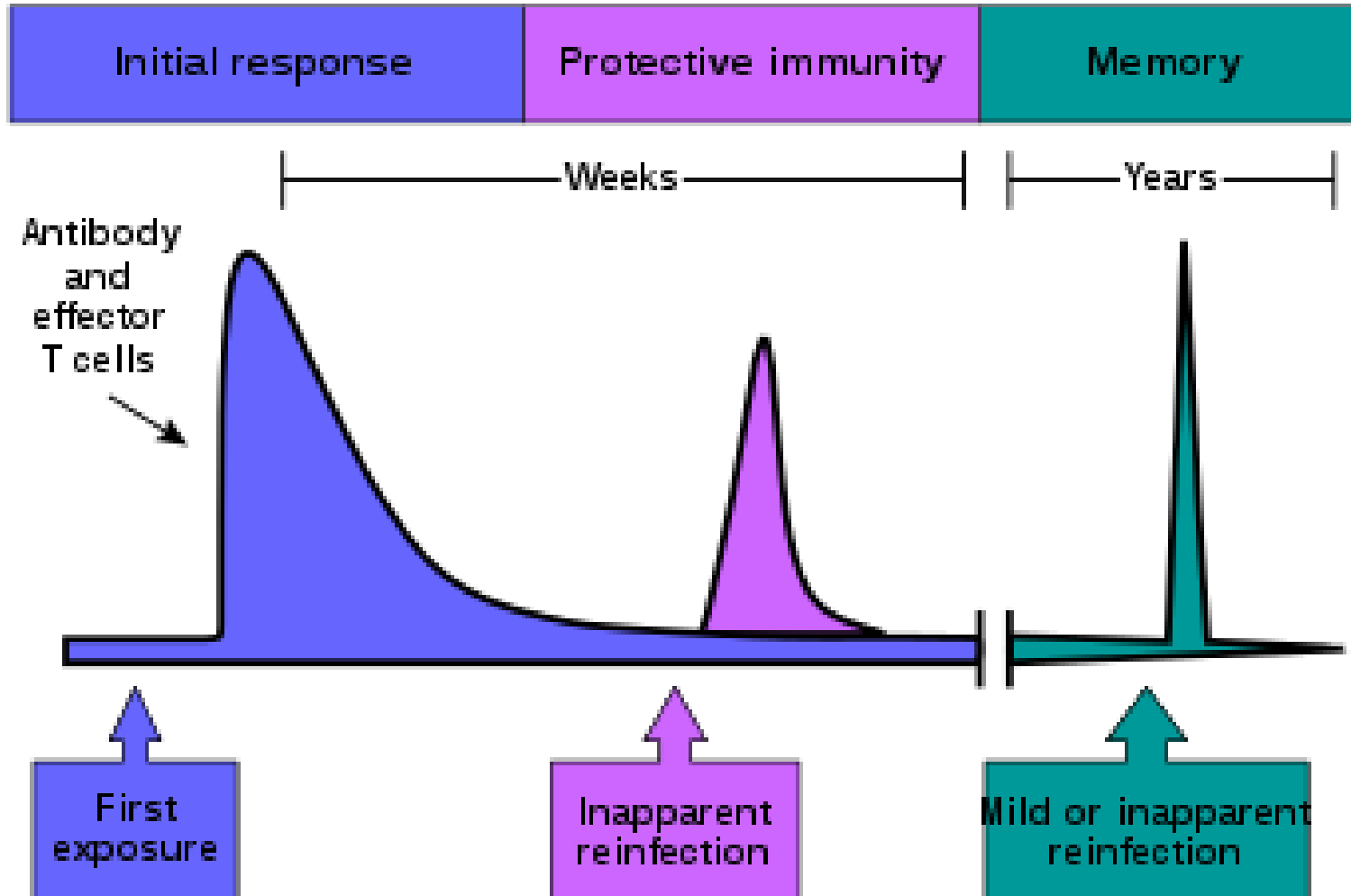
# Different organs...

- **Adenoids.** Two glands located at the back of the nasal passage.
- **Bone marrow.** The soft, spongy tissue found in bone cavities.
- **Lymph nodes.** Small organs shaped like beans, which are located throughout the body and connect via the lymphatic vessels.
- **Lymphatic vessels.** A network of channels throughout the body that carries lymphocytes to the lymphoid organs and bloodstream.
- **Peyer's patches.** Lymphoid tissue in the small intestine.
- **Spleen.** A fist-sized organ located in the abdominal cavity.
- **Thymus.** Two lobes that join in front of the trachea behind the breastbone.
- **Tonsils.** Two oval masses in the back of the throat.

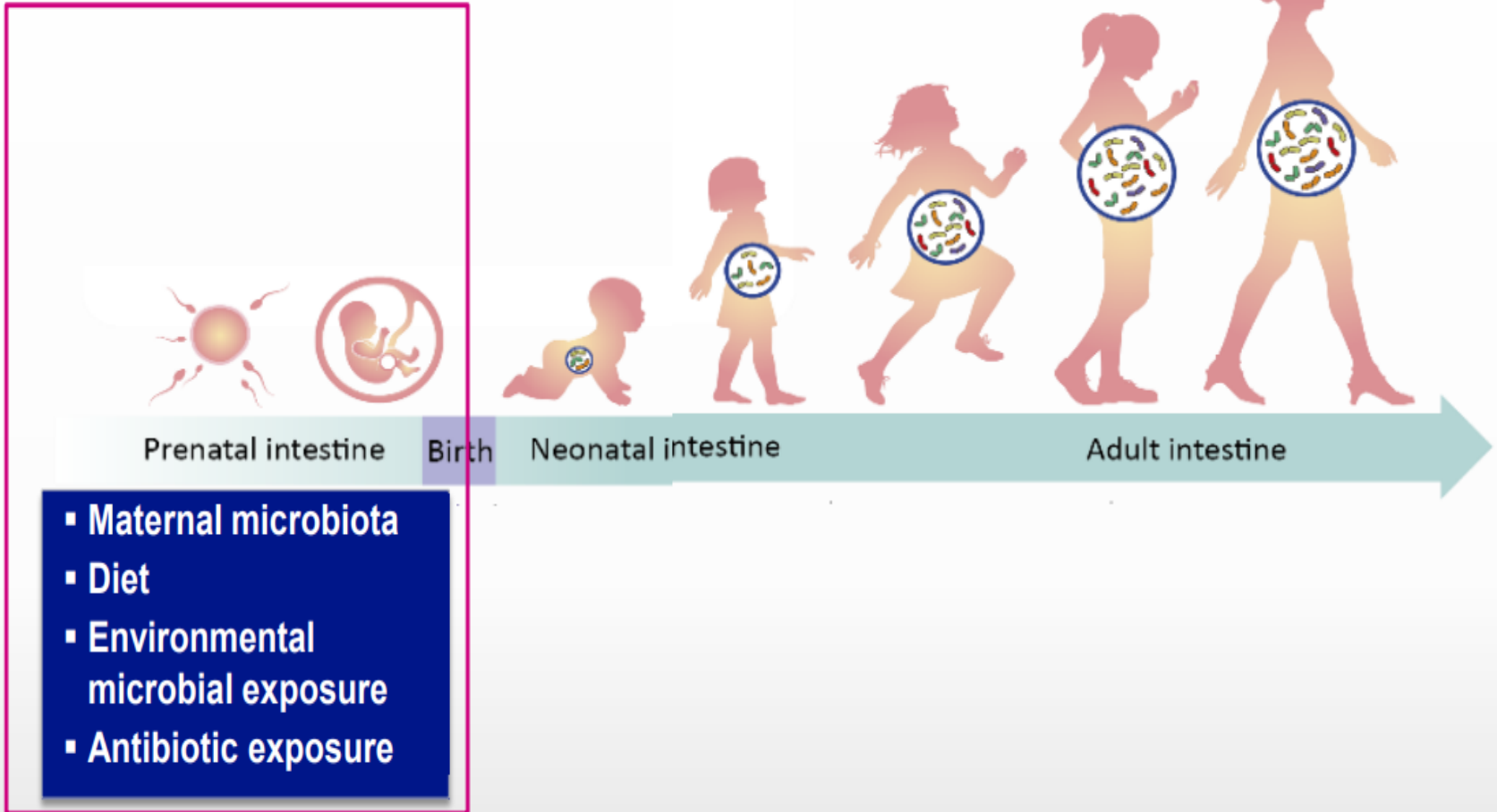
# Antibodies



# Immunity



# MULTIPLE INFLUENCERS IN THE FORMATION OF OUR LIFELONG MICROBIOTA



# Gut microbiome

- Trillions of these microbes exist mainly inside your intestines and on your skin.
- Most of the microbes in your intestines are found in a “pocket” of your large intestine called the cecum, and they are referred to as the gut microbiome.
- In fact, there are more bacterial cells in your body than human cells. There are roughly 40 trillion bacterial cells in your body and only 30 trillion human cells. That means you are more bacteria than human
- What’s more, there are up to 1,000 species of bacteria in the human gut microbiome, and each of them plays a different role in your body. Most of them are extremely important for your health, while others may cause disease

# Gut microbiome

- As your microbiome grows, it affects your body in a number of ways, including:
- **Digesting breast milk:** Some of the bacteria that first begin to grow inside babies' intestines are called *Bifidobacteria*. They digest the healthy sugars in breast milk that are important for growth
- **Digesting fiber:** Certain bacteria digest fiber, producing [short-chain fatty acids](#), which are important for gut health. Fiber may help prevent weight gain, diabetes, heart disease and the risk of cancer
- **Helping control your immune system:** The gut microbiome also controls how your immune system works. By communicating with immune cells, the gut microbiome can control how your body responds to infection
- **Helping control brain health:** New research suggests that the gut microbiome may also affect the central nervous system, which controls brain function



# Gut microbiome

- These beneficial bacteria are particularly important for the body in early life.
- In fact, they are one of the first types of bacteria to grow in babies' intestines after they're born
- In the first few weeks of life, they can make up 60% of all of the bacteria in the infant gut microbiome
- Their main role during this time is to digest the healthy sugars in breast milk that are important for babies' growth

# Gut microbiome

- In fact, babies who are breastfed tend to have much higher levels of these beneficial bacteria in their intestines than those who are bottle-fed
- Similarly, babies who are born by standard vaginal delivery usually have more *Bifidobacteria* in their intestines compared to those born by caesarean section. Preterm birth can also reduce levels of these bacteria in infants
- *Bifidobacteria* may also help control the immune system and help the gut wall stay intact in infants, which can help prevent infections

# MICROBIAL LEGACY TRANSMISSION



**Maternal Gut  
Microbial Source**



**First contact:  
Pregnancy**



**Second contact:  
During birth**



**Third contact:  
Breastfeeding**

# Micro-organism in vaginal tract

- មេរោគដែលមានក្នុងផ្លូវបន្តពូជ lactobacilli (L. crispatus, L. jensenii, L. gasseri, and L. vaginalis) Eggerthella, Dialister, Gardnerella, Atopobium (L. iners, L. crispatus, L. jensenii and L. johnsonii
- Lactobacillus . Bifidobacterium Bacteroidetes
- មេរោគខ្លះល្អចំពោះពោះវៀនកូននិងជួយជំរុញភាពស៊ាំអោយប្រសើរឡើង

# C-section delivery



Maternal Gut  
Microbial Source



**First contact:**  
Pregnancy



**Second contact:**  
During birth



**Third contact:**  
Breastfeeding

# C-section NB

CS babies are not directly exposed to mother vaginal microbiota, so this first inoculum comes from other maternal localizations, such as skin or mouth, or from non-maternal sources like the surrounding delivery environment. (*Staphylococcus* spp.), whereas the microbiota of VD infants was closer to the mother's vaginal microbiota (*Lactobacillus*, *Prevotella*, or *Atopobium* spp.)



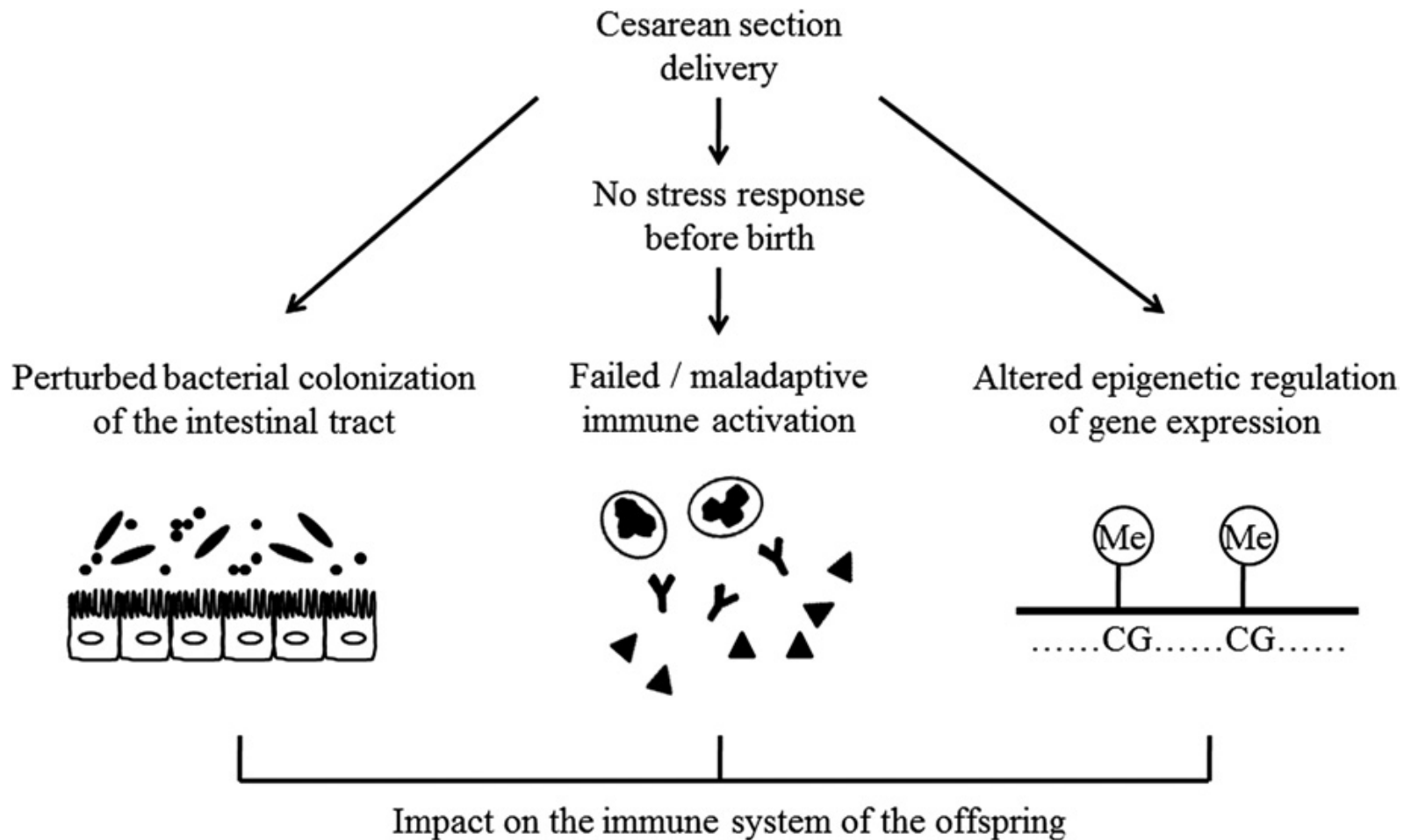
# Neonatal microbial colonization in C-section

- Clostridioides, Enterobacter, Klebsiella, Haemophilus, Staphylococcus, Streptococcus, and Veillonella ភាគច្រើន និតមមេរោគទាំងនេះមកពីស្បែកនឹងមាត់ ជាមេរោគក្នុងមន្ទីរពេទ្យ
- ការវះកាត់យកកូន ការប្រើអង់ទីប៊ីយ៉ូទិច ការដាក់កូនឆ្ងាយពីម្តាយ ស្ថានភាពមិនប្រសើររបស់ម្តាយឬកូន ការពន្យារពេលបំបៅដោះម្តាយ ធ្វើអោយភាពស៊ាំរបស់កូនមិនល្អ ហើយបង្កបញ្ហាថែមទៀត





# Mechanisms by which mode of delivery may influence immune system



# Early and Long-Lasting Effects

## C-SECTION

WHO recommendation: up to 10–15% total deliveries  
Nowadays: >30% in some countries



\* **Maternal indications:** chorioamnionitis, eclampsia or HELLP syndrome, foetal asphyxia/acidosis, umbilical cord prolapse, placenta praevia, obstructing labour, uterine rupture, etc.

\* **Neonatal indications:** large preterm, disease or foetal malformations in uterus, HIV or genital herpes in mothers, etc.



CS >15% → Risk mother and baby

Antibiotics  
(IAP)



Consequences

GUT MICROBIOTA → *Dysbiosis*

↓  
Bacteroides  
Bifidobacteria

↑  
Clostridia  
Firmicutes

**EARLY and LONG-LASTING Effects**



→ Infection, organs damage, negative consequences future gestations, etc.

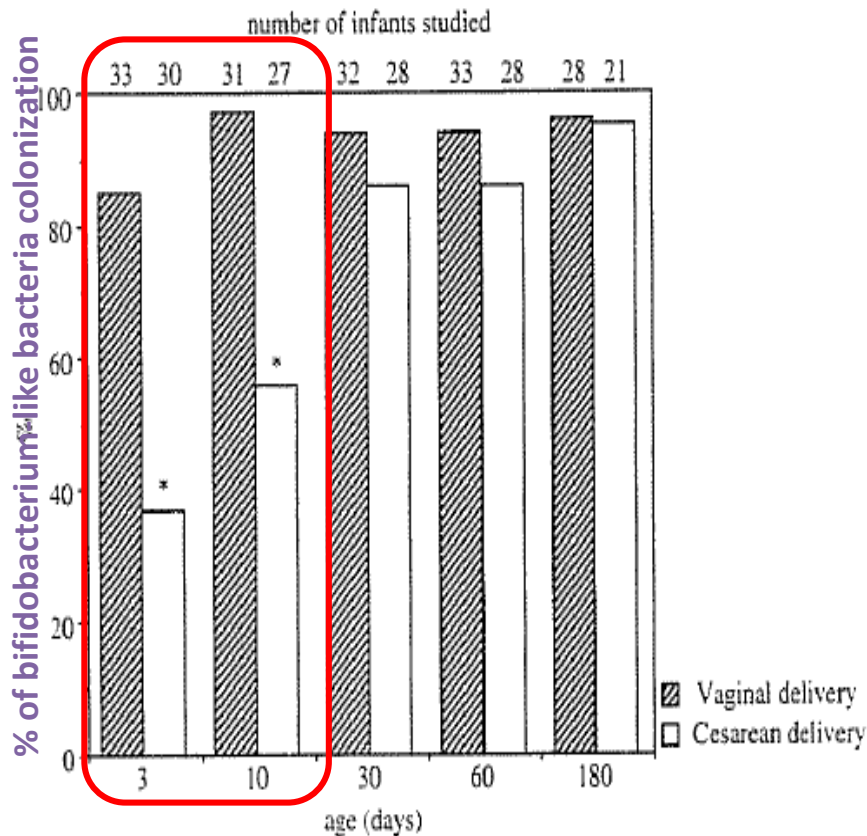
→ Obesity, allergy, type-1 diabetes, etc.



STRATEGIES FOR GUT MICROBIOTA RESTORATION  
HEALTH IMPROVEMENT

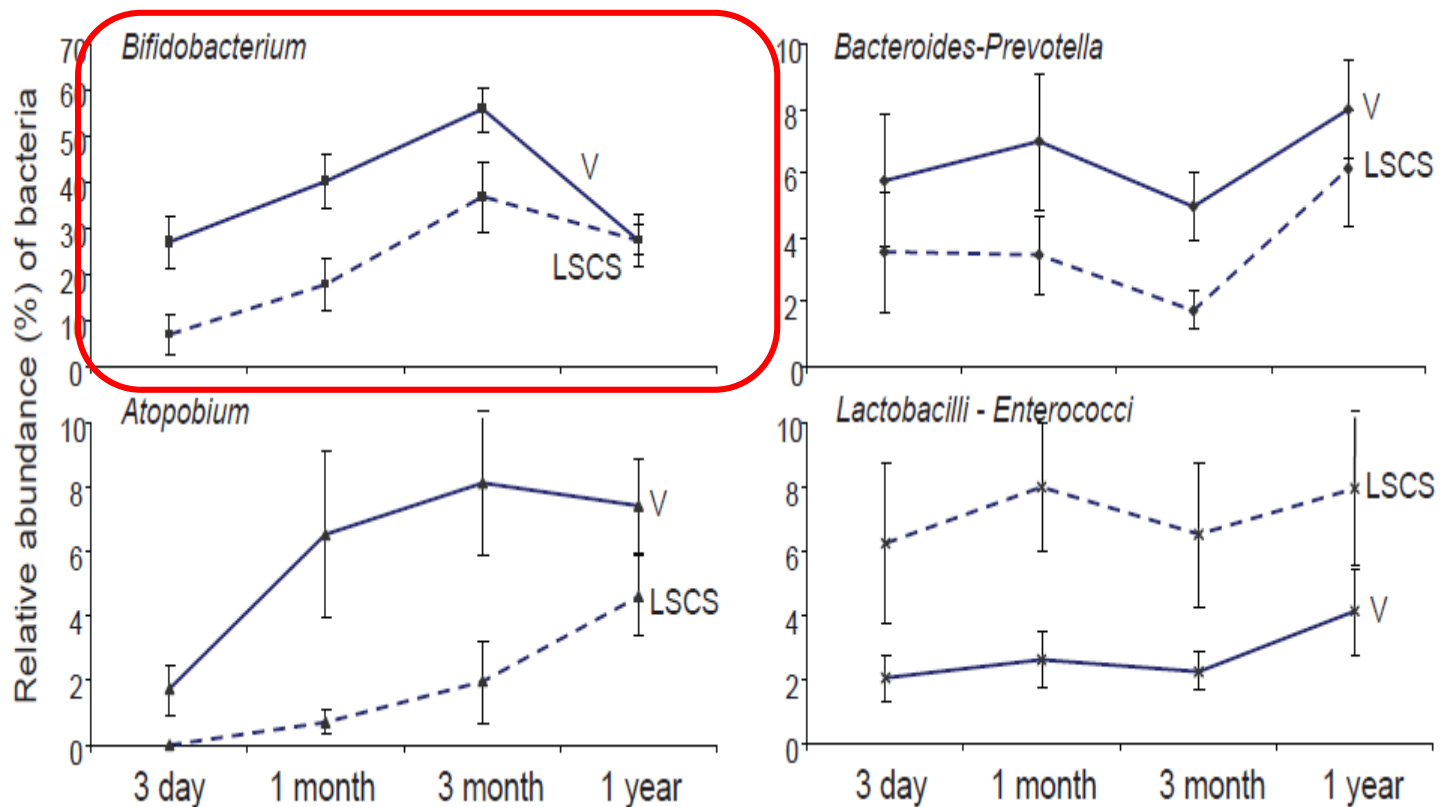
**Fig. 1.** CS and its implication on the neonatal gut microbiome acquisition. CS, C-section; HELLP, hemolysis, elevated liver enzymes, and low platelet count; HIV, human immunodeficiency virus; IAP, intrapartum antibiotic prophylaxis

# C-section born babies have less bifidobacterium, significantly from the very first day (European study)



- **European infants stool microbiota (64 Finnish infants)**
- **Gut microbiota of C-section born infants may be disturbed**

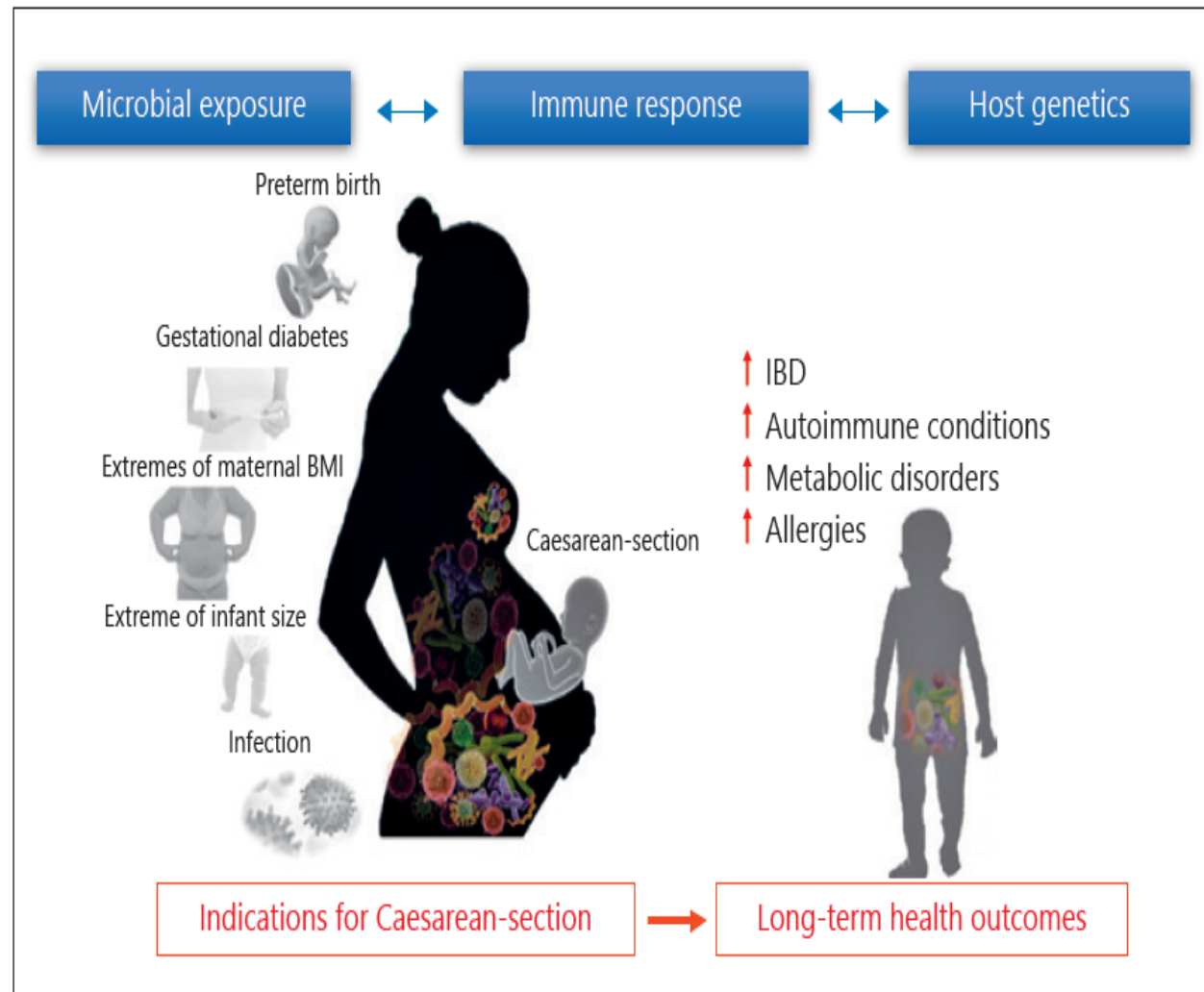
# C-section born babies have less bifidobacterium, significantly from the very first day up to 3-12 months (Asian study)



- **Asian infants stool microbiota** (42 Singaporean, 32 Indonesian)
- **Mode of delivery had largest effect on microbiota signature**

# C-Section and Long-Term Health Outcomes

**Fig. 1.** A summary of our current understanding of factors that indicate and conditions linked with a Caesarean-section delivery. The developing gut microbiota, microbial exposures from the environment, and host genetics interact to mediate infant immune responses. Several indicators of Caesarean-section, including preterm birth, extremes of maternal body mass index (BMI), infection, extremes of infant size, and gestational diabetes, may independently cause microbial dysbiosis and confound our understanding of the effects of Caesarean-section. Microbial dysbiosis caused by Caesarean-section delivery is linked with an increased risk for inflammatory bowel disease (IBD) and a wide range of autoimmune, allergic, and metabolic conditions.



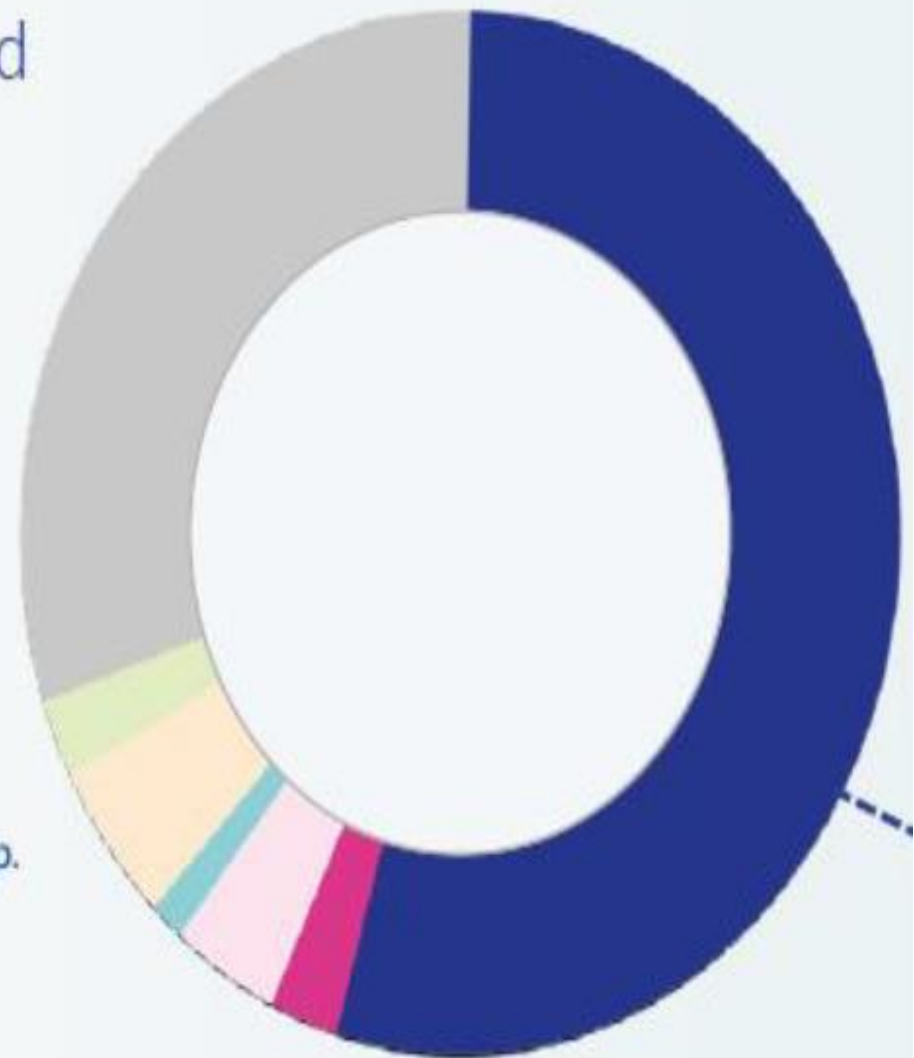
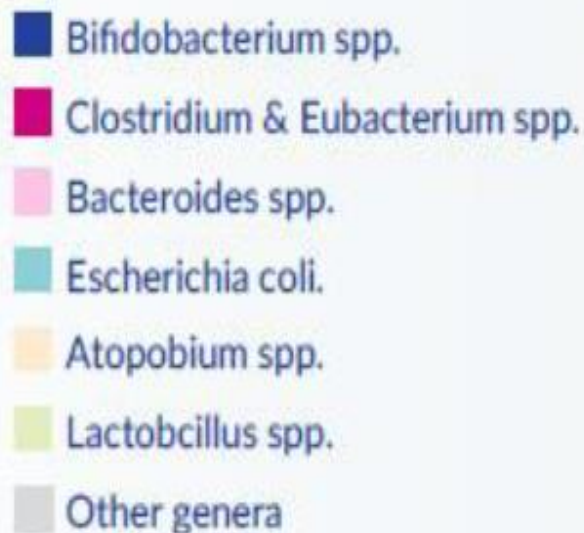
# Strategies for Shaping Gut Microbiota and Improving Health

**Breast milk** is the best nutrition for infants and constitutes the best modulator for the correct establishment of the microbiota and maturation of the immune system through its microbial content, bioactive oligosaccharides and extracellular vesicles including diverse cargo, as mRNA, miRNA and proteins.

- **Breastfeeding** is recognized as the optimal nutrition for infants. Previous studies have demonstrated that breast-milk provides a different recovery of the beneficial gut microbiota profile after its alteration.



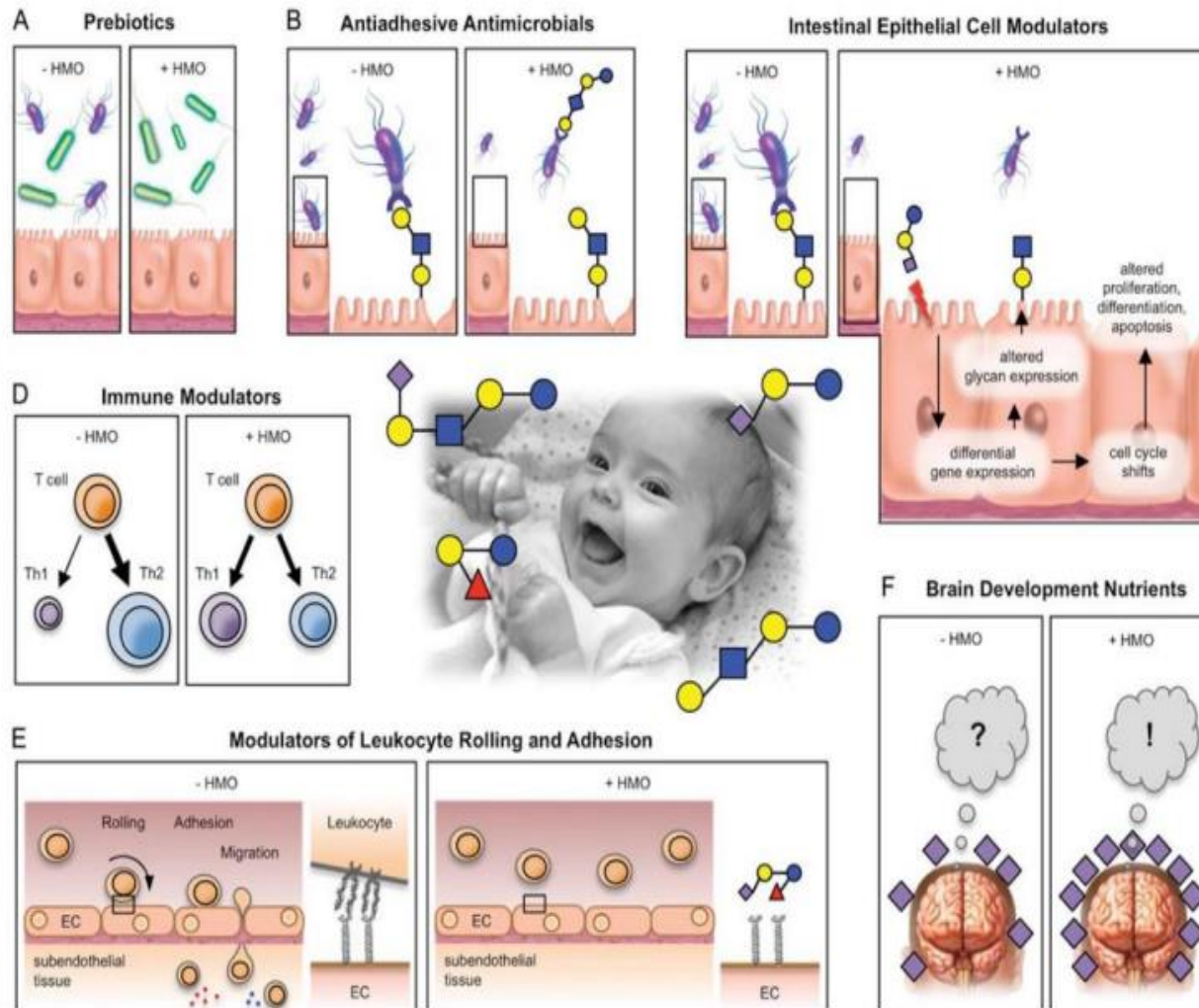
Healthy vaginally born breastfed infants have *Bifidobacteria* dominated gut bacteria<sup>1</sup>



Gut microbiota of healthy, breast-fed infants



# Human milk oligosaccharides: Every baby needs a sugar mama



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# Summary

- The babies born by C-section have different gut microbiota /gut flora, or microbiome to those born vaginally, but the differences largely disappear by the time the babies are between 6-9 months old.
- The premature babies and caesarean newborn are at higher risk of developing an illness because their immunity systems aren't as strong and they haven't had as many antibodies passed to them.
- Breast milk also contains antibodies, which means that babies who are breastfed have passive immunity for longer.
- The thick yellowish milk(colostrum) produced for the first few days following birth is particularly rich in antibodies.



**THANK YOU**