The role of gut microbiota in gastrointestinal tract health

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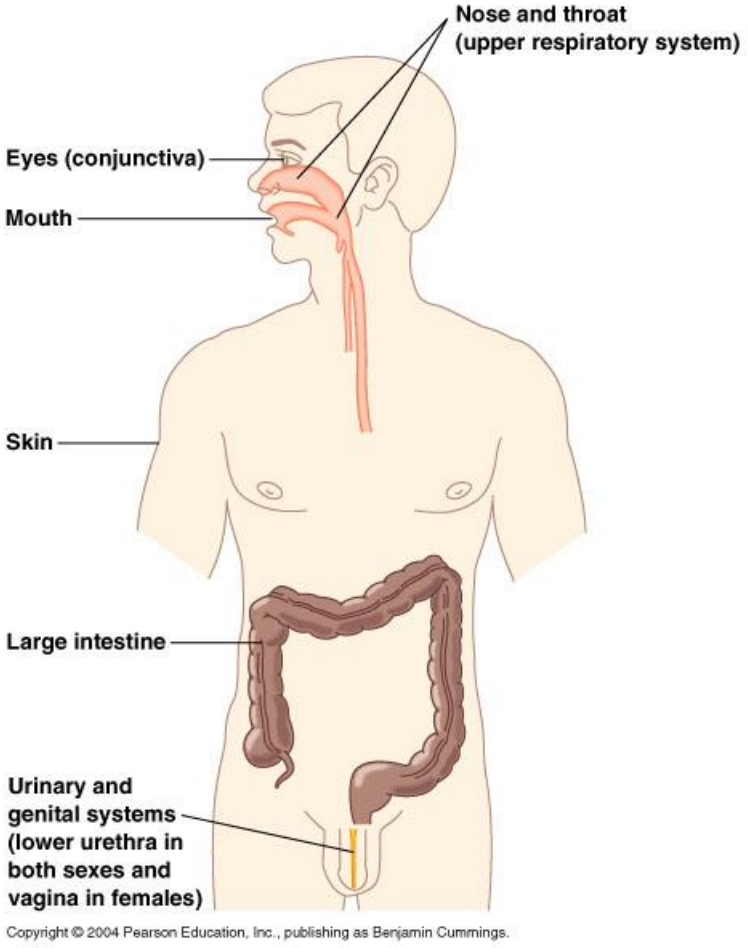
Introduction

- Of all the bacteria we encounter in our lives, **only a small minority are dedicated pathogens.**
- Bacteria have historically been the cause of a disproportionate amount of human diseases and death.
- Specifically, about one in a billion microbial species is a human pathogen. Indeed, **approximately 1400 human pathogens** have been described, whereas it has been **estimated that there are one trillion microbial species on Earth**, the vast majority of which remain uncharacterized.

- Microflora containing tissues:
- Skin
- Eyes (i.e.Cunjunctiva)
- Nose (i.e. Respiratory tract)
- Mouth (i.e Human Oral Cavity)
- Ears
- Urogenetal tract
- Elementry tract



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Sterile tissues:

In a healthy human, the internal tissues such as:

- blood
- brain
- muscle
- cerbrospinal fluid (csf.)

are normally free of microorganisms.



The Human Microbiome in Numbers

- The ratio of microbiome to human cells is approximately **10:1** (1972- Thumas Luckey)
- (One who is 70 kg, 20-30 years old and 1.7 m tall) contains on average about 30 trillion human cells and 39 trillions microbes
- Ratio for microbial to human cells for the average man of 1.3:1, with a wide uncertainty.
- It has been calculated that the normal flora human body about 10^{12} bacteria on the skin, 10^{10} in the mouth, and 10^{14} in the gastrointestinal tract.

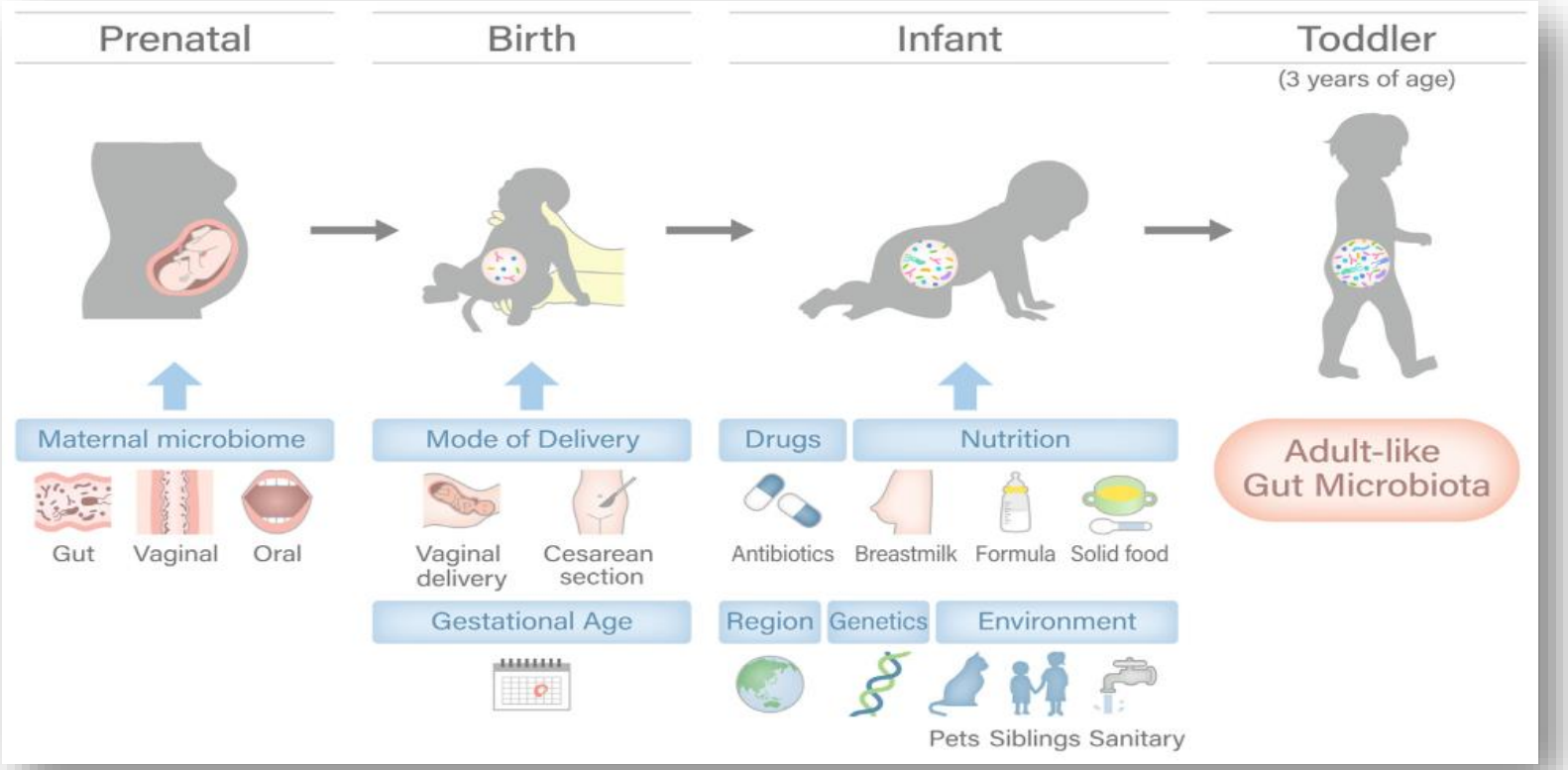
The Microbiome and GI Health



- At birth, the gastrointestinal tract is a sterile environment. Within a few months after birth, a relatively stable microbial population is established.
- The human microbiome **begins to develop in infancy**.
- After birth and during early maturation, exposure to **new energy sources** from **food** and the **external environment shapes** the content of the microbiome until a young child's microbiome reaches "adult status.

Multiple influencers in the formation of lifelong microbiota

Genetics, stress, diet, maternal microbiota, environment, hospitalization, antibiotics

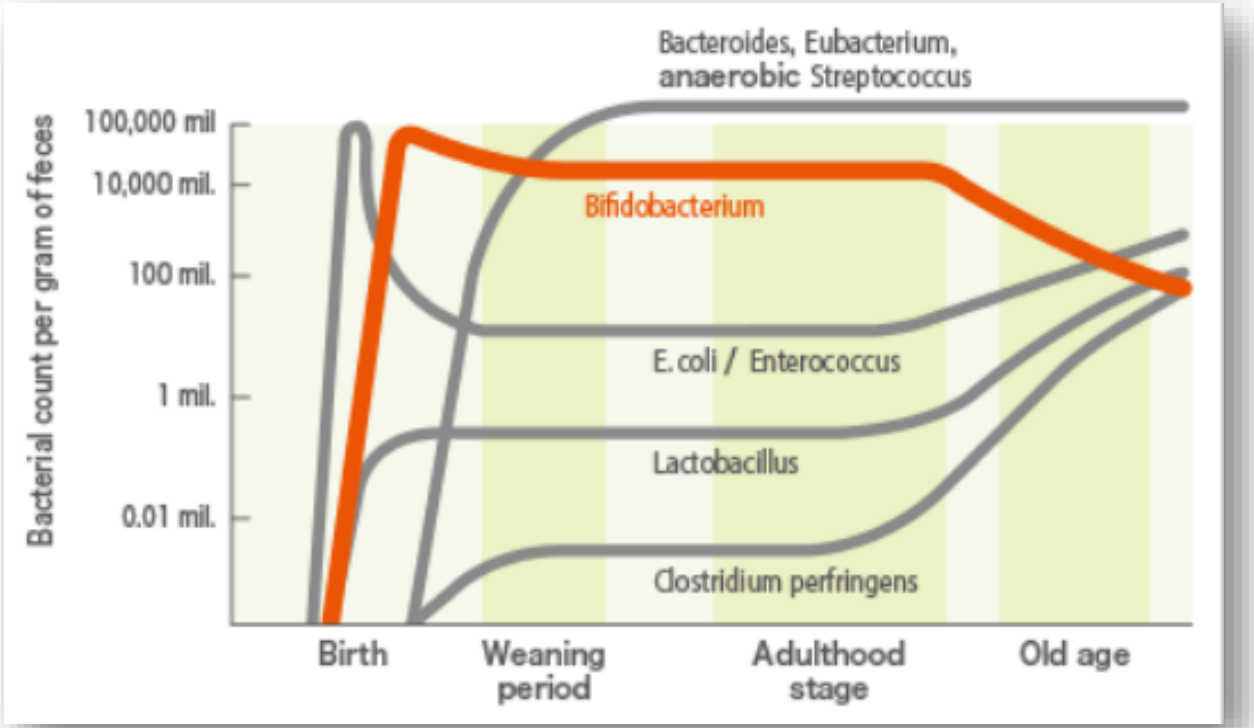


Family size, antibiotics, hygiene, geography, living environment, breast/formula feeding, weaning, diet

- This abundant, diverse and dynamic intestinal microflora normally lives in a complex, symbiotic relationship with the eukaryotic cells of the mucosa.

- Firmicutes are the most representative bacteria found in the human colon, and include Clostridia and lactic acid bacteria (LAB), and Bacteroidetes.

Changes in gut microbiota balance with age



The Microbiome and GI Health

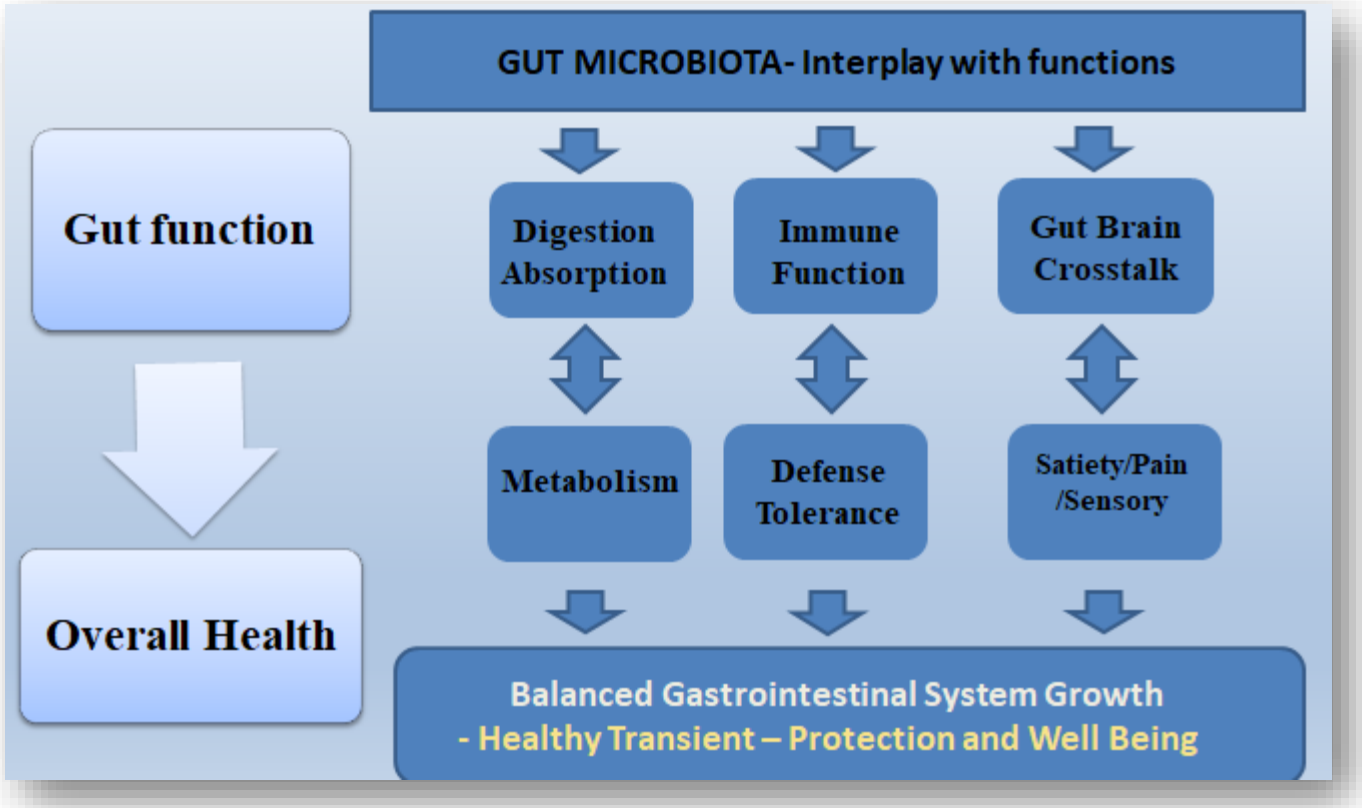
- Scientific evidence makes significant connections between **microbiome diversity**, **diet**, **physiological effects** – good and bad. For example, **poor microbiome health** is linked to increased levels of inflammatory cytokine

- **Many Factors May Affect The Content And Diversity Of The Human Microbiome:**

- Antibiotic Use, Prolonged Prescription Drug Use, Dietary Changes, Gastrointestinal Illness, Development Of Chronic Conditions, Moving To A New Country, Short Term Travel, And Even The Stressful Holiday Season

Gut microbiota

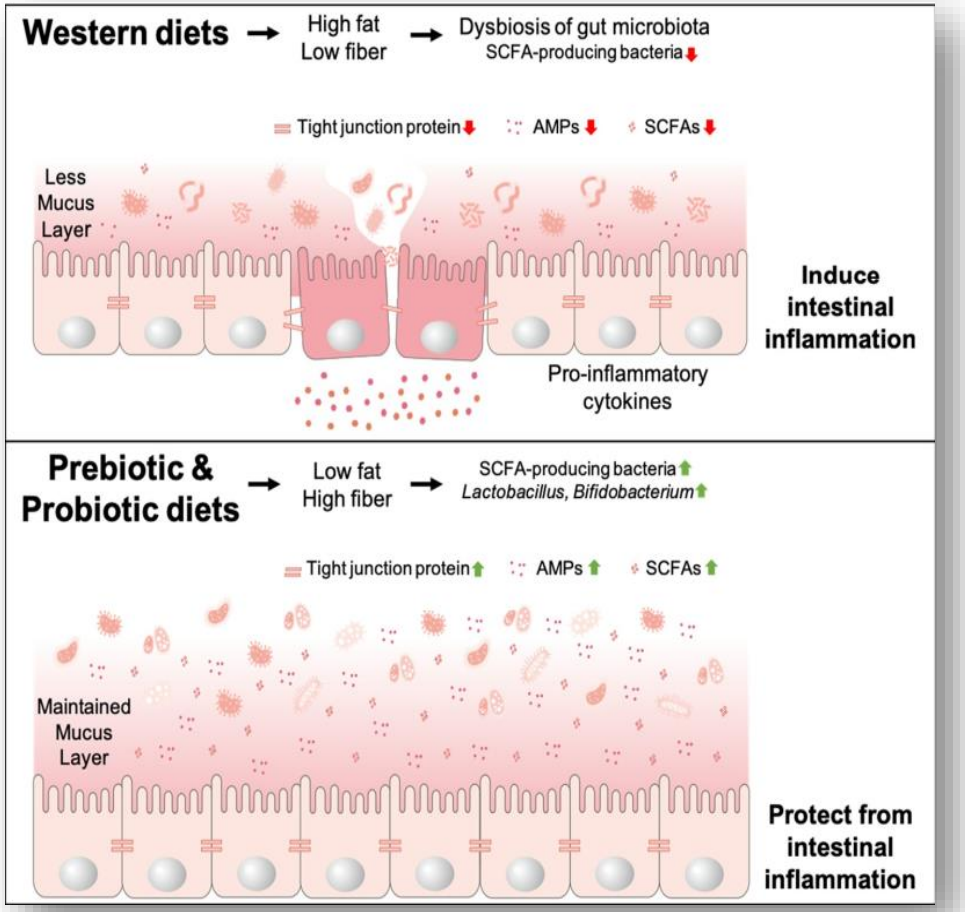
- **A key functional entity of the gut**



GI Dysbiosis

- GI dysbiosis can occur when the balance of the intestinal environment becomes disrupted by stress, poor diet, limited physical activity, or antibiotic overuse or misuse.
- Whether because of **genetics**, **early colonization**, **lifestyle**, or **other factors**, GI dysbiosis is associated with a myriad of health conditions such as:
- **Mood disorders (anxiety and depression)**
- **Leaky gut: a condition characterized by weakened junctions between epithelial cells**
- **Nutrient deficiencies**

Diet alters gut microbiota associated with intestinal inflammation



Western diets containing high fat and lack of fiber changes gut microbiota population

Phytonutrients and the Microbiome

- For the most part, phytonutrients from plant foods circumvent chemical breakdown in the gut until they reach the lower GI tract, giving them the opportunity to interact with the microbiota living there.
- Bacteria then break down these phytonutrients into metabolites small enough to then be absorbed through enterocytes and travel through the circulation.

Phytonutrients and the Microbiome



- Specific phytonutrients are uniquely able to support microbiota growth, which is associated with beneficial effects, like improving intestinal barrier integrity.
- Phytonutrients can also impact microbial diversity in the GI tract by both enhancing and reducing bacterial populations.
- **Microbial populations that benefit from phytonutrient support include:**

-Lactobacilli

-Bifidobacteria

-Akkermansia muciniphilia

North American Fat and Lazy Disease (NAFLD)

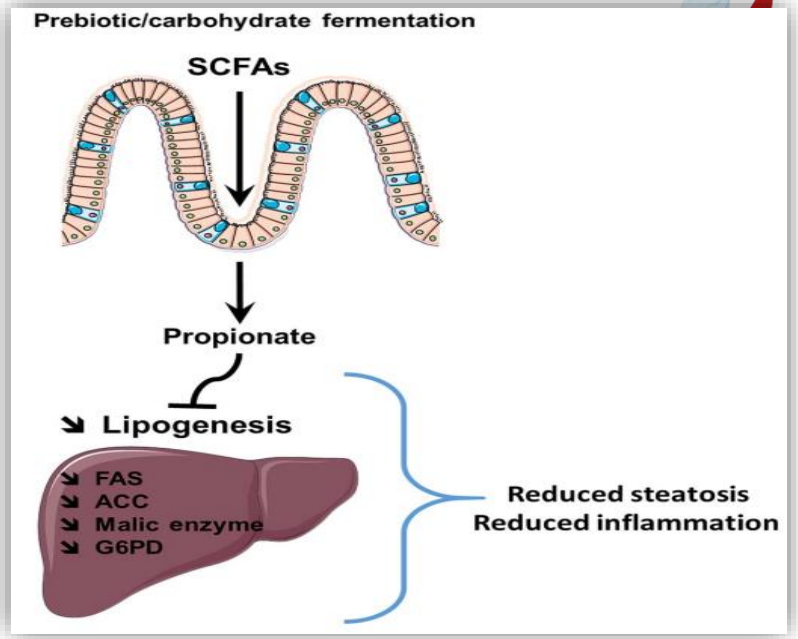




NAFLD/NASH

- In 2003, Letexier et al showed that changing the microbiota by using prebiotic decreased hepatic lipogenesis and plasmas triglycerides, thereby showing one of the first metabolic links between microbiota and liver in humans.

- **HIGH FAT OR HIGH CARBOHYDRATE DIET IN HUMANS:**
- **Bifidobacteria reduction**
- **Decrease in genes coding for tight junction proteins (Increase intestinal permeability, circulating LPS concentrations and endotoxemia)**



- In particular, obese people were shown to have lower Bacteroidetes and more Firmicutes in their distal gut compared to lean control, and this alteration was abolished after diet-induced weight loss.
- Moreover, in healthy subjects, the **microbiote suppresses** the expression of a fasting induced adipocyte factor (Fiaf), a lipoprotein lipase inhibitor, which is produced not only by the intestine, but also by liver and adipose tissue, and thereby being an important regulator of peripheral fat storage.

- Normally, intestinal **anaerobic bacteria** outnumber **aerobic bacteria**, the latter being responsible for bacterial translocation. Thus, anaerobic bacteria, suppressing the **colonization** and **growth** of potentially invasive microbes, exert an important role in maintaining gastrointestinal health and in reducing the translocation of potentially dangerous microbes.

- Evidences so far suggest that intrahepatic lipid accumulation does not always derive from obesity.
- Gut microbiota has been considered as a regulator of energy homeostasis and ectopic fat deposition,suggesting its implications in metabolic diseases.
- Probiotics are live microbes able to modulate the intestinal microflora and enhance body health.

Gut–liver axis

- Due to its anatomical links to the gut, the liver is a major filter organ and a first-line defense for the host.

- The liver is constantly exposed to gut-derived bacterial fractions or metabolites, and it is an important site for bacterial phagocytosis and clearance, as it hosts more than 80% of the body's macrophages.

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Thank
You