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Get to Know The Gut

Yakult Science Academy

A Guide for HCPs

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This practical guide aims to educate HCPs about the gut microbiota, its role in the body, and the factors which can influence it.

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About us

Yakult Science for Health is an educational hub for healthcare professionals to deepen their knowledge and understanding of the gut microbiota and probiotics.

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Gut Microbiota

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Gut glossary

Microbes
Tiny living beings which are too small to be seen by the naked eye e.g., bacteria, yeasts, archaea

Metabolome
The complete set of small molecule chemicals found in a biological sample e.g., short-chain fatty acids (SCFAs)

Gut microbiota
The community of microbes which reside in the gut

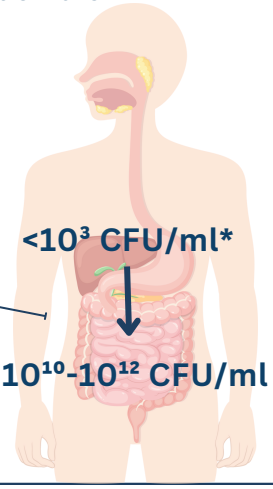
Gut microbiome
The microbes, their genes and metabolites comprising the microbiota

Gut microbiota diversity

Our guts harbour a complex community of ~38 trillion microbes[1], comprising 1000+ different bacterial species. Like a fingerprint, each person's gut microbiota is unique. It is estimated that we share only ~40% of the same microbiota as someone else.[2]

The gut microbiota extends throughout the entire digestive tract, from the oesophagus to the anus. The number and diversity of microbes increases from the top to the bottom of the digestive tract with most residing in the colon.[1] This is because the colon has an environment which allows microbes to thrive:

- Higher pH than the stomach
- Slow transit time



*CFU; colony forming unit - a unit which estimates the number of microbial cells in a sample that are viable

Defining a 'healthy' gut microbiota

There is no universally accepted definition of a 'healthy' gut microbiota due to the large inter- and intra-variability and the many combinations of the thousands of different species of microbes which can reside there. In general, a gut microbiota is considered optimal when it is:[3]

Diverse
Gut microbiota diversity refers to the number of different species of microbes present and their distribution.

Stable
In a dynamic state but allowed it to maintain its functional richness under external influences.

Resilient
The capacity to return to equilibrium in response to chemical (e.g., antibiotic), physical (e.g., pH changes), or microbial (e.g., faecal transplants) changes.

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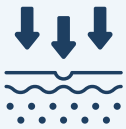
Key Roles of the Gut Microbiota

Comprising trillions of microorganisms, the gut microbiota inhabits our gastrointestinal tract and influences various aspects of our physiology.[4,5] The commensal bacteria in our gut microbiota (which exist to benefit the host without causing harm, supply essential nutrients and defend the host against opportunistic pathogens) play a key role in maintaining our health.

Immunity

The gut microbiota can stimulate an immune response. For example, by producing metabolites such as SCFAs which mediate cross-talk between gut epithelial and immune cells (70-80% of our immune cells reside in the gut).[6]



Absorption

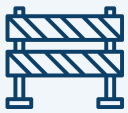
The gut microbiota plays a role in absorption of nutrients by breaking down complex complements such as dietary fibre. The gut microbiota also supports absorption of minerals e.g., calcium and iron.[7]

Fermentation

Gut microbes ferment dietary fibres to SCFAs to provide energy to gut cells.[4] These SCFAs play key roles in regulating bodily processes such as metabolism, gut-brain communication and immunity.

Communication

The gut microbiota communicates with major organs and systems around the body. For example, the brain and nervous system, amongst others.[8]



Intestinal barrier integrity

The intestinal epithelial barrier is not a static physical barrier. It interacts with the gut microbiota and immune cells to protect against pathogens.[9]

Protection

The gut microbiota stimulates secretion of antimicrobial substances to protect against harmful bacteria.[4]

Synthesis

The gut microbiota contributes to the synthesis of key vitamins (e.g., K and B vitamins).[4]

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Factors Affecting the Gut Microbiota

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The gut microbiota composition is affected by a number of different factors, some modifiable and some non-modifiable.[10]

Method of delivery

The composition of the gut microbiota is influenced by the method of birthing delivery.[11] Newborns delivered via caesarean section acquire their gut microbiota from the skin, leading to dominance of *Staphylococcus*, *Corynebacterium*, and *Propionibacterium*. Whereas babies delivered vaginally have a gut microbiota dominated by *Lactobacillus* and *Prevotella* (i.e., more beneficial bacteria) derived from the mother's vaginal microbiota.

Exercise

Regular exercise can help to promote healthy bacteria in the gut, which in turn could reduce inflammation and support immune function. Exercise enriches the diversity of the gut microbiota and improves the *Bacteroidetes* : *Firmicutes* ratio. This may contribute to a weight reduction.[12] Exercise also improves mucosal barrier function and stimulates production of SCFAs (e.g., butyrate, propionate) which can protect against gastrointestinal disorders.[13]

Age

As we age, the diversity of the gut microbiota often decreases and there are unfavourable alterations to the *Bacteroidetes* : *Firmicutes* ratio indicative of an imbalanced gut microbiota.[14] Due to a loss of gut microbiota diversity, there is often a reduction in SCFA-producing microbes meaning that fewer SCFAs are produced in the colon of older people.[15]

Diet

The gut microbiota adapts according to what we eat.[16] Consuming a variety of plants results in a greater consumption fibre. Fibre feeds gut microbes and increases the number and types of beneficial bacteria (i.e., lactobacilli and bifidobacteria) in the gut, creating a more diverse gut microbiota. A landmark study showed that individuals who consumed >30 different types of plant (from the 6 categories below) per week had a more diverse gut microbiota compared to those who ate <10 different plants.[17]

Fruits | Vegetables | Legumes | Nuts & Seeds | Wholegrains | Herbs & Spices

Antibiotics

Antibiotics destroy both pathological and beneficial microbes leading to the loss of gut microbiota. They disrupt the gut bacteria's ability to compete for available nutrients and mucosal adhesion sites (i.e., competitive exclusion) which is needed for the microbiota to eliminate pathogens.[18]

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The Gut Microbiota Throughout Life

The composition of the gut microbiota changes throughout life and is influenced by both modifiable and non-modifiable factors.

Pregnancy

The maternal gut microbiota shapes the neonatal gut microbiota, via direct transfer of bacteria. This process plays a vital role in infant development, and can contribute to the neurodevelopment of the child with potentially long-term and multi-generational outcomes.[19]

Mode of delivery

Babies born by vaginal delivery are exposed to diverse maternal microbes[20] and have been shown to have increased bifidobacteria. This is associated with a lower risk of childhood infections, atopic disorders, and obesity.[21,22]

Milk source

The type of milk given to the infant influences the gut microbiota. Research shows that greater numbers of *Bifidobacterium* and *Bacteroides*, and lower numbers of *Streptococcus* and *Enterococcus* are seen in breastfed babies compared to those consuming formula milk.[24]

Childhood

Increased hygiene measures and broad-spectrum or excessive antibiotic use can contribute to a reduction in gut microbiota diversity in children.[18,23]

Adolescence/Adulthood

The gut microbiota composition is determined by modifiable diet and lifestyle factors as detailed on page 3.

Menopause

The gut microbiota becomes less diverse during menopause, reflecting that of the male gut microbiota.[25]

Older adulthood

Gut microbiota diversity rapidly declines with age.[26]

From birth to ~3 years-old is the critical window of opportunity to modulate the gut microbiota composition.[26–28] Beyond this age, the microbiota is more stable and mature, showing 40%-60% similarity with the adult microbiota.[29]

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Gut-Everything Axis

The gut microbiota can be seen as the conductor in the orchestra of health. It communicates with a number of major organs to regulate and facilitate their functioning.

Gut-immune axis

The gut-immune axis refers to the two-way relationship between gut health and immunity. The gut microbiota supports effective digestion and absorption of nutrients from food, trains immune cells and produces metabolites which play an important role in immune function.[30]

Gut-brain axis

The gut-brain axis is the bidirectional communication between the gut and the brain. The most direct route of communication between the gut microbiota and the brain involves signalling via the vagus nerve. The enteric nervous system (ENS) is central to the gut-brain axis and allows the gut to function independently of the brain.[5] The gut microbiota helps to regulate the gut-brain axis through many complex pathways, including the immune, neurological, endocrine and nervous systems.

Gut-metabolism axis

The gut microbiota influence host metabolism. The gut microbe-mediated release of hormones (e.g., CCK, PYY, GLP-1, GIP, and 5-HT) play an important role in key metabolic processes such as insulin sensitivity, glucose tolerance, fat storage, and appetite.[31]

Gut-skin axis

The main route of communication between the gut microbiota and the skin is via the immune system. The gut microbiota is a key regulator for the immune system as it aims to maintain homeostasis by communicating bidirectionally with key tissues and organs. The occurrence of dysbiosis in the skin and/or gut microbiome is associated with an altered immune response which can lead to the development of skin diseases including atopic dermatitis, psoriasis, acne vulgaris, dandruff, and even skin cancer.[32]

Click here to access our Gut-Everything resources to learn more

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