

## Role of Gut Health in Overall Health and Immunity

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### Abstract

Gut plays a crucial role in maintaining overall health and influencing various physiological processes beyond digestion through activation of gut-organ axes. Gut health is intertwined with the immune system, with gut flora acting as a key player in immune function of the host. A balanced gut flora contributes to proper nutrient absorption, supports mental well-being and even affects weight management. Imbalances in gut bacteria, often caused by diet, stress, or antibiotics, can lead to digestive disorders and impact overall health negatively. Prioritizing gut health through a diverse, fiber-rich diet, probiotics and stress management is essential for achieving optimal gut health and ultimately, better overall health and wellbeing.

**Keywords:** Gut flora, Gut health, Gut-organ axes, Overall health

### Introduction

The gastrointestinal tract (GIT) is commonly called “gut”, however, gut is actually comprised of an epithelium, an immune system and the gut flora or gut microbiome. ‘Gut flora’ refers to a diverse community of trillions of bacteria and other useful microorganisms that inhabit the gastrointestinal tract. ‘Gut health’ is defined as the absence of diseases of GIT, as well as absence of other adverse local conditions such as disrupted intestinal integrity, intestinal inflammation, *etc.* A healthy gut is responsible for maintaining the normal physiological functions and enables the host to defend against infectious and non-infectious stressors. The gut health is often seen as synonymous with overall health, immunity and performance of the host.

The concept of gut health has gained significant attention in the current era, reflecting an evolving understanding of the intricate relationship between the GIT and overall well-being. There exists a pivotal role of the gut microbiome in influencing various aspects of health. Gut health plays a major role in immune functions, mental health, metabolic health, digestive health and overall cumulative health (Bischoff, 2011).

#### Composition of Gut Flora

The most common and useful bacterial populations found in the gut flora are (Fouhse *et al.*, 2016):

- *Bacteroidetes*: This phylum of bacteria is known for its ability to break down complex carbohydrates and produce short-chain fatty acids, which can have various health benefits.
- *Firmicutes*: This includes several genera such as *Lactobacillus* and *Clostridium*. Some of these bacteria are associated with obesity when their populations are out of balance.
- *Actinobacteria*: This group includes *Bifidobacteria*, known for their beneficial effects in fermenting dietary fibres and producing vitamins like B<sub>12</sub> and folic acid.
- *Proteobacteria*: This phylum includes a diverse range of bacteria, some of which can be pathogenic if their populations grow unchecked. However, these also play roles in various metabolic processes.
- *Fusobacteria*: While some *Fusobacteria* species are associated with diseases like periodontitis, others are part of the normal gut flora and have roles in carbohydrate metabolism.

#### Functions of Gut Flora in Gut Health

Gut flora plays an important role in maintaining nutritional, physiological and immunological functions. The data of experiments on humans and animals have shown that the gut communicates with gut flora that helps in digestion by their enzymatic action. Gut flora also regulates the immune

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functions by producing chemical substances that kill bad bacteria, viruses and fungi. The gut immune system plays a crucial role in preventing infections and gut epithelial cells are the largest immune organ. Intra-epithelial T-lymphocytes (IELs) and M-cells are the main components of gut immune system. IELs contribute to repair and replacement of gut epithelial cells while M-cells serve as gatekeeper for mucosal immune system as they possess microvilli and short brush borders. Gut-associated lymphoid tissue (GALT), mesenteric lymph nodes and immunoglobulin A (IgA) prevent the attachment of pathogens with gut epithelial cells. Moreover, gut flora prevents colonization of pathogenic microbes, contribute to energy homeostasis, synthesize vitamin K and support angiogenesis (Figure 1). Several bacterial components and metabolites have been demonstrated to promote intestinal satiety pathways and control the appetite (Fetissov, 2017).

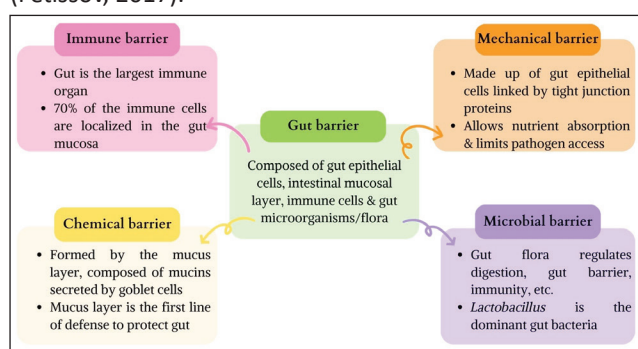


Figure 1: Different gut barriers for optimal health and immunity

### Gut-Organ Axes

The gut is responsible not only for digestion, but also for assisting other vital functions of the body through various 'gut-organ axes'. These axes act between the gut and non-gastrointestinal organs as:

#### 1. Gut-Brain Axis

The gut-brain axis (GBA) involves two-way interaction between the central nervous system and enteric nervous system. This connects the brain's emotional and cognitive areas with the gut functions. Several psychological disorders, such as anxiety, depression, etc. have well-established links to functional diseases of gut; whereas gut diseases (irritable bowel syndrome, etc.) involve psychological comorbidities associated with disturbed gut flora.

#### 2. Gut-Skin Axis

The gut-skin axis describes two-way communication between the gut microbiome and skin health. Disruption in the balance of gut bacteria has been observed in inflammatory skin conditions like atopic dermatitis, psoriasis, etc.

#### 3. Gut-Bone Axis

The gut flora plays a crucial role in regulating bone health, impacting both postnatal skeletal development and skeletal changes as age advances. Short-chain fatty acids (SCFAs), which are formed by fermentation of complex carbohydrates in the gut, have regulatory effects on bone apoptosis (Zaiss

et al., 2019).

### Interrelationship between Gut Health and Overall Health

- **Digestive Function:** Good gut health is crucial for effective digestion and an imbalance in the gut flora or a compromised gut lining can lead to digestive issues such as bloating, diarrhea and constipation.

- **Nutrient Absorption:** The gut is responsible for absorbing nutrients from the food and a healthy gut lining allows for efficient absorption of essential vitamins, minerals and other nutrients necessary for overall good health.

- **Immune Functions:** A large portion of the immune system is located in the gut and a balanced and diverse gut microbiome is associated with a strengthened immune system, helping the body to defend against infections and diseases.

- **Mental Health:** The gut flora can influence mental health and cognitive functions. Microorganisms in the gut release neurotransmitters like serotonin, which can affect the mood and psychology. Thus, imbalances in the gut flora may lead to anxiety and depression.

- **Inflammation Regulation:** A healthy gut helps to regulate inflammation and therefore, chronic gut inflammation is linked to health troubles, including autoimmune diseases and metabolic disorders.

- **Metabolism and Obesity Control:** The gut microbiome can influence metabolism and energy balance. An imbalance in gut bacteria may contribute to weight-related issues and metabolic disorders

- **Hormonal Control:** The gut is involved in the metabolism and regulation of hormones. Poor gut health can influence hormonal levels, potentially resulting in conditions such as insulin resistance (Bischoff, 2011).

### Strategies to Promote Gut Health

Achieving and maintaining gut health involves a combination of lifestyle, dietary choices and overall wellness practices. Several strategies for promoting a healthy gut are (Upadhaya and Kim, 2021):

- Dietary inclusion of a range of fibre-rich foods (fruits, vegetables, whole grains, legumes, nuts) and nutrients that support a diverse gut flora.

- Supplementation of probiotics, prebiotics and synbiotics in the daily diet.

- Restricted intake of artificial additives and sugar intake to maintain the gut flora.

- Adequate intake of water as staying hydrated is important for gut health and overall health.

- Addition of omega-3 fatty acids, such as fatty fish, flaxseeds and walnuts, which can have anti-inflammatory effects on the gut.

- Regular exercise is linked to a more diverse gut flora and superior gut health.

- Following adequate sleep patterns is essential for gut health and overall health.

- Overuse or misuse of antibiotics without expert opinion must be avoided as it can disrupt the balance of the gut flora leading to poor gut health and consequently, decreased immunity and wellbeing.

### Conclusion

Gut health plays a crucial role in maintaining overall well-being and is essential for optimal functioning of the human and animal body. A balanced and diverse gut flora contributes to proper digestion and absorption of nutrients, supports a strong immune system and helps to regulate metabolic functions. The gut-organ axes highlight the impact of gut health on mental well-being, mood regulation, cognitive function, skin inflammation and bone health. Judicious use of antibiotics and dietary supplementation of probiotics and fiber-rich foods result in improved gut health and enhanced wellbeing.

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