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Gut Microbiota and Its Importance for Our Health

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ABSTRACT

In 450 BC, Hipocrates stated, "All diseases begin in the gut. When the gut is sick, the back part of the body is also sick." This sentence is explained with the term "microbiota" in human body. Microbiota is the environment where microorganisms such as fungi, bacteria, and virus live together in our body. These microorganisms are found in certain parts of our body, upper respiratory tract, gastrointestinal tract, urinary system, eyes, and skin. Microbiota has been shown to change according to drug use, nutrition, age, and environment. As a result of these changes, learning, memory, functioning of the psychological or immune system, drug metabolism, and hormonal changes may occur. The aim of this article is to explain the importance of intestinal microbiota which is our second brain and the importance of our health.

Keywords: Intestinal flora, microbiota, microorganism

INTRODUCTION

Microorganisms that are normally found in plants, animals, and humans and are a part of their lives are called "normal micro flora," and the microorganism found in the environment is called "environmental microflora." Normal microflora and environmental microflora are in constant interaction with each other. This interaction is sometimes beneficial, often harmful.[1]

Human gut is a habitat for various microorganisms such as bacteria, fungi, parasites, and viruses. After years of joint development, the human body has become a mutually beneficial symbiotic relationship with gut bacteria.[2,3] The terms microbiome and microbiota are often used. Microbiome refers to the genes carried by microorganisms living commensally with humans.[4,5] Microbiota organisms, which are symbiotic with the human body, form a complex microecological flora. This symbiosis can affect both systems. For example, a change in the amount and distribution of the intestinal microorganism population may affect the intestinal barrier function, increase the secretion of toxic substances, and reduce the secretion of beneficial substances in the human body, leading to enteral and other diseases.[2] Age and diet, in particular, can have a significant impact on gut microbiology. Numerous human and animal studies have shown that different diets can cause significant changes in the microbiota. Infection and disease can also have an adverse effect on the normal intestinal flora of the host, thereby causing detrimental effects on the host.[6-8] Microbiota also plays an important role in human disease and health. In humans, the microbiota, especially the gastrointestinal (GI) microbiota, acts by providing the necessary signals for disease and health conditions, the maturation of immune cells, and the normal development of immune system functions, by absorbing and fermenting undigested carbohydrates.[9] There are different ecosystems in our world, each of which creates its own species and communities. Likewise, there are different ecosystemic structures in a human body—skin, mouth, intestines, and reproductive organs—and every organ that has a connection with the outside world has its own characteristic microbe communities.[10] The microbiota has been colonized in many systems in the human body.[11] The interactions of microorganisms (microbiota) inside the oral cavity with their hosts is oral microbiota.[12] Skin microbiota refers to microorganisms typically found on human skin. Most of them consist of about 1000 different types of bacteria.[13,14] This flora prevents the colonization of pathogenic microorganisms on the skin surface by consuming the nutrients of transient pathogenic organisms, secreting chemicals against pathogenic microorganisms, or stimulating the immune system.[15] The vaginal microbiota is composed of especially lactobacilli and plays a very important role in maintaining the health of the female genital tract and preventing genitourinary infections.[16] However, since the digestive system has a very large surface area and contains rich nutrients for microorganisms, it offers the most suitable environment for colonization. Therefore, the colon alone contains more than 70% of the microorganisms in our body.[11]

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The Relationship Between Flora and the Human Body

The fetus is sterile while in the uterus. The baby comes into contact with microorganisms during and immediately after birth. These microbes that settle on the skin and mucous membranes form the groups of microorganisms we call flora.[17] Normal microbial flora can be examined in 2 groups as permanent flora and temporary flora. Permanent flora is a community of microorganisms that are always present in certain body parts at a certain age, generally unchanged, that regenerate even if they are eliminated for a short time and that shows continuity. Temporary flora, in addition to the permanent flora, is a community of environmental microorganisms, most of which do not cause disease, can sometimes be pathogenic, and can remain from a few hours to several weeks.[18] The number of people living on earth is approximately 7 billion (as of 2012). On the other hand, the number of bacteria living on earth is 5 nonillion (5×10^{30}). There is approximately 1 quintillion (10^{18}) bacteria per every living person. There are approximately 100 trillion cells in a human body.[19] There are microorganisms that live in the flora 10 times more than that, and the majority of them are bacteria.[20]

Formation of Intestinal Flora

The adult human intestine is an organ rich in microorganisms, the number of which reaches about 100 trillion. The number of species in this microorganism pool is between 300 and 1000 and the microorganism weight is about 2 kg. The majority of the microbiota consists of eukaryotic fungi, viruses, and a few archaea, with colonies formed by bacteria along the intestinal line.[21] Our brain is affected by our intestines and even our GI tract.[22] This situation complies with psychiatrists' principle of opening or closing our appetite as our mood changes. Biologists describe this line of communication as the "brain–gut axis line."[23] Gut–brain axis is a 2-way communication system between the central nervous system (CNS) and the enteric nervous system (ENS) and intestinal communities.[24,25] An organism's microbiota can control its social attitude and ability to cope with stress, including the host's behavior. In our intestines, mainly firmicutes, bacteroidetes, *Actinobacteria*, *Proteobacteria*, *Fusobacteria,* and *Verrucomicrobio* bacteria families live.[23] However, the human gut microbiota contains more than 1000 species and more than 7000 subspecies.[26]

Intestine–Brain Axis and Its Relationship with Microbiota

The mechanisms behind the developing gut–brain axis are still unclear, but there are many hypotheses explaining the role of the immune system, bacterial metabolites, and endocrine effects in this axis.[27] In the gut–brain axis, molecular communication between the CNS and the GI tract is critical for maintaining healthy brain function, especially in the aging state.[28,29] Today, this axis is accepted as a bidirectional system that regulates the functions of 2complex organs under physiological conditions or becomes disordered under pathological conditions. Bi-directional communication between gut and brain is regulated by neuronal, endocrine, and immunological levels. The second brain, known as the "Enteric Nervous System," consists of neuronal sheaths embedded in the walls of the long tube of our intestines, or digestive tract, which extends about 9 m from the alimentary canal to the anus.[30] The ENS is sometimes called the "second brain" and actually arises from the same tissue as the CNS during embryonal development. The microbiotic composition of the gut is associated with maintenance of gut homeostasis, protection against pathogens, and an appropriate immune response.[31] Many environmental factors affect the gut microbiome. Geography, life cycle, mode of birth, infant feeding, stress, exercise, hygiene, infections, medications, and nutrition are some of these environmental factors. Worldwide, western diet and lifestyle changes have increased cardiovascular disease, cancer, and metabolic and allergic diseases. Nutrition has a major impact on the shape and structure of the intestinal and even farther uterine microbiome during the neonatal period and into adulthood.[32]

The GI tract system (GIS) is the largest immune organ. The GIS-related products may be neuropathogenic. The potential mechanisms of the effect of the microbiota on the CNS are summarized as follows: changes in microbial content, immune stimulation, neural pathways (via nerve vagus), tryptophan metabolism, serotonin, intestinal hormonal response, and bacterial metabolites. Short-chain fatty acids are formed as a result of fermentation in carbohydrate-heavy diets, and they affect brain functions by mixing with the systemic circulation. The nervus vagus connects the brain directly with the stomach and intestines like a broad highway. Hormonal, nervous, and, interestingly, bacterial changes in the intestines are transmitted to the brain via the vagus nerve.[31] Various cancers, asthma, autism, diabetes mellitus, insulin and metabolic syndrome, obesity, autoimmune diseases, multiple sclerosis, psychological problems, and many other diseases can occur as a result of intestinal–brain disorders.[33]

CONCLUSION

In conclusion, it is understood that microbiota is an indispensable element for our health. In particular, the gut microbiota manages our body like a second brain. Keeping the intestinal microbiota composition in the right balance is very important for a healthy life. There is a mutual and strong interaction between nutrition and gut microbiota. It is thought that a significant part of the differences in the intestinal microbial patterns of individuals can be explained by nutrition. It has been shown that nutrition can affect both intestinal microbiota composition and function by affecting microbial diversity, microbial taxonomy, genetic information, gene expressions, and enzyme activities. Further studies are needed in order to solve the mechanism of the effects of nutrition on the microbiota and to develop recommendations in this regard. The results obtained from current studies underline the importance of adequate and balanced nutrition in terms of energy and macronutrients. In addition, it is predicted that it will be beneficial to enrich the diet with plant-based foods containing fiber components, which are natural prebiotic sources, and fermented foods, which are natural probiotic sources.

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