Healthy Aging and Intestinal Microbiota

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Abstract

Aging is defined as the deterioration that occurs in physiological functions with the progress of the age. The intestinal system consists of a complex structure of approximately 1013 - 1014 microorganisms. Human intestinal microbiota has an important role in various metabolic, nutritional, physiological and immunological systems. Deterioration in physiological functions with aging causes a decrease in microbial diversity, DNA damage, stress response and protection of the immune system in the intestinal system. Aging also affects the gastrointestinal tract, negatively affecting the hormones that control food intake; thus, reducing food intake. Nutritional status affects bowel health, bowel microbiota composition, and activity. Due to dietary differences, low-fat and high fiber content polysaccharides from vegetable origin have led to high *Firmicutes* type of colonization, while animal fats containing high fat and low fiber content have led to low *Firmicutes* type of microorganism colonization in intestinal microbiota. Aging has an effect on nutrient consumption, while nutrient consumption has effects on aging. For this reason, the consumption of nutrients containing probiotic bacteria (probiotics) or nutrients (prebiotics) will enable the beneficial microorganisms to survive/multiply in microbiota. The consumption of nutrients high in fiber content to provide short-chain fatty acid synthesis has become increasingly important in recent years. Therefore, this review aims to investigate the interaction between intestinal microbiota and healthy aging to understand the relationship between microbiota and nutrition and its effects on metabolism.

Keywords: Healthy Aging; Intestinal Microbiota; Firmicutes

Introduction

Aging; is defined as the deterioration that occurs in physiological functions with the progress of age [1]. Developments in health, nutrition, hygiene and economic, social and medical care conditions of the countries have led to an increase in lifespan. In addition to all these factors, intestinal microbiota, which is related to nutrition, plays an important role in this increase in life expectancy [2]. The microbiota that starts to change with birth continues to change until the adulthood and continues to change with the effect of aging, diet, environmental factors, disease and drug use [3]. With aging, microbiome species change and their diversity decrease in the intestinal system [4]. It has been determined that the variability and diversity of microbiome species are associated with diseases [5]. Aging not only causes a reduction in the intestinal microbial diversity but also DNA damage and a reduction in stress response. Moreover, aging is also one of the main reasons in the reduction of the biosynthesis of the vitamins that play a role in the regulation of deleterious microbial activity, which leads to a reduction in the proinflammatory response [6]. A healthy human intestinal microbiota is active in the metabolic pathway and one of the most important defense mechanisms for our bodies. Alterations in the digestive and immune systems that accompany with aging inevitably affect intestinal function as the diet changes [7]. Many of these changes affecting nutrient intake are controlled by peripheral hormones such as cholecystokinin, leptin, ghrelin, and insulin secreted by the gastrointestinal tract during food intake [8]. Physiological changes that occur with aging affect the gastrointestinal tract and negatively affect these hormones that control nutrient

uptake; thus, reducing nutrient uptake [9]. Nutritional status affects intestinal health, intestinal microbiota composition and activity [10]. Inadequate intake of macro and micronutrient items by the elderly is a common nutritional problem [11]. To provide optimal nutrition is one of the highest priority, easy and inexpensive methods that can be applied to maintain and improve health during aging [7,12]. In a study consisting of 10 volunteers, the effects of dietary patterns on intestinal microbiota were investigated. While people who were fed with animal-derived high-fat and low-fiber foods have a high bile-tolerant microorganism (a sulphite-reducing bacteria) such as *Alistipes*, *Bilophila, Bacteroides*, *Bilophila wadsworthia* colonization and a low *Firmicutes* colonization, people who were fed with plant-derived low-fat and high-content polysaccharides have a high microorganisms of the genus *Firmicutes* (*Roseburia*, *Eubacterium rectale* ve *Ruminococcus bromii*) [13]. In recent years, probiotics and prebiotics have been affecting intestinal microbiota, affecting elderly health and optimal living conditions positively [7]. Pre-pro and synbiotics are short chain (oligosaccharides) carbohydrates with health-promoting effects in the intestine. Prebiotics regulate the composition and balance in both the lumen and mucosal surface as microbiome-friendly habitats. Besides, prebiotics are fermented in the colon to short-chain fatty acids and provide energy for the intestinal and other body tissues and play an important role in increasing the optimum quality of life [14]. In one study, *Geldium* algae supplementation in the commercial form provided a significant increase in the number of *Bifidobacterium* microorganisms and in the synthesis of short chain fatty acids in humans [15]. The present study was carried out to investigate the interaction between intestinal microbiota and healthy aging to understand the relationship between microbiota and nutrition and its effects on metabolism.

Intestınal Microbiota

Microbiota colonization begins in the prenatal period with amniotic fluid, placenta, cord blood, the presence of bacteria in meconium and the effect of mother's diet [16]. Following the birth, microbiota colonization continues to occur with the effect of the microbiota of the mother's vagina and environmental microbiota [17]. The human intestinal microbiota provides a wide variety of living species including bacteria, archaea, eukaryotes, viruses and parasites [18]. The intestinal system consists of a complex structure of approximately 10^{13} - 10^{14} microorganisms [19]. Although in the past it was thought by humans that the normal intestinal microbiota consisted of 500 - 1000 microorganisms, the identification and classification of new species have been accelerated by using large-scale studies and cheap, efficient, culture-independent polygenetic methods and 16S ribosomal RNA (rRNA) gene sequence-based metagenomic methods in recent years. Thus, the intestinal microbiota is estimated to be composed of over 35,000 species of microorganisms [20]. With the use of these new methods, more extensive microbiomes have been identified and classified [21]. Microorganisms that colonize in the intestinal microbiota in healthy humans; *Firmicutes, Bacteroidetes, Proteobacteria, Actinobacteria, Fusobacteria* and *Verrucomicrobia* were divided into 6 bacterial classes *Bacteroidetes* and *Firmicutes* constitute 90% of the intestinal microbiota. When examined at the class level, less frequently seen facultative anaerobic *Escherichia, Enterobacter, Enterococcus, Klebsiella, Lactobacillus* and *Proteus* and more frequently seen in strict anaerobic *Bacteroides, Eubacterium, Clostridium, Ruminococcus, Peptococcus, Peptostreptococcus, Bifidobacterium, Fusobacterium* were detected [21].

There are significant differences in microorganism diversity in the system extending from esophagus to rectum. While stomach and esophagus have 10^1 - 10^2 microorganism colonization, colon and distal gut have more than 10^{12} microorganism colonization. Figure 1 describes the intestinal microbiota that can change from esophagus to colon [22]. Intestinal microbiota has important metabolic functions such as eliminating food toxins and carcinogens, the synthesis of micronutrients by fermenting indigestible nutrients, the absorption of some electrolytes and minerals, growth and differentiation of enterocytes, the production of short-chain fatty acids via colonists [23]. The nutrients required by the intestinal microbiota are supplied by substantial amounts of dietary carbohydrates. Carbohydrates that cannot be digested and absorbed in the proximal canal are fermented by microorganisms such as *Enterobacteria, Bacteroides, Roseburia, Bifidobacterium, Fecalibacterium* ve *Clostridium clusters* IV and XIVa to synthesize short-chain fatty acids (SCFA) such as butyrate, propionate, and acetate which are good sources of energy for the host [24]. They improve health and provide resistance to infection. Other bacterial populations associated with a healthy intestine are active butyrate producing microorganisms. Butyrate production; regulate the differentiation of colonic T-regulatory (TREG) cells, increase mucosal formation, affect inflammatory and allergic reactions, and also play a role in

propionate production and gluconeogenesis [25]. In addition, butyrate also plays a vital role in the formation of a barrier in the colon by inducing mucin secretion, antimicrobial peptides and other factors, in cell growth, the regulation of the differentiation of cell and tissue development [26,27]. The intestinal microbiota is in a symbiotic relationship with intestinal mucosa. This gives the person metabolic, immunological and protective functions. The intestinal microbiota is a single organ which has microorganisms obtaining nutrient from nutrients, has an extensive metabolic ability and significant functional effects and ensures the continuity of epithelial cells [28]. Organisms living in germ-free conditions provide important information on the effect of intestinal microbiota on the physiological and pathological properties of intestinal hosts. The information obtained shows that microbiota is important and specific in terms of metabolic, nutritional and protection functions [29]. Beyond microbial richness and diversity, a healthy intestinal microbiota can also be described as a structure that enhances metabolism against infection and inflammation, increasing endocrine signal and brain function (brain-intestinal axis) and resistance to cancer or autoimmune diseases. Microbiomes can also mediate these effects through intestinal permeability, a mucus layer, epithelial cell function, natural and acquired immunity, secretion of intestinal motility and neurotransmission [30].
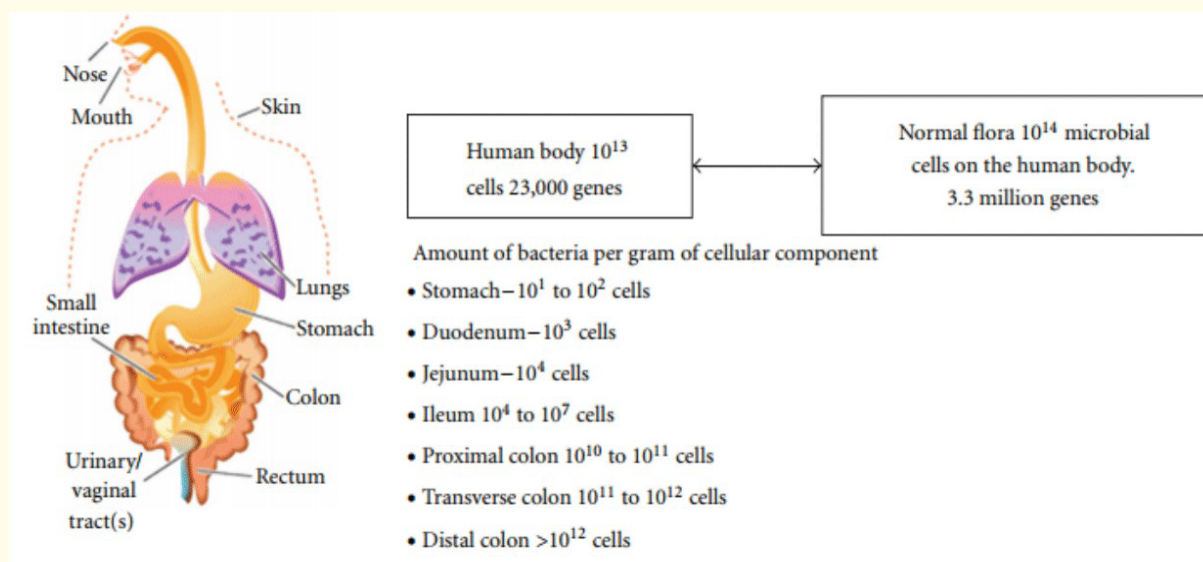

Figure 1: Distribution of normal human intestinal microbiota [22].

Intestinal microbiota composition and microbial activity change with aging

Human intestinal microbiota plays an important role in metabolic, nutritional, physiological and immunological functions [31]. Human intestinal microbiota, which is considered to be sterile at birth, starts to be shaped by the effects of birth and environmental factors immediately after birth, and significant changes occur throughout life [32]. Meconium has been shown to have a microorganism profile of *Escherichia, Shigella, Enterococcus, Leuconostoc, Lactococcus* or *Streptococcus* by 16S rRNA gene searches [33]. *Streptococcus, Corynebacterium* and *Propionibacterium*-type microorganism colonization occur in infants born with a cesarean (C-section) and fed with formula nutrients while infants with normal birth and breast milk have a dynamic ecosystem formation dominated by *Lactobacillus* and *Prevotella* [32,34]. This colonization starting with birth is stabilized by gaining diversity and similarity to adult microbiota by 40 - 60% at the age of 2 - 3 years [35]. Intestinal microbiota shows a stable form in adulthood, but some changes occur in the microbiota diversity resulting in physiological, environmental, disease, nutritional and factors related to drug use during the aging. The change in the intestinal microbiota, including the period from the prenatal period to the old age, is shown in figure 2 [13]. The research revealed that the composition of intes-

tinal microbiota in the elderly is different from that of young adults. For this purpose, it has been determined that *Firmicutes* microbiomes in elderly individuals are low in number compared to *Bacteroidetes* microbiomes and that this variability is associated with diseases [36]. Decrease in the intestinal microbial diversity of the elderly; In addition to DNA damage, stress response and protection of the immune system, a decrease in vitamin B12 biosynthesis, which plays a role in the regulation of deleterious microbial activity, leads to a reduction in proinflammatory response [37]. Thus, aging and inflammation become intertwined processes. Aging results in chronic or low-grade inflammation of the gastrointestinal function and a decrease in the host immune response, leading to diverse diseases such as obesity [38], malnutrition [39], diabetes [40], inflammatory bowel diseases, ulcerative colitis, and crohn [20].
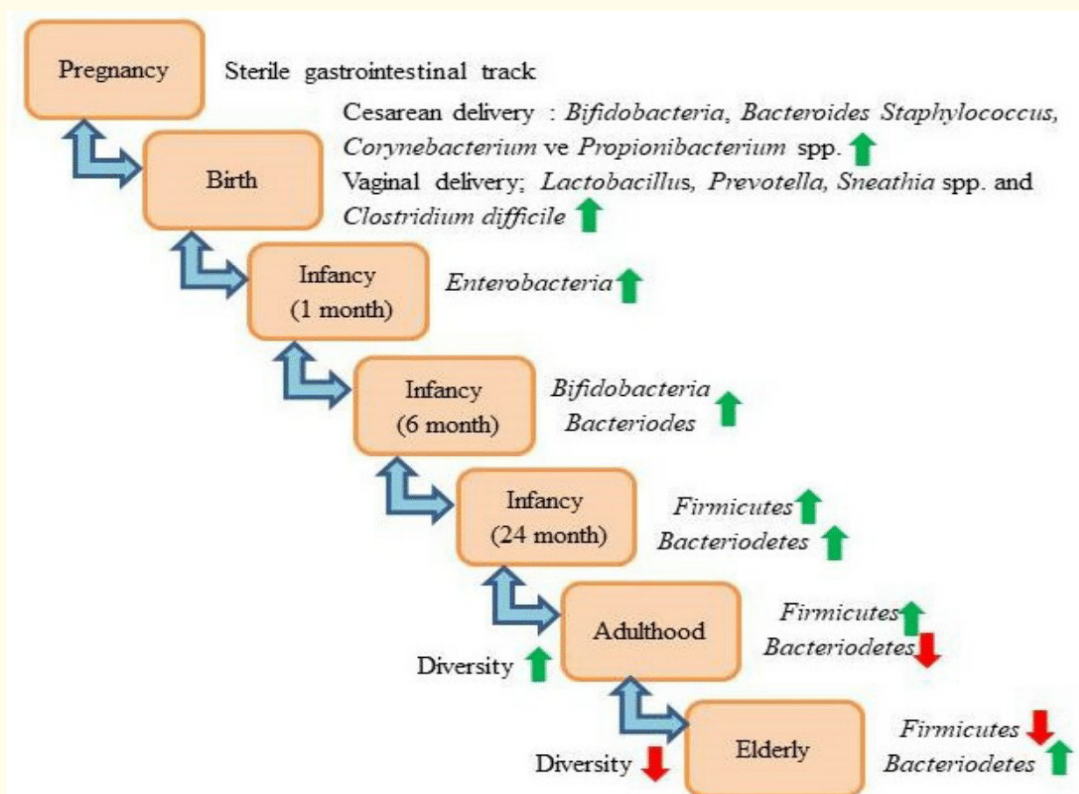

Figure 2: Change in intestinal microbiota from prenatal period to old age [13].

Effects of aging to intestınal functıons and nutrition relationshıp

The mammalian intestinal system is unique among organ systems. Anatomically and functionally, it is composed of different tracts and various types of cells. It contains the largest and most complex neuronal system outside the central nervous system, the largest populati-on of immune system cells in our bodies and the diversity of specific epithelial cells [41]. Gastrointestinal system disorders such as gast-rointestinal cancers, dysphagia, reflux, chronic constipation, defecation problems, and bacterial reoccurrence that delay gastric emptying and cause impaired absorption are common in the elderly population [41]. The intestinal immune system deteriorates with aging and causes increased sensitivity to intestinal infections in the elderly [42] Accordingly, intestinal inflammation also increases with aging, and these various effects are associated with the gastrointestinal system-related old-age anorexia [43]. Many of the individual conditions ca-use malnutrition which causes chronic diseases such as osteoporosis, sarcopenia, inflammatory diseases in addition to specific local

symptoms in the intestine and related organs [44]. Delayed gastric emptying and additionally changes in the feeling of satiety lead to an increased sense of saturation and inadequate energy intake in the elderly [45]. Alterations in age and tissue repair rate and differentiation in enterocytes cause decreased carbohydrate, protein and fat absorption in the small intestine, age-related neurodegeneration in the enteric nervous system, and changes in motor function cause decreased peristaltic motor function in the colon. This may be the main cause of chronic constipation in more than 50% of the elderly, especially in nursing homes. In addition, this situation leads to the daily use of laxative by 74% of this group [46]. Nutritional status affects bowel health, bowel microbiota composition, and activity. The inadequate intake of vitamin D, vitamin B12, calcium and protein among the elderly is a common nutritional problem [47]. Many of these changes affecting the nutritional status are related to the peripheral hormones cholecystokinin (CCK), leptin, ghrelin, insulin and YY peptide (PYY) modifications secreted by the gastrointestinal tract. These hormones are released during the consumption of nutrients and control nutrient uptake by affecting the activities in important brain regions [48]. Physiological changes that occur with aging affect the gastrointestinal tract and negatively affect these conditions that control nutrient uptake; thus, reducing nutrient uptake [49]. Water is vital for life because it is an important key to preventing dehydration and survival. Water intake has an impact on health and energy intake. Therefore, decreased thirst has a negative effect on both intestinal motility and water balance in the body. In infants, water accounts for 75% of the body weight, while in old age this proportion decreases to 55% [50]. Due to a decline in chewing and taste sensation, especially smell degradation, the elderly consume carbohydrate containing a lower amount of fiber or non-digestible starch, which reduces microbial fermentation in colon [51]. Just like aging has an effect on the consumption of nutrients and the foods that are consumed also have an effect on aging [52]. Although the role of dietary carbohydrates in human aging is unclear, clinical trials show that a diet containing low carbohydrate, adequate protein, and high fat is beneficial to human health [53]. The application of low-carbohydrate diets containing high amounts of fat and adequate amounts of protein significantly reduces body weight after 3 months [53]. In one study, low-carbohydrate diets containing high amounts of fat and adequate amounts of protein resulted in a decrease in insulin, fasting blood glucose, triglyceride levels, and body weight, leading to aging and metabolic diseases [54]. In another study, it was determined that diets rich in glycemic load were caused by age-related diseases such as diabetes and heart disorders [55]. Dietary proteins are an important part of a balanced diet. Humans can not synthesize many essential amino acids and they are needed to be taken on a diet to maintain health. Some protein-rich foods such as meat, eggs, and oilseeds are good sources of nutrients such as iron and vitamins. There is a lot of evidence suggesting that when a diet containing medium and high protein is combined with exercise, it can contribute to weight loss in obese individuals [56]. Dietary proteins also have a significant effect on intestinal health. The study found a slight but significant association between the risk of colorectal cancer and high consumption of red and processed meats [57]. Dietary protein serves as a nitrogen source for the production of useful products such as fermented carbohydrates and short chain fatty acids and microbiota growth. For this reason, the combination of protein and carbohydrate in the large intestine can contribute to intestinal health. However, unlike carbohydrates, the colon fermentation of protein sources may produce harmful effects on the colon by producing a greater variety of gases and metabolites [58]. Dietary fat affects the composition and metabolic activity of intestinal microbiota, while at the same time it triggers the onset of obesity. High-fat diets increase circulating bacterial lipopolysaccharides (LPS), leading to increased intestinal permeability. LPS is an immune system modulator associated with the development of common metabolic diseases and a strong inflammatory agent [55]. As a result, the intestinal flora balance is impaired, the Bifidobacteria are reduced and the pathogenic Proteobacteria bacteria increase, leading to diseases [59]. People consuming significantly less fat, salt and sugar, much more vegetable fiber, minerals and probiotic nutrients at significant levels during periods when natural and unprocessed foods are consumed are now increasingly being fed with high-energy, refined products of energy content. There is an important relationship between the increased incidence of chronic diseases and the decreased consumption of plant-derived pulps and various antioxidant species [60]. The intestinal microbiota composition also plays an important role in the synthesis of short chain fatty acids, which play a vital role in some immunological functions and have an active physiological and immunological roles and can vary in the elderly independently from the diet. For example, when comparing younger individuals with older populations, *Ruminococcus* and *Blautia* spp. type microorganisms decrease, whereas *Escherichia* species microorganisms increase. In another study, it was reported that microorganisms, which are aging and microbial strains of short chain fatty acid butyrate producers (key members of *Clostridium cluster* XIVa and *Clostridium cluster* IV) have a lower amount compared to younger individuals [61]. In a study on

dietary differences investigating the effect of intestinal microbiota, bile-tolerant microorganisms such *as Alistipes, Bilophila, Bacteroides* and *Bilophila wadsworthia* (a sulphite-reducing bacteria), high colonization and *Firmicutes* type microorganism colonization was found to be low in the gut microbiota of people who are fed with foods containing high fat and low fiber content of animal-based, while a decrease was noticed in the abundance of *Firmicutes* involved in metabolizing dietary plant polysaccharides (*Roseburia, Eubacterium rectale* and *Ruminococcus bromii*) [62]. Dietary changes, various antibiotic use, and diseases such as cancer cause significant changes in microflora [63]. For this reason, the consumption of foods which are the most important components of microbiota containing probiotic bacteria (probiotics) or nutrients (prebiotics) that enable the beneficial microorganisms to survive/multiply in microbiota and short-chain fatty acid synthesis of fiber content to provide high nutrients consumption has become increasingly important in recent years [64].

Effects of pro-pre and sinbiotic suplements on elderly nutrition

It is evaluated that the elderly are at increased risk for the development or the severity of the death of various types of infections than younger people. After infections break out in older nursing homes, it is more likely to spread among the elderly easily. Hence, the prevention of infections is a very important point in elderly health [65]. According to the definition of the United Nations Food and Agriculture Organization (FAO) and the World Health Organization (WHO), probiotics are "live microorganisms that provide health benefits to living organisms when applied/taken in sufficient quantities" [66]. The Turkish Food Codex Regulation on Nutrition and Health declares that a food should contain at least 1×10^6 CFU/g living probiotic microorganism in order to characterize a food as a probiotic [67]. Prebiotics are oligomers, usually composed of 4 to 10 monomeric hexose units, which are converted into various metabolites that pass through the colon without being digested in the small intestine, and thus ensure that the intestinal microbiota remains optimal at optimal health [68]. Pro/prebiotics and synbiotics are nutritional supplements for targeting the homeostasis of the intestinal microbiota ecosystem, whose composition and functionality have been associated with the health care of the elderly [69]. The most common prebiotic galactooligosaccharides (GOS) are inulin, lactulose, fructo-oligosaccharides (FOS), isomaltooligosaccharides (IOS), xylooligosaccharides (XOS), soyagosaccharides (SOS) and pyrodextrins [70].

Bifidobacterium and *Lactobacillus* are two commonly known and well-known probiotics for the treatment of human health [71]. Synbiotics are defined as probiotic and prebiotic mixtures that improve the health of microbiota and beneficially affect the bowel by benefiting the survival of live microbiomes in the gastrointestinal tract with nutritional supplements [72]. Nowadays, the combination of probiotic nutrients created by adding prebiotic under 10 g/kg is called synbiotic [73]. When inulin, fructooligosaccharides (FOS), galactooligosaccharides GOS and lactulose are taken in small doses (5 - 20 g/day) *in vivo* studies, they increase the health indicator *Bifidobacterium* and *Lactobacillus* species in microbiota. In addition, synbiotic combinations of inulin and FOS prebiotic and *Bifidobacteria* probiotics have increased the frequency of defecation, while decreasing inflammatory markers in the elderly [74]. A common problem in the elderly is reduced bowel function. This may be due to physical activity, reduced fiber consumption, reduced water consumption or decreased mobility of the intestine, or a combination of these. Probiotics have been successfully used to treat and relieve constipation by increasing bowel motility [75]. In the study, *L. rhamnosus Lc-705* and *P. freudenreichii subsp. Shermanii JS* and *L. Reuteri* type probiotics have been successfully used to relieve constipation by increasing the number of stools from 2,1 to 2,6 per week [76]. In another study, it has been observed that probiotics such as *B. longum* or *B. lactis* and prebiotics such as lactulose, polydextrose, galactooligosaccharides and inulin/fructooligosaccharides have improved intestinal function in the elderly, facilitating the frequency of defecation [77]. It is not known exactly how microbiomes affect brain behavior, but the enteric nervous system, which is embedded in the wall of neuron casings, is called the second brain. *Lactobacillus* and *Bifidobacterium*; GABA, *Escherichia, Bacillus* and *Saccharomyces*; Norepinephrine, *Candida, Streptococcus, Escherichia* ve *enterococcus*; Serotonin *Bacillus* ve *Serratia*; Dopamine, *Lactobacillus;* producing Acetylcholine type neurochemicals and they affect neuronal mechanisms [77]. Increased proinflammatory cytokine levels, such as interleukin-6 (IL-6) and C-reactive protein (CRP), affect Alzheimer's disease and mortality in the elderly [78]. *Streptococci, Staphylococci*, *Enterococci*, and *Enterobacter* species facultative anaerobes, often classified as pathogenic, cause an increase in intestinal microbiota with aging and a decrease in immunomodulatory species that contribute to the development of pro-inflammatory profile such as *Clostridium* clusters IV and XIV'a [79].

In studies investigating the ability of probiotics to modulate the immune system, the strains investigated most extensively in this regard were *L. rhamnosus HN001* and *B. lactis HN019*, which have been shown to enhance natural killer cells and phagocytic activity in healthy elderly. In elderly patients with a mean age of 69 years, 1.5×10^{11} *B. Lactis HN019* ssp. daily nutritional supplementation and as a result *Staphylococcus aureus* and increase mitogen with stimulates phagocytosis ability in peripheral blood immunomodulator cells [80]. In another study, 50 patients aged 60 years were given 1×10^9 *B. Lactis HN019* ssp. daily nutritional supplementation and consequently stimulated the ability of phagocytosis in immunomodulatory cells [81]. In the elderly, obesity can cause serious chronic complications such as cardiovascular morbidity, osteoarthritis, hypertension and impaired quality of life [82].

In one study, fecal microbiota of 12 obese individuals consuming low-calorie diets was analyzed and found that the proportion of *Firmicutes* was lower than the rate of *Bacteriodetes* in obese people before dietary treatment compared to slim people. After the diet therapy, the rate of *Bacteriodetes* decreased and the rate of *Firmicutes* increased [83]. In a study of the potential relationship between body weight reduction of probiotic strains, *Lactobacillus gasseri SBT 2055 ssp., Lactobacillus rhamnosus ATCC 53103 ssp.* combination *ramnoz ATCC 53102 ssp.* and *Bifidobacterium lactis BB12 ssp.* have been found that they can reduce body weight and weight gain [84]. In a study of postmenopausal obese older women, *Lactobacillus paracasei* F19 ssp. and flaxseed mucilagin were investigated on obesity in 58 obese patients for 6 weeks and found that obesity was decreased by increasing insulin sensitivity in these patients [85]. Type 2 diabetes, which results in decreased ability to metabolize glucose, is one of the most common diseases in the elderly [86]. The number of *Roseburia, Faecalibacterium prauznitzii* bacteria producing butyrate in the intestinal microbiota of patients with type 2 diabetes was significantly lower. Butyrate plays a role in the production of short-chain fatty acids, which increases insulin secretion and plays a role in the synthesis of glucagon-like peptide hormone, which compensates the glucose level of the metabolism. In the study, probiotics contribute to butyrate synthesis and are effective in lowering blood HbA1c levels and in metabolic control of type 2 diabetes [87]. Osteoporosis is among the diseases that are more chronic with aging and affect the living standards of the elderly. One study also found that prebiotic consumption increases calcium and magnesium absorption and improves bone density, thereby alleviating the effects of osteoporosis [88]. Oligosaccharides are short chain fructooligosaccharides (FOS), soybean oligosaccharides, xylodisaccharides and galacto-oligosaccharides (GOS). inulin (long-chain FOS) and resistance starch resulting from the fermentation in colon decrease in the pH of colon and increase the *Bifidobacterium* and *Eubacterium ssp.* microbiomes showed positive colonization with calcium and magnesium absorbation [88]. Chronic gastritis, peptic ulcer or gastric mucosal lymphoid tissue due to *Helicobacter pylori* infection also has a higher incidence of lymphoma in developing countries than in developed countries. The incidence of lymphoma in chronic gastritis, peptic ulcer or gastric mucosal lymphoma due to H. pylori infection is higher in developing countries than in developed countries. Studies have shown that *Lactobacillus gasseri chen* and *Lactobacillus plantarum* can prevent the penetration of *H. pylori* in gastric epithelial cells [89,90].

Conclusion

Aging is defined as the impairment of physiological functions with age progression. Aging is a period of increased sensitivity to diseases. Therefore, the bacterial composition and metabolic functions change in the intestine in the aging process. Along with this, the progress of age and various factors to ensure that the changing microbiota remains healthy helps prevent or delay age-related illnesses.

Probiotics, prebiotics, and synbiotics exhibit the potential to alleviate gastrointestinal problems in older people by modulating microbial activity and immune status. Probiotics are short chain (oligosaccharides) carbohydrates with health-promoting effects in the intestine. Prebiotics regulate the composition and balance in both the lumenal and mucosal surfaces as a suitable living space for *Bifidobacteria* and *Lactobacilli* in microbiota. Prebiotics are also fermented to short-chain fatty acids in the colon to provide energy for the intestines and other body tissues. As a result, healthy microflora is resistant to intestinal infections and shows immunomodulatory effect.

All in all, pro-prebiotics and synbiotics alleviate the defects caused by aging and environmental effects in the organism and play an important role in increasing the optimum quality of life. Besides, the adequate and balanced nutrition for the optimum development of the intestinal microbiota, considering the elderly's aging, difficulties in chewing and other digestive problems, it is thought that the supplementation of pre-probiotic and synbiotics by the qualified professionals is important for the health of the intestinal microbiota.

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