



Review of the Impact of Dietary Patterns on Health and Longevity

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Abstract. With the acceleration of global population aging, health and longevity have become core issues of public concern. Dietary patterns, as key controllable factors influencing human health and lifespan, are becoming increasingly prominent. Dietary patterns encompass multiple dimensions such as food variety, quantity, proportion, and eating habits, offering a more comprehensive reflection of dietary effects on human health compared to single nutrients. This paper systematically analyzes the core characteristics of global mainstream healthy dietary patterns, including the Mediterranean diet, DASH diet, MIND diet, Nordic diet, and China balanced diet. It summarizes the physiological mechanisms by which dietary patterns influence health and longevity, such as anti-inflammatory effects, antioxidant effects, regulation of gut microbiota, metabolic modulation, and epigenetic regulation. Additionally, it explores current research limitations and future research directions, providing theoretical basis and practical references for achieving health and longevity through optimized dietary patterns and formulating scientific dietary guidelines.

Keywords: Dietary patterns, Health and longevity, Chronic diseases, Gut microbiota, Anti-inflammatory mechanisms.

With advancements in medical technology and improvements in living conditions, global life expectancy has significantly increased. However, the aging population has led to a rising prevalence of chronic diseases such as cardiovascular diseases, diabetes, and cognitive impairment, which have become increasingly prominent. These conditions not only reduce the quality of life for the elderly but also exacerbate the societal healthcare burden. Data from the World Health Organization (WHO) indicate that poor dietary habits are one of the major risk factors for mortality and disability worldwide, accounting for over 11% of total deaths annually due to diet-related causes[1].

Traditional nutritional research has predominantly focused on the health impacts of individual nutrients such as proteins, fats, vitamins, and minerals. However, the effects of single nutrients alone cannot fully reflect the comprehensive impact of diet on human health. Dietary patterns, as a concentrated manifestation of long-term dietary behaviors, exhibit more significant and stable effects on health and longevity. Through the synergistic interactions of multiple food components, dietary patterns regulate physiological

processes including metabolic regulation, immune function, and inflammatory responses, thereby influencing the onset and progression of chronic diseases as well as lifespan[2]. This study summarizes recent research findings on dietary patterns and provides a systematic review of their associations with health and longevity. The aim is to elucidate the core mechanisms by which dietary patterns influence health and longevity, offer scientific guidance for the public to achieve healthy longevity through rational dietary practices, and provide references for the formulation of dietary-related public health policies.

1 Core Characteristics of Major Healthy Dietary Patterns

Diverse healthy dietary patterns have evolved across regions due to differences in geography, culture, and food availability. Despite their distinct features, all emphasize naturalness, balance, and diversity, prioritize plant-based foods, and restrict processed, high-sugar, and high-fat products.

1.1 Mediterranean Diet

The Mediterranean diet originated in Mediterranean coastal countries such as Greece, Italy, and Spain, and is currently recognized globally as a healthy dietary pattern. It has been listed as intangible cultural heritage by UNESCO. Its core characteristics are based on plant-based foods, emphasizing freshness and naturalness. The key advantages include a diverse range of food varieties, balanced nutrient combinations, and high levels of bioactive substances such as polyphenols, dietary fiber, and unsaturated fatty acids. Its health benefits have been extensively studied and confirmed, particularly in cardiovascular protection and longevity [3].

1.2 DASH Diet

The DASH diet (Dietary Approaches to Stop Hypertension), also known as the "Dietary Model to Stop Hypertension," was proposed by the National Institutes of Health (NIH) and was initially developed for the prevention and management of hypertension. It has demonstrated significant positive effects on cardiovascular health, metabolic balance, and longevity. Its core characteristics include a high-potassium, low-sodium, high-fiber, and low-fat diet. A unique advantage is its rapid and pronounced antihypertensive effect, which becomes evident within two weeks and remains unaffected by body weight changes [4].

1.3 MIND Diet

The MIND Diet (Mediterranean-DASH Intervention for Neurodegenerative Delay), also known as the "Mediterranean-DASH Intervention Diet Model for Neurodegenerative Delay," is an optimized version of the Mediterranean diet and DASH diet specif-

ically designed for cognitive function protection. Developed by Rush University Medical Center in the United States, its core objectives are to delay cognitive decline, reduce the risk of neurodegenerative diseases, and thereby promote health and longevity. A key feature of this diet is its clear distinction between "brain-protective foods" and "brain-damaging foods," making it particularly suitable for individuals aged 50 and above, as well as those with a family history of Alzheimer's disease [5].

1.4 Nordic Diet

The Nordic diet, originating in Denmark, Sweden, Norway, Finland, and Iceland, emphasizes local, organic, seasonal, and sustainable foods. Similar to the Mediterranean diet but adapted to Nordic food systems, it is rich in berries, root vegetables, cruciferous vegetables, whole grains, and fish. It limits red meat, processed foods, and added sugars, and uses gentle cooking methods to preserve nutrients. Its strong anti-inflammatory properties reduce risks of chronic diseases including cardiovascular disease and cancer.

1.5 The Eastern Dietary Pattern

The Eastern Dietary Pattern, recommended in the Dietary guidelines for Chinese Residents (2022), is tailored to the cultural and physiological characteristics of Chinese populations. It emphasizes food diversity, balanced combinations, and harmony between diet and physical activity, retaining traditional strengths such as grain-based diets while integrating modern nutritional principles for all age groups.[6]

2 Mechanisms Underlying the Effects of Dietary Patterns on Health and Longevity

The impact of healthy dietary patterns on human health and longevity is not mediated through a single pathway, but rather by modulating multiple physiological processes to achieve multifaceted effects such as anti-inflammatory activity, antioxidant capacity, metabolic improvement, and intestinal health protection, thereby delaying aging and reducing the risk of chronic diseases [7].

2.1 Anti-Inflammatory Effects

Chronic low-grade inflammation serves as a common pathological basis for aging and various chronic diseases, often referred to as an "accelerator of aging." Prolonged consumption of unhealthy diets high in sugar, fat, and processed foods leads to sustained release of inflammatory factors, triggering systemic chronic low-grade inflammation that damages cells and tissues and accelerates the aging process. Healthy dietary patterns such as the Mediterranean diet, Nordic diet, and MIND diet effectively suppress chronic low-grade inflammation and delay aging by incorporating abundant anti-inflammatory components. For instance, extra virgin olive oil in the Mediterranean diet is rich in hydroxytyrosol, while vegetables and fruits contain polyphenols. These components synergistically inhibit the NF- κ B pathway (a core pathway of inflammatory

responses) and reduce C-reactive protein (a marker of inflammation) levels by 40–60%. Omega-3 unsaturated fatty acids found in fish and nuts can be converted into anti-inflammatory substances (e.g., prostaglandin E3), suppressing the expression of pro-inflammatory factors (e.g., TNF- α , IL-6) while promoting the release of anti-inflammatory factors (e.g., IL-10). Dietary fiber from whole grains and legumes is fermented by gut microbiota to produce short-chain fatty acids (SCFAs), which not only provide energy for intestinal cells but also inhibit inflammatory responses, improve intestinal barrier function, reduce intestinal toxin entry into the bloodstream, and consequently lower systemic inflammation levels.[8]

2.2 Antioxidant Effects

Oxidative stress refers to the excessive production of reactive oxygen species (ROS) or decreased antioxidant capacity in the human body, leading to free radical accumulation that damages cellular DNA, proteins, and lipids, accelerates cellular aging and apoptosis, and increases the risk of chronic diseases. Healthy dietary patterns rich in various antioxidant components can effectively eliminate free radicals, enhance the body's antioxidant capacity, protect cells from damage, and delay the aging process. Antioxidant components in various healthy dietary patterns are widely sourced: spinach, broccoli, tomatoes, blueberries, strawberries, and oranges are abundant in antioxidant vitamins and phytochemicals such as vitamin C, vitamin E, β -carotene, and anthocyanins; Omega-3 unsaturated fatty acids in fish can enhance the activity of antioxidant enzymes (e.g., superoxide dismutase and glutathione peroxidase), reducing free radical generation. These antioxidant components synergistically form an "antioxidant network," effectively eliminating excess free radicals in the body, minimizing cellular damage, delaying aging, and simultaneously lowering the risk of chronic diseases associated with oxidative stress, such as cancer and cardiovascular diseases [9].

2.3 Modulation of Gut Microbiota

The gut microbiota refers to the microbial community residing in the human intestine, which participates in multiple physiological processes such as nutrient absorption, metabolic regulation, and immune function modulation. It is referred to as the "second genome of the human body," and its equilibrium state is closely associated with human health and longevity. Dysbiosis of the gut microbiota, characterized by an increase in harmful bacteria and a decrease in beneficial bacteria, can lead to impaired nutrient absorption, exacerbated inflammatory responses, metabolic disturbances, thereby elevating the risk of chronic diseases and shortening lifespan. Conversely, a healthy dietary pattern can regulate the structure of the gut microbiota, maintain microecological balance, and consequently promote health and longevity. Short-chain fatty acids (e.g., acetic acid, propionic acid, butyric acid) produced by beneficial bacteria through the fermentation of dietary fiber not only provide energy for intestinal cells but also regulate intestinal pH levels, enhance intestinal barrier function, reduce the entry of intestinal toxins (e.g., lipopolysaccharides) into the bloodstream, and lower systemic inflammatory levels [10].

2.4 Regulation of Metabolic Homeostasis

Metabolic disorders (such as obesity, hyperglycemia, hyperlipidemia, and hypertension) are significant contributors to chronic diseases and key factors influencing longevity. A healthy dietary pattern regulates human energy metabolism, glucose metabolism, and lipid metabolism through rational food combinations, maintaining metabolic balance, preventing metabolic diseases, and thereby extending lifespan. Its regulatory effects include controlling total energy intake to avoid obesity caused by energy surplus; modulating glucose metabolism by consuming low-glycemic index foods (e.g., whole grains, legumes, vegetables) to slow blood glucose elevation, reduce insulin secretion, and lower the risk of type 2 diabetes; and regulating lipid metabolism by incorporating unsaturated fatty acids (e.g., olive oil, fish, nuts) to replace saturated and trans fatty acids, thereby reducing serum triglyceride and low-density lipoprotein cholesterol (bad cholesterol) levels while increasing high-density lipoprotein cholesterol (good cholesterol) levels, preventing atherosclerosis, and decreasing cardiovascular disease risk.

2.5 Epigenetic Regulation

Epigenetics refers to the regulation of gene expression without altering DNA sequences through mechanisms such as DNA methylation, histone modifications, and non-coding RNA regulation, which is closely associated with aging and chronic diseases. Recent studies have revealed that dietary patterns can modulate the expression of aging-related genes via epigenetic regulation, thereby delaying the aging process and extending lifespan, and this regulatory effect is independent of "longevity genes." A study published in *Science Advances* in 2026 by Tongji Medical College of Huazhong University of Science and Technology and other institutions demonstrated that healthy diets can regulate the activity of aging-and disease-related genes through epigenetic mechanisms, promote DNA repair, and reduce the risk of carcinogenesis[11].

3 Evidence Linking Dietary Patterns to Health and Longevity

In recent years, scholars both domestically and internationally have conducted in-depth research on the associations between various dietary patterns and health longevity, accumulating substantial reliable evidence. This research has clearly demonstrated the positive effects of healthy dietary patterns in reducing the risk of chronic diseases and extending lifespan, while also revealing the health hazards associated with unhealthy dietary patterns.

3.1 Association Between Healthy Dietary Patterns and Longevity

Studies have demonstrated that adherence to healthy dietary patterns can significantly prolong lifespan and reduce all-cause mortality. A 2025 study led by the NIH conducted a 30-year follow-up of 105,000 participants (70,000 women and 35,000 men), revealing that middle-aged individuals who strictly followed healthy dietary patterns (such as the

Mediterranean diet, DASH diet, or MIND diet) exhibited a significantly higher proportion of healthy longevity (free from major chronic diseases with good cognitive and physical status) beyond the age of 70. Approximately 9.8% of participants met the criteria for healthy longevity, compared to only 3.2% among those following unhealthy dietary patterns.[12]

A 2026 study by Huazhong University of Science and Technology demonstrated that healthy diets significantly extend lifespan. Taking a 45-year-old population as an example, men with the most healthy dietary habits lived 1.9–3 years longer than those with the least healthy diets. The most effective hypoglycemic diet could prolong lifespan by 3 years. Among women, those with the most healthy diets lived 1.5–2.3 years longer than those with the least healthy diets. The Mediterranean diet showed the best efficacy, extending lifespan by 2.3 years, and this effect was not influenced by longevity genes [13].

Additionally, a landmark study published in the American Journal of Clinical Nutrition in 2024 demonstrated that individuals adhering to an overall dietary pattern exhibited a 34% reduction in cardiovascular disease risk and a 23% decrease in all-cause mortality compared to those focusing solely on nutrient intake. This finding further confirms the superior comprehensive effects of dietary patterns over individual nutrients.[14]

3.2 Association Between Healthy Dietary Patterns and Chronic Diseases

Chronic diseases (such as cardiovascular diseases, diabetes, cancer, and cognitive impairment) are major obstacles to longevity, while healthy dietary patterns can significantly reduce the risk of chronic diseases through multiple mechanisms, delay disease progression, and thereby extend healthy lifespan. The 10-year follow-up results of the 2024 PREDIMED-Plus study demonstrated that the Mediterranean diet can reduce the risk of major cardiovascular events by 31%. Type 2 diabetes mellitus (T2DM), the predominant type of metabolic disease, is closely associated with dietary patterns. Studies indicate that the Mediterranean diet can lower the risk of T2DM by 30%; the DASH diet can reduce T2DM risk by modulating glucose metabolism and improving insulin resistance, while also helping diabetic patients stabilize blood glucose levels [15].

Cancer is the second leading cause of death globally. A healthy dietary pattern can reduce cancer risk through mechanisms such as antioxidant effects, anti-inflammatory actions, modulation of gut microbiota, and inhibition of cancer cell proliferation. A 2024 study on the Mediterranean diet demonstrated that individuals who strictly adhered to this dietary pattern exhibited a 24% overall reduction in cancer risk, with particularly significant decreases in colorectal cancer and breast cancer risks[16]. The MIND diet has been shown to lower the incidence of cancers including colorectal cancer and lung cancer. As a dietary pattern specifically designed for cognitive protection, the MIND diet demonstrates the most pronounced efficacy in preventing cognitive im-

pairment. A 2024 15-year follow-up study revealed that individuals who strictly followed the MIND diet experienced a 54% reduction in Alzheimer's disease risk and a 53% slowing of cognitive decline rate [17].

3.3 Health Hazards of Unhealthy Dietary Patterns

In contrast to healthy dietary patterns, unhealthy dietary patterns centered on high sugar, high fat, high salt, and processed foods (such as Western dietary patterns and high-sugar diets) significantly increase the risk of chronic diseases and shorten lifespan. The core characteristics of Western dietary patterns include excessive consumption of red meat, processed meats, fried foods, desserts, and sugary beverages, which are rich in saturated fats, trans fats, added sugars, and salt. Prolonged adherence to such patterns leads to metabolic disorders such as obesity, hypertension, hyperlipidemia, and hyperglycemia, thereby elevating the risk of chronic diseases including cardiovascular diseases, diabetes, and cancer. A 2025 NIH study also found that long-term intake of ultra-processed foods (containing industrial manufacturing components such as high-fructose corn syrup, flavorings, unhealthy fats, and emulsifiers) disrupts gut microbiota balance, exacerbates chronic inflammation, reduces the body's antioxidant capacity, and consequently increases the risk of chronic diseases and shortens lifespan[18].

4 Research Status and Existing Shortcomings

In recent years, research on the association between dietary patterns and health longevity has made significant progress, clarifying the core characteristics and mechanisms of healthy dietary patterns, which provides important evidence for public dietary guidance and public health policy formulation. However, current studies still have certain limitations that require further exploration. Firstly, existing research predominantly relies on epidemiological surveys and prospective cohort studies, with a limited number of randomized controlled trials and relatively short intervention periods (mostly 1-5 years), making it difficult to accurately assess the long-term effects of dietary patterns on longevity (e.g., over 10 years). Additionally, the relatively small sample sizes in intervention trials necessitate further validation of the generalizability of results. Secondly, assessment methods for dietary patterns have inherent limitations. Current self-report methods such as food frequency questionnaires and 24-hour dietary recalls are prone to recall bias, leading to inaccurate dietary pattern evaluations and compromised research reliability. Thirdly, existing studies primarily focus on the impact of single dietary patterns, with limited research on synergistic effects of different dietary patterns. Variations in dietary pattern responses across regions and populations (e.g., age, gender, ethnicity, health status) further highlight the need for more comprehensive studies on personalized dietary patterns and their association with health longevity. Moreover, the molecular mechanisms underlying dietary patterns' influence on health longevity require deeper investigation. Current research on epigenetic regulation, gut-brain axis, and gut-heart axis signaling pathways remains insufficient, and the specific mechanisms of synergistic effects among different dietary components have yet to be fully

elucidated. Finally, existing studies predominantly focus on the "quantity" and "variety" of dietary patterns, with limited research examining the associations between eating habits (such as meal timing, eating speed, and regularity of three meals) and cooking methods with health and longevity. These factors may also influence health and lifespan by affecting nutrient absorption and metabolism.

5 Future Research Directions

In light of existing research limitations and considering global population aging trends alongside public demand for health and longevity, future research on dietary patterns and health longevity should focus on the following aspects. First, conduct long-term, large-sample randomized controlled trials with extended intervention periods (over 10 years) to elucidate the long-term effects of healthy dietary patterns on longevity. Sample sizes should be expanded to include populations of diverse ages, genders, ethnicities, and health statuses to enhance the generalizability of findings. Second, optimize dietary pattern assessment methods by integrating biomarkers (e.g., inflammatory markers in blood, gut microbiota composition, epigenetic markers) to improve accuracy, reduce recall bias, and strengthen research reliability. Third, investigate molecular mechanisms underlying dietary patterns' impact on health longevity, with emphasis on epigenetic regulation, gut-brain axis, and gut-heart axis signaling pathways to clarify synergistic mechanisms of dietary components. Fourth, advance personalized dietary pattern research by developing individualized health plans tailored to genetic backgrounds, gut microbiota profiles, health status, and lifestyle habits to optimize dietary interventions and achieve precision nutrition integration with longevity goals. Fifth, strengthen studies on correlations between eating habits, cooking methods, and health longevity, exploring how different cooking techniques (e.g., steaming, boiling, frying, deep-frying) affect nutrient absorption, as well as the metabolic and health impacts of meal timing (e.g., intermittent fasting) and eating speed, thereby enriching dietary pattern research frameworks. Sixth, strengthen interdisciplinary research by integrating theories and methodologies from multiple disciplines such as nutrition science, medicine, biology, epidemiology, and public health to comprehensively explore the association between dietary patterns and health longevity. This will provide more robust evidence for formulating scientific dietary guidelines and public health policies.

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