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# NUTRITION AND AGING: EXPLORING THE ROLE OF DIET IN PROMOTING HEALTHSPAN: A NARRATIVE REVIEW

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## Abstract

The gradual deterioration of physiological function, including a heightened vulnerability to chronic illness, is a hallmark of aging, which creates formidable burdens on public health internationally. Nutrition has become a major modifiable factor that may influence the aging process and prevent age-related diseases, improving the health span. This narrative review discusses current evidence with regard to the role diet plays in promoting healthy aging, focusing on key nutrients, dietary patterns, and their biological mechanisms. Adequate intake of high-quality protein, dietary fiber, healthy fats, vitamins, minerals, and plant-derived bioactive compounds has been associated with preserved muscle mass, improved cognitive function, enhanced immune response, and reduced inflammation. The more balanced dietary patterns, such as plant-forward diets supplemented with moderate amounts of healthy animal-based foods, have shown potential in supporting longevity and overall health. Yet, there are still various challenges to individual variability of nutritional needs, physiological and sensory age-related changes, comorbidities, access to nutrient-dense foods, and difficulties with adherence to dietary interventions. Future studies should focus on personalized nutrition approaches, life-course dietary strategies, and intervention studies conducted over long periods to truly elucidate the influence of diet on health span. The integration of nutritional strategies with lifestyle measures (physical activity and social engagement) holds great promise for optimizing the quality of life and reducing the burden of a number of age-related chronic diseases. Understanding and applying evidence-based nutritional interventions represents one of the essential strategies for ensuring healthy aging in populations.

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## INTRODUCTION

Physiological integrity gradually deteriorates with age, increasing susceptibility to death and impairing functioning abilities. Long-term human diseases like cancer, diabetes, neurological decline, and cardiovascular disease are significantly increased by it (Cai et al., 2022). According to estimates, 16% of the population will be over 65 by 2050, which would provide serious problems for social structures and healthcare systems (Xu et al., 2022). Aging is a slow, irreversible disease process. In addition to significantly increased risks of many aging-connected ailments, including immune system illnesses and neurological, cardiovascular, metabolic, and musculoskeletal diseases, it shows up as reduced tissue and cell functions. Even while advances in contemporary medicine have significantly enhanced life expectancy and improved human health, a variety of chronic illnesses have gradually emerged as the main causes of disability and mortality among the elderly as civilization ages (Guo et al., 2022).

The biological processes of aging and the prevention of age-related disorders have been found to be significantly influenced by nutrition. An increasing amount of data suggests that nutrition impacts the development of the most significant age-related illnesses and plays a significant role in controlling aging processes. For example, a diet's macronutrient and micronutrient content can be used to describe it qualitatively, while its calorie content can be used to describe it numerically. Cardiovascular disorders are largely caused by poor diet. The cardiovascular system is heavily burdened by illnesses like obesity, diabetes, hypertension, and dyslipidemia that can be brought on by unhealthy eating habits. For instance, eating too little fruit and vegetables, too much sodium, too many added sugars, etc. Cardiovascular disease risk can be lowered by up to 30% with a nutritious diet (Fekete et al., 2022).

In addition to preventing obesity, CVD, and inflammation, diets high in fruits, vegetables, nuts, grains, fibers, fish, unsaturated fats, antioxidants, vitamins, potassium, and omega-3 as well as lowering intake of red meat and UPF may also improve glycemic, insulinemic, and lipidemic responses. Additionally, consuming more vegetables and green tea catechins, together with the MedDiet and KD or a mixture of these diets (MMKD), may enhance working memory and reduce the realm of attention and the brain network destabilization, hence decreasing cognition. Lastly, a

low-fat diet high in antioxidants or the MedDiet enhanced with CoQ or VOO may help reduce oxidative and DNA damage and lower the incidence of atherothrombosis, hepatic steatosis, diabetes, and telomere attrition. These diets can increase longevity and improve one's standard of living (Leitão et al., 2022). The danger of mortality and age-related chronic non-communicable diseases is significantly influenced by dietary variables. In recent decades, there has been a significant shift in nutrition and health outcomes research, focusing less on single nutrients and more on meal combinations rather than individual nutrients. In addition to nutritional quality, caloric function and timing have been raised for its possible role in health span improvement. Evidence has been accumulating for the beneficial impact of caloric restriction and intermittent fasting on health outcomes such as life span, insulin sensitivity, and metabolic function in human models (Dominguez et al., 2022).

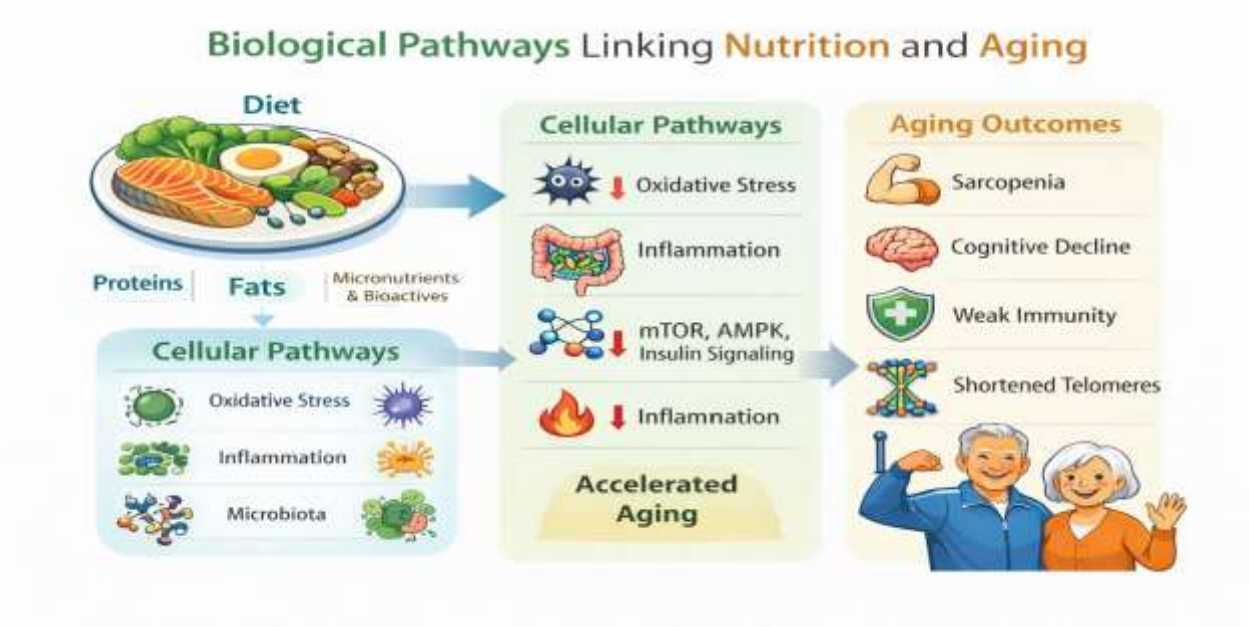
These interventions target mechanisms for detecting nutrients, which play a fundamental role in cellular aging as well as lifespan determination. It is important to uncover the importance of dietary interventions in the aging population with increased aging rates combined with a rising rate in chronic ailments. To address dietary patterns, essential nutrients, and the mechanisms underpinning health span extension, the bulk of this review aims to discuss the most recent evidence on the association between nutrition and aging with the aim of underpinning health interventions for the aging population.

## 1. Biological Basis of Aging and Nutrition

One way to conceptualize aging is as a slow process of physiological failure over time, accompanied by progressively diminished function and increased vulnerability to death. However, aging is not just a reflection of time because it has its own distinct biologic process. The understanding of biologic processes of aging, which are distinct, gave birth to a science known as geroscience, or the study of aging and its correlation to chronic diseases. One of its core axioms is known by the name of "longevity dividend," which refers to its postulate that interventions aimed at aging can potentially prevent or slow chronic diseases all at once. This represents a marked shift away from developing

individual therapies for individual diseases towards developing therapies for their common cause: biologic aging (Kałucka–Janik et al., 2025).

Resilience is defined as "the ability to recover or optimize function in the face of age-related losses or illness." Targeting biological mechanisms with geroscience-based interventions—such as pharmacological (metformin, angiotensin receptor blockers, dasatinib, and quercetin), hormonal (oxytocin), physical (brain and muscle stimulation), and nutraceutical (vitamin D, resveratrol, and omega-3) is a promising strategy for maintaining and improving mobility function in older adults. Pharmacological treatments (like low-dose mammalian Target of Rapamycin [mTOR] inhibitors) may also offer opportunities to improve immunological status while addressing the underlying biology of aging in the setting of infectious illnesses (including COVID-19, influenza, and pneumonia). Chemotherapy may cause illnesses that accelerate aging (Cesari et al., 2022).




## 2. Age-Related Changes Affecting Nutritional Status

Due to comorbidity, age-related physiological deterioration, and limited availability of nutrient-dense meals, older people are especially susceptible to malnutrition. Clinical guidelines state that routine screening for malnutrition should be performed on all elderly individuals. A nutritional examination

and tailored nutritional support should be provided to older persons who test positive. Examples of nutritional support include enteral or parenteral feeding, when necessary, oral nutritional supplements, fortified meals, and individualized nutritional counseling and recommendations (Dent et al., 2023). Elderly people's diets are often defined by shortages in important vitamins, minerals, and macronutrients; high intake of meals high in carbohydrates; and inadequate intake of plant-based foods like fruits and vegetables. Because compared to their early years, people are less efficient at absorbing calcium from low or marginal diets. Older people who ingest insufficient amounts of calcium may be at risk of developing a calcium shortage (Zhanalina et al., 2024).

The term "presbyphagia" describes distinctive age-related alterations in the intricate neuromuscular swallowing system. Reduced pharyngeal feelings are linked to swallowing changes, such as pharyngeal residue, which are common in healthy older adults. A compensatory try to maintain swallowing function in the face of sensory deterioration may be represented by increased sensorimotor brain activation. Changes in swallowing are linked to prefrailty and declining nutritional status (Labeit et al., 2022). When certain meals lose their appeal and recognition, age-related changes in food odor identification and familiarity may have an impact on an individual's nutritional status and general health. Therefore, sensory compensation for meals and contextual assistance surrounding specific foods may help older adults who have weak perceptions of olfactory familiarity to improve their feeling of familiarity. Although a quick testing setup would be necessary to detect flavor perception deficiencies, this strategy might enhance senior folks' appreciation of food during mealtimes. Changes in an older population's sensory abilities might have a detrimental effect on how much they enjoy a meal (de Lichtenberg Broge et al., 2023).

One of the primary problems with aging is sarcopenia. It is caused by a variety of reasons, including sedentary lifestyles and a negative net protein balance, and is typified by a loss of muscle mass. The WHO projects that the number of elderly people will increase by 38% by 2025. Therefore, it's critical to create guidelines for preventing sarcopenia and several associated events and comorbidities (Rogeri et al., 2022).

## 3. Key Nutrients in Healthy Aging

### 4.1 Protein

Elderly people continuously experience detrimental changes in skeletal muscles. In medically stable elderly persons, existing literature indicates the ingestion of protein below the RDA Accent-acetateenersses the age-related reduction in muscle mass, quality, and functional capacity. Experimental studies using the elderly with diverse states of metabolic, physiologic, hormonal, and physical functional health yield conflicting findings on the relationship of protein intake with skeletal muscle. With the ingestion of about 1.3 g/kg body weight/day of protein, the retention or buildup of appendicular lean body mass occurs in the face of systematic catabolic (weight loss) or anabolic stressors. Elderly persons with confirmed medical diagnoses and acute illnesses may require the use of specific protein/amino acid preparations to enhance skeletal muscle protein synthesis and alleviate their protein nutrient status, reducing losses of muscle mass, function, and survival time in malnourished elderly subjects, respectively (Campbell et al., 2023).

When talking about protein intake, quality is crucial. The quality of the protein source may have a greater effect on anabolic responses and maintenance of muscle mass in older individuals because anabolic resistance of aging reduces the sensitivity of older muscle to protein/amino acid ingestion, even though protein quality does not appear to be a determining factor for younger individuals consuming an adequate amount of protein daily. Aspects of protein quality, such as amino acid composition (especially EAA content) and digestion and absorption kinetics (i.e., bioavailability), directly hinder the protein's ability to support the anabolic process in addition to protein amount (Rogeri et al., 2022).

### 4.2 Dietary Fiber

Food is one of the most significant of the numerous complex environmental elements that support healthy aging. The biological phenomenon of aging is quite complex. Intestinal bacteria, particularly Lactobacillus and Bifidobacterium, are thought to be common in the guts of both humans and animals, and there is a favorable correlation between their abundance levels and the host's health.

Dietary fiber can improve human health by lowering the risk of cardiovascular disease, helping obese patients lose weight, and modulating the immunological system. Furthermore, it has been discovered that increasing dietary fiber intake lowers the risk of chronic illnesses and encourages healthy aging, especially beginning in middle age (Yu et al., 2022).

Cognitive function declines with age, which is a global health concern. Based on the DSST score, a cohort of Americans over 60 showed a positive correlation between dietary fiber consumption and cognitive performance. AFT scores were not correlated with dietary fiber intake. Public health interventions aimed at reducing aging-related cognitive impairment may center on adequate fiber consumption (Prokopidis et al., 2022). Several disorders linked to aging are significantly influenced by dietary fiber. Low dietary fiber intake has been consistently linked to higher rates of cancer, cardiovascular death, cognitive decline, and poor physical performance. Increased consumption of cereal fiber lowers the incidence of cardiovascular disease and reduces the number of inflammatory markers in older people. This is especially crucial because aging is characterized by a condition of persistent inflammation. It is widely known that growing older reduces the ability to regulate and maintain the inflammatory response homeostasis (Niero et al., 2023).

### 4.3 Fats and Fatty Acids

Due to advancements in health care, nutrition, and public health initiatives, as well as a decrease in newborn mortality, life expectancy has significantly increased globally. However, higher life expectancy and lower birth rates have led to a rise in the number of elderly people in many populations. A lower risk of death was linked to higher intakes of unsaturated fats, which are mostly found in plant-based diets and marine fish. Specifically, linoleic acid demonstrated the largest adverse relationship with mortality. Higher consumption of both trans and saturated fat, however, was linked to increased mortality; the negative effects of trans fat were far more apparent than those of saturated fat. When cause-specific mortality (such as mortality from CVD, cancer, respiratory problems, or neurological difficulties) was examined independently, these correlations remained unchanged (Hu et al., 2024).

Because of improvements in medicine and lifestyle, people have lived longer over the past century, but their health has not followed up, particularly with regard to brain aging. As a result, preventative health interventions, particularly the discovery of dietary substances that may mitigate the negative consequences of aging, have emerged as a critical tactic. DHA and EPA, two long-chain ω-3 LCPUFAs, have demonstrated significant promise as nutrition to address aging, in particular cognitive decline. Because DHA and EPA have neuroinflammatory-resolving properties, increased levels have been linked to better cognitive performance and a lower incidence of dementia in older adults (Mora et al., 2022).

### 4.4 Micronutrients and Bioactive Compounds

Techniques that increase longevity by delaying the onset of age-related illnesses until later in life are necessary to maintain the health of an aging global population. As a result, it's critical to concentrate on variables that can be changed, like micronutrients, especially in "at-risk" groups for those who exhibit pre-frailty and/or signs of cognitive decline if they can be detected early. Testing for micronutrient deficiencies or insufficiencies may be used as an intervention target in these "at-risk" populations to promote biological function, delay biological aging and the onset of physical and cognitive decline, and keep an eye on older people's health. Vitamin D intake is essential for the aging population because of its recognized link to bone and muscle health. It is well known that vitamin D controls inflammation, bone mineralization, and calcium homeostasis (O'Connor et al., 2023).

With individuals over 60 accounting for approximately 25% of the world's illness burden, the healthcare costs associated with an aging population are still rising. Micronutrient deficiencies, such as immune-supporting vitamin C, are more common in older people and can both cause and result from acute and chronic illnesses. However, it is unclear whether lower and greater vitamin C requirements are associated with good aging in general. Elderly persons have reduced vitamin C status and greater vitamin C requirements due to poor dietary intakes and/or chronic diseases. These extra needs can be met by taking oral supplements or eating more foods high in vitamin C (Carr et al., 2023).

Certain illnesses, such as neurodegenerative and cardiovascular diseases, can be brought on by aging. It is important to note that during this post-pandemic phase, accumulating stress can cause extremely rapid cellular aging. Additionally, the chemicals derived from vegetables are highly suggested as dietary accompaniments. Vegetables may have an anti-aging impact since they include a number of bioactive compounds that are both primary and secondary metabolites. These bioactive substances exhibit anti-aging properties through a number of mechanisms, including anti-apoptotic effects, cycle and cell memory activities, and suppression of cell senescence. Nevertheless, the selectivity of these compounds is still poorly known due to the limited understanding of their pharmacokinetics (Mechchate et al., 2022). As people age, their chance of developing neurodegenerative diseases and other age-related neurological disorders (ANDs) rises. Aberrant behavior, increased oxidative stress, increasing functional losses, and neuronal cell death are the primary pathologic features of ANDs. The rising age-dependent incidence of ANDs has prompted recent measures to combat them. By altering cell survival signaling and death, piperine, the main bioactive neuroprotective ingredient found in black pepper, successfully prevents AND symptoms and pathological illnesses (Balakrishnan et al, 2023).

**Table 1. Key Nutrients and Their Role in Healthy Aging**

| Nutrient | Major Food Sources | Mechanism of Action | Health Benefits in Aging |
|---|---|---|---|
| Protein | Eggs, dairy, legumes, fish, and lean meat | Stimulates muscle protein synthesis | Prevents sarcopenia, improves strength |
| Dietary Fiber | Whole grains, fruits, vegetables, and legumes | Modulates gut microbiota, reduces inflammation | Improves gut health, cognition, and cardiovascular health |
| Omega-3 Fatty Acids (EPA, DHA) | Fatty fish, flaxseed, walnuts | Anti-inflammatory, neuroprotective | Reduces cognitive decline, CVD risk |

| | | | |
|---|---|---|---|
| Vitamin D | Sunlight, fortified dairy, fish | Regulates calcium metabolism, immune function | Bone health, reduced frailty |
| Antioxidants (Polyphenols) | Fruits, vegetables, green tea | Reduces oxidative stress | Delays cellular aging |

## 4. Dietary Patterns and Health Span

The DGA 2020–2025 states that "nutrient-dense forms of foods and beverages across all food groups, in recommended amounts, and within calorie limits" constitute a healthy eating pattern. These suggestions also clarify how a balanced diet can enhance well-being in later stages of life and improve health at any age. Another crucial point raised by DGA 2020–2025 is that establishing a healthy eating pattern early in life and sticking to it later may considerably lower the risk of chronic diseases linked to diet, or, to put it another way, promote healthy aging (Dominguez et al., 2024).

Finding diets that best support healthy aging in addition to preventing noncommunicable diseases is crucial as the world's population ages. Higher intakes of fruits, vegetables, whole grains, unsaturated fats, nuts, legumes, and low-fat dairy products were linked to better odds of healthy aging, but higher intakes of trans fats, sodium, sugary drinks and red or processed meats (or both) were negatively correlated. Our results imply that eating a diet high in plant-based foods combined with a moderate amount of nutrient-dense animal-based meals may improve overall healthy aging and have an impact on future dietary recommendations (Tessier et al., 2025).

Living arrangements significantly improve older persons' eating habits, with anxiety and loneliness acting as partial mediators; younger older adults tend to eat better than their older counterparts. Compared to females, older male individuals have healthier eating habits. Additionally, there is a substantial positive correlation between healthy eating habits and pre-retirement career, income source, and education level, but there is a negative correlation with health insurance participation. Eating habits are not much impacted by exercise. These findings suggest that living arrangements improve older people's eating habits by reducing emotions of worry and loneliness (Hu et al., 2025). Understanding dietary habits is crucial as the population ages, particularly with regard to malnutrition, which puts this age group at significant risk for health issues. This group may also be challenged in meeting the necessary energy and nutrient needs every day, which may be due to many considerations, such as reduced appetite, changed sense of taste and smell, dental problems, and the ability to prepare meals. Changes caused by the age of the person, for example, the metabolic rate and efficiency of digestion, may lead to deficiencies in the use of nutrients. Elderly people require thorough nutritional treatment because social problems like loneliness and the need for support exacerbate these challenges (Moradell et al., 2025).

### 5. Caloric Restriction and Dietary Timing

Many individuals believe that lowering calories may lead to longer lifespans and healthier living. Nevertheless, it is more difficult to research how a prolonged reduction in calories would cause a reaction among individuals, given the current dietary environment. The longest trial about a reduced intake of calories among individuals who were not obese demonstrated, in the Comprehensive Assessment of Long-term Effects of Reducing Intake of Energy, that after two years, individuals who practiced calorie reduction had a significant weight reduction of 10% contrasted to the control group. This also led to a considerable improvement in blood lipids, blood pressures, and insulin, along with pro-inflammatory cytokine levels (Hu et al., 2024).

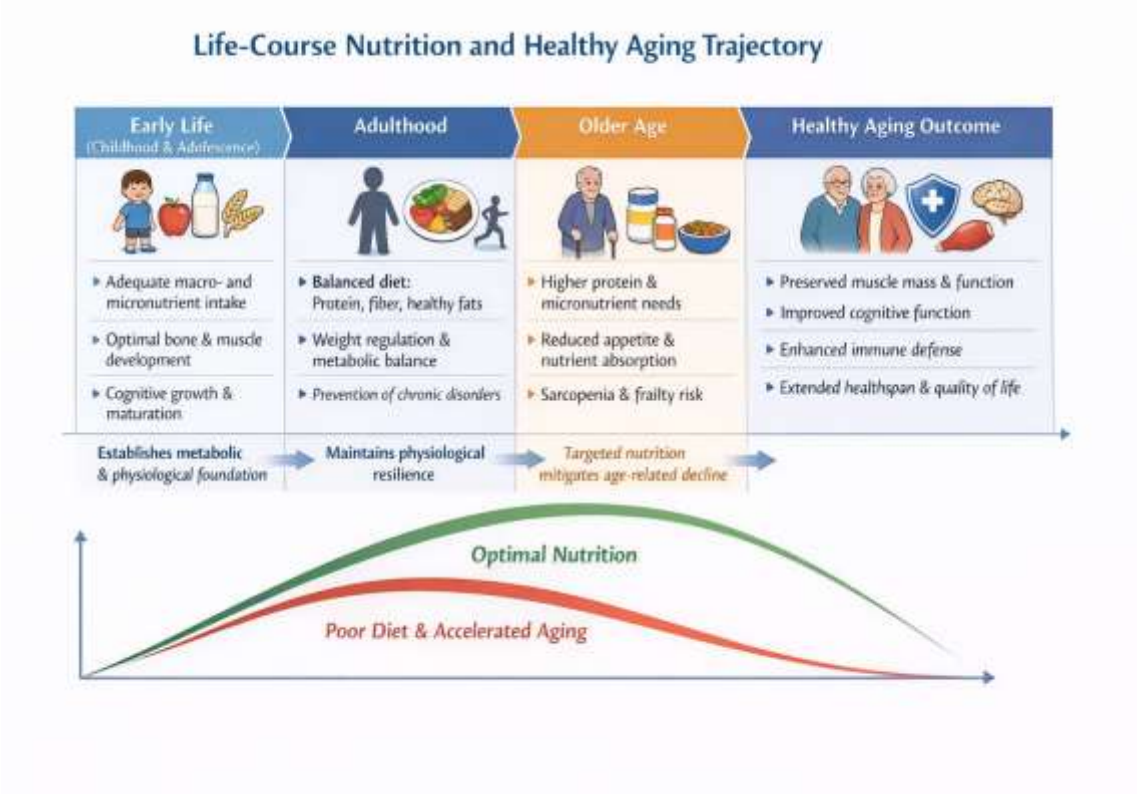
Calorie restriction (CR) lowers age markers in human colonic mucosa and mouse organs, making it the most successful non-genetic strategy for delaying the aging phenotype (Ogrodnik et al., 2017;

Fontana et al., 2018). In order to prevent malnutrition, CR, often referred to as dietary restriction, typically refers to a daily decrease of 20% to 50% of the total calories of the diet while supplying the organism with sufficient nutrients (such as necessary amino acids, vitamins, etc.). One strategy to control aging and extend life is calorie restriction (CR). By controlling aging-related signaling pathways and intercellular signaling molecules' anti-aging mechanisms, CR has currently achieved some headway (Zhai et al., 2023).

A dietary approach to prevent and mitigate obesity-related diseases and aging-related effects is calorie restriction (CR). CR does not need consumption to take place during any particular time domain for energy intake; instead, it involves a general decrease in daily calorie intake, typically more than 20% less than a normative consumption of energy. Although CR has long been associated with longevity and the avoidance of obesity, most people probably cannot sustain CR at the suggested energy intake reduction in the long run (James et al., 2024). Maintaining skeletal muscle function is crucial for preserving quality of life as one ages. Calorie restriction (CR) is a powerful way to increase longevity and health. CR focuses on mTORC1-centered nutrient-sensing pathways. Rapamycin, a mTORC1 inhibitor, has been shown to prevent age-related muscle loss and is seen as a possible CR mimic (Ham et al., 2022).

## 6. Nutrition Interventions Across the Life Course and Their Impact on Aging

It is acknowledged that each period of life is distinct and has specific requirements that affect health and well-being. Every stage of life offers the chance to make food choices that promote health and well-being, achieve and maintain appropriate weight status, and reduce the risk of diet-related chronic disease, even though early food preferences set the stage for food choices and eating habits in later childhood and adulthood. Dietary trajectories may demonstrate how dietary modifications at particular life stages can affect health outcomes, given the global endeavor to close the gap between life expectancy and healthy life expectancy (Chong, 2022).




The diet should not only support the prevention of disease but also promote optimal use of physical, mental, and social capabilities. The maximal cognitive capacity, which can be described in general terms as learning, remembering, and directing attention, is considered to have a pivotal role in mental health and overall mental efficiency in life. In most people, the slow process of cognitive atrophy, impacting cognitive capabilities, starts at the age of 30. In addition, a heightened rate of cognitive decline could also predict a high probability of death. The rate of cognitive decline is determined by a multifaceted environment and genetic gradient of educational attainment, socioeconomic status, and early exposures to mental engagement tasks and stimuli. As a consequence of the high nutrient content of potential neuroprotective ingredients and substances in food, nutrition has received increasing attention, particularly as a modifiable component emphasizing its possible role in reducing susceptibility to age-related cognitive pathologies (Dalile et al., 2022).

At different phases of one's life, weight regulation is required to promote healthy longevity or successful aging. This approach mimics the benefit of mild caloric restriction in one's entire life,

especially in today's obesogenic dietary environment. It has been noticed that the kind of fat, protein, and carbohydrates has more influence on mortality, as well as the risk for various chronic diseases. Healthy living, such as stopping smoking, regular exercise, weight regulation, and consumption of alcohol in moderation (if one consumes), helps in enhancing one's life expectancy (Hu, 2024).

## 7. Challenges and Future Directions

Despite an emerging body of information regarding the importance of nutrition to healthy aging, it has proven to be difficult to effectively apply nutrition techniques to senior citizens. This can be attributed to a number of reasons, with the primary being the heterogeneity of senior citizens. This takes into account genetic, health, metabolic, and activity disparities, collectively resulting in a challenge to offer health advice to senior citizens. A number of senior citizens can be prone to health conditions or using health products that influence nutrition. Following particular dietary regimens, for example, calorie restriction diets or intermittent fasting, might be difficult for older people. This could be due to a lack of appetite, changes in taste or smell, dental problems, or swallowing difficulties with aging. Also, conditions such as loneliness, isolation, and lack of support with psychological distress, such as depression, could have a detrimental effect on dietary status. The other challenge is that most of what is known about nutritional factors and aging comes from observational studies. While such studies provide associations but not causations, long-term studies involving large groups of people remain difficult to conduct. Moreover, most of what is known about nutritional factors comes from studying each nutrient independently. The interactions of various nutrients come into play when it comes to comprehensive food patterns. Although some nutritional factors, like those from fruits, vegetables, and foods, appear to delay aging, more work needs to be done on these.

An approach tailored to specialized nutritional plans in consideration of an individual's current health status, genetic makeup, and lifestyle may prove helpful in future research. Research on the various correlated relationships between nutrients, dieting, and the various aspects of lifestyle modifications, including exercise and mental stimulation, may prove to be of great interest. Formulations on how to enhance patient compliance in the consumption of healthy nutritional plans

may prove to be of immense help. Lastly, research on an individual's dietary habits spanning the lifetime of an individual may prove to be of immense help in comprehending the relationship between nutritional aspects and the induction of age-related chronic illnesses. All the above-mentioned issues may prove to be of great help in formulating strategies to promote the long life of the aging population.

## 8. Conclusion

To be able to age healthily with minimal age-related diseases, proper nutrition is important. A balanced dietary regimen that is rich in fibers, healthy fats, vitamins, and minerals, as well as high-quality proteins, is good for fortifying muscles and improving mental acuity during old age. A healthy diet consists of a significant number of plant nutrients along with some good animal proteins. It also involves a reduction in some bad dietary sources that consist of processed meals and unhealthy fats. Personalized nutritional methods, life-course nutritional planning, and merging nutritional interventions with other lifestyle modification therapies, such as physical activity, can be very useful in overcoming obstacles such as individual variability, patient compliance, sociopsychological aspects, and a shortage of long-term trial research aimed at increasing healthy lifespan. Research focusing on functional bioactive substances, combinations, and nutritional patterns may give rise to more effective methods to optimize nutritional therapies in elderly persons. It is crucial to develop sustainable, feasible, and scientifically proven nutritional therapies to enhance a healthy lifespan and quality of life.

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