



Live Longer, but How? Nutrition and Aging Uzun Yaşayalım ama Nasıl? Beslenme ve Yaşlanma

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ÖZET

Yaşlı nüfus ve daha uzun yaşam beklentisi dünya çapında artmaktadır. Bu artışla birlikte sağlıklı yaşlanma önem kazanmaktadır. Daha uzun ve sağlıklı bir yaşam beklentisinin artması, beslenmenin nasıl olabileceği konusunda merak uyandırmıştır. Beslenme, sağlıklı yaşlanmanın temel faktörlerinden biridir. Yaşam kalitesi ve süresini uzatmak için bazı diyet modelleri ve diyet uygulamaları (kalori kısıtlaması) bulunmaktadır. Dünyanın bazı yerlerinde (Mavi Bölgeler, Hunza, Abkhazya, Vilcabamba) yaşam beklentisi daha uzundur ve bu çoğunlukla beslenme ile bağlantılıdır. Daha uzun yaşayan insanlar, genelde sebzeler, meyveler, balık ve yoğurt gibi doğal yiyecekler yerler. Beslenme davranışına ek olarak yaşam tarzı çok önemlidir. Dünyadaki sağlıklı yaşlılar sosyal, zihinsel ve fiziksel olarak aktif yaşama sahiptir.

Anahtar kelimeler: Beslenme, yaşlanma, uzun yaşam, Mavi Bölgeler, Akdeniz diyeti,

ABSTRACT

The elderly population increases and more prolonged life expectancy and increased worldwide, and with this increase, healthy aging gained importance. The increased expectancy of a longer and healthier life has created curiosity about how nutrition can be. Nutrition is one of the critical factors for healthy aging. Some diet models and diet applications (for example, calorie restriction) extend the quality and span of life. Life expectancy is longer in some places globally (Blue Zones, Hunza, Abkhazia, Vilcabamba), which is mainly linked to nutrition. Peoples who live longer eat natural foods, primarily vegetables and fruits, fish, yogurt, and drink pure water. In addition to nutritional behavior, lifestyle is essential. In the world's healthy elderly's have social, mental, and physically active life.

Keywords: Nutrition, aging, longevity, Blue Zones, Mediterranean diet

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Geliş Tarihi / Received: 06.04.2021 **Kabul Tarihi / Accepted:** 29.08.2021

INTRODUCTION

In "Global Strategy and Action Plan on Ageing and Health," a report published by the World Health Organization (WHO), it is stated that in 2050, one in five people will be 60 years or older, a total of 2 billion people worldwide (1). The physiological and anatomical changes that occur as part of the aging process affect all body systems and lead to sensory weaknesses, mental problems, and chronic diseases (2). Because an increase in the number of older adults worldwide is being predicted, implementing adequate, balanced, healthy nutrition for healthy aging is also gained importance on the agenda.

There are too many definitions for healthy aging, but all definitions' common point is good health and well-being in social, physical, and mental. Healthy aging descriptions are based on two different theories. Based on the biomedical aging model, the first theory stands on the physiological dimension. It includes physical, cognitive, and functional health. The second theory consists of the psychological dimension: psychological well-being, social activities, new social networks, and enjoys life (3). In addition, healthy aging is linked to some environmental factors like physical activity, avoiding smoking, fresh air, socializing and healthy nutrition (4).

Various studies have shown the importance of nutrition in making people's lives healthy and longer (5,6). It is known that there are some places in the world, Okinawa, Ikaria, Nicoya, which are known as Blue Zones, and other areas such as Hunza, Abkhazia, Vilcabamba where people live longer. Notably, these different regions combine on the point of similar eating patterns. Longer life and healthy aging are linked to optimal nutrition with age, social life, and the environment. Some of the mechanisms in the aging process are related to food and eating patterns, and it is considered that optimal nutrition can provide longer life expectancy and healthy aging (7). This review

aims to evaluate different dietary models and lifestyle habits for healthy aging.

NUTRITION

Nutrition is defined as the use of nutrients taken from foods into the body to grow and develop, maintain life, and protect health. Therefore, it cannot be denied that nutrition is an essential component in regulating health and physical abilities.

In western societies, the elderly population (those over 65) increases every passing day, and it has been found that a balanced and healthy diet plays an essential role in healthy aging. It is also a fact that the effects of nutrition on physical and mental well-being are higher in the elderly (8–10). With advancing age, food intake changes due to the slowing of the metabolic rate and reduced mobility. However, consuming insufficient food and nutrients is the leading cause of malnutrition (11). In addition, negative physiological changes in the body, increased nutrient requirement (due to impaired digestion or absorption function, infection, inflammatory disease), socioeconomic status, and behavioral factors contribute to malnutrition in the elderly (12).

AGING

Aging is defined as all the irreversible, structural, and functional changes that occur with the progress of time, at the levels of an organism's molecule, cell, tissue, organ, and systems. It is a fact that the functions of tissues and organs are impaired over time. In mammals, aging occurs heterogeneously in multiple organ systems, resulting in a progressive impairment leading to tissue dysfunction. For this reason, aging is accepted as a risk factor for many diseases (13,14). On the other hand, most people expect to live into their sixties and beyond for the first time in history (15).

Aging is divided into two strands as normal aging, and normative aging. Normal aging involves surviving accidents and advanced age-related cognitive diseases. In contrast, normative aging means survival from environmental factors (such as air pollution and infectious agents), behavioral factors (such as smoking and diet), and social factors (such as socioeconomic status and education) to maintain the interaction of epigenetics, cells, and organs (16).

Although some health variations come with genetic, it cannot be ignored that many factors originate with physical and social life. Some of these factors are neighborhood, communities, gender, ethnicity, and socioeconomic status. (17).

Blue Zones are the determined locations where people live longer in the world. Blue zones have a limited and homogeneous geographical area. People in the Blue zones share the same lifestyle habits, which are thought the cause of their high life expectancy. For example, Okinawa in Japan, the Nicoya peninsula in Costa Rica, and Ikaria in Greece are Blue Zones. Studies carried out in the Blue Zones Project have shown similar eating patterns in the regions where people live longer. Still, the relationship between Blue Zones and eating patterns needs further exploration (18,19).

Aging mechanism models

A review of aging carried out in 1999 showed that more than 300 theories of aging had been reported (20). The most current and comprehensive aging mechanism models and their effects on diet are shown in Table I (7,21).

CAN NUTRITION STOP AGING?

It is widely known that a healthy diet decreases the risk of cardiovascular disease and cancer and helps prevent some diseases by its antioxidant and anti-inflammatory properties (51). In particular, nutrient-rich diets positively

affect healthy aging because they include vegetables, fruits, nuts, fish, whole grains, and olive oil. Therefore, an adequate, balanced, and healthy diet is associated with higher life expectancy. Each diet is specific to a person; in addition to that, the content of the diet varies according to individual factors. A balanced and healthy diet contains all the necessary macro and micronutrients in adequate amounts for each individual. According to their personal needs, individuals have four main food groups in a meal: grains, dairy products, vegetables and fruits, and meats. The energy distribution must be 45-60% as carbohydrates, 10-20% as proteins, and 25-30% as fats in a balanced diet. In a healthy diet, trans-fatty acid intake is recommended to be less than 1% of the energy intake. In addition, saturated fats (fats in animal-based foods, butter, tallow, tail fat) should be less than 10% (preferably 7-8%), monounsaturated fats (olive oil, hazelnut oil, rapeseed-canola oil) should provide 12-15%, and polyunsaturated fats (corn oil containing omega-6 fatty acid, soy, sunflower and cotton oil and fish containing omega-3 fatty acid, fish oil, walnuts, flaxseed) should provide 7-10% of the total fat. The distribution of omega-3 and omega-6 are also important. Omega-6 should provide 5-10%, and omega-3 0.6-1.2% of the total fat (52). Individuals should eat all the food groups, all colors of vegetables and fruits, and drink at least 6-8 cups of water each day to achieve the requirements of nutrients. They should also limit added sugar, salt, carbonated drinks sweetened with sugar, processed grains, and meat products.

Some dietary models such as Dietary Approaches to Stop Hypertension (DASH), Mediterranean and vegetarian are accepted as reducing the risk of age-related and chronic diseases (53-55). These diet models include lots of vegetables, fruits, fish, grains, and natural, unprocessed foods commonly. In addition to a healthy diet, people also have

Table I. Aging mechanism and the association with foods and diet

MECHANISM OF AGING	MECHANISM OF ACTION	THE EFFECTS OF FOOD OR DIET
Oxidative stress	Excessive free radical production in cells disrupts normal cell metabolism and causes aging (22).	Consumption of vegetables, fruits, and nuts rich in vitamins A, E, and C, which have antioxidant effects, reduces oxidative stress (23). Also, melatonin, which has antioxidant effects, has positive effects on oxidative stress (24). Reducing the amount of methionine in the diet reduces the production of mitochondrial ROS(25).
Telomere-telomerase	Telomeres protect the ends of DNA strands in cell renewal. Telomerase is an enzyme that controls and regulates the sequencing of telomeres – the longer the telomeres of a cell, the longer the lifespan (26).	Increasing consumption of legumes and fruit has been associated with long telomeres. On the other hand, red and processed meat consumption, carbonated beverages flavored with sugar, white bread, and sodium have been associated with short telomeres (27–30).
Epigenetic Regulations	This means the activation of the gene sequence and the inhibition of some unwanted methylation states. It regulates histone modifications which can affect chromatin structure and transcriptional activity such as methylation, phosphorylation, and acetylation (31).	Folic acid, calorie restriction, resveratrol, and protein modifications may affect epigenetic regulation (32,33).
mTOR (mammalian Target of Rapamycin)	This has effects on cellular growth, regeneration, protein synthesis, transcription, and survival. Low mTor levels have been associated with longevity (34).	Protein restriction (especially of animal origin) lowers mTor levels (35).
IGF-1 (Insulin-like Growth Factor-1)	Low IGF-1 levels have been associated with longevity (36).	Dietary methionine reduction, calorie restriction, protein restriction (especially animal protein), resveratrol consumption, and intermittent fasting reduce IGF-1 levels(25,37–39).

Table I. Aging mechanism and the association with foods and diet (continued)

MECHANISM OF AGING	MECHANISM OF ACTION	THE EFFECTS OF FOOD OR DIET
SIRT1 (Sirtuin 1 Protein)	This regulates various cellular and metabolic processes such as DNA regeneration, fat differentiation, insulin sensitivity, fatty acid oxidation, and neurogenesis. High SIRT1 levels have been associated with longevity (40).	Resveratrol consumption, calorie restriction, and intermittent fasting increase SIRT1 levels(39,41).
AMPK (AMP-activated protein kinase)	This increases the glucose uptake into the cell by enhancing insulin sensitivity in muscle cells. The increase in AMPK has been associated with longevity (42).	Calorie restriction and resveratrol consumption increase AMPK levels (39,41).
Autophagy	This is the self-digesting function of the cell by which cellular homeostasis is produced and prevents the formation of diseases such as cancer (43).	Calorie restriction and increasing the amount of spermidine consumed in the diet increase cellular autophagy(39,44).
Inflammation (Inflammaging)	Cancer, cardiovascular disease, and other diseases in the body have been associated with increased inflammation (45).	Foods that contain antioxidants and a diet rich in omega-3 fatty acids reduce the formation of inflammation markers (46).
Adrenomedullin (ADM)	Cardiovascular effects were defined when ADM was first described, but later research has shown that it is not just a simple vasodilator and that ADM has a wide range of effects, from cell growth and differentiation to the regulation of hormone secretion and antibacterial effects. Increased levels of ADM have been associated with vasodilation (47-49).	Mediterranean diet, vegetarian diet, and plant-based diet (50).

similarities in lifestyle factors. These factors comprise not smoking, regular physical activity, and socialization. (56).

Another factor affecting this issue is calorie restriction. Various studies have shown that calorie restriction has a beneficial effect on the aging process (37,57). Calorie restriction is a quantitative attempt to lower energy intake, limit food consumed, and reduce energy compared with a standard diet. In addition to decreasing the total energy, it is thought that reducing the energy intake, especially some macronutrients such as proteins, or decreasing both energy and protein intake, has an impact on life expectancy (57). Reducing the intake of essential amino acids such as methionine, tryptophan, and branched-chain amino acids from proteins in *ad libitum* fed mice has been shown to delay aging (58–60). A previous study has shown that calorie restriction is not effective worldwide but is affected by gender, genotype, and diet types (61). Protein and/or calorie restriction can be harmful because they can induce diseases such as malnutrition, sarcopenia, and muscle mass and strength loss, commonly seen in the elderly (62).

The best effect of calorie reduction on life length occurs when total calories are 50%, and protein is 20-30% of total calorie intake. (63).

Therefore, in older adults, adequate energy, macro, and micronutrients are vital for maintaining health. So, the overall diet of older adults must be balanced with the energy provided by macronutrients.

Calorie restriction can be achieved by intermittent fasting-like practices involving the restriction of foods containing high calories and flavor-enhancing substances, especially in western societies. It has been shown that intermittent fasting increases human regeneration markers and delays diabetes, cardiovascular diseases, cancer, and aging (64).

Some metabolic changes, however, occur in the body due to calorie restriction. While ROS production, glycolysis, oxidative stress, inflammation, DNA damage and cholesterol, fatty acid, and triglyceride synthesis, and insulin release decreases, increases in the mitochondrial respiratory rate, gluconeogenesis, glycogenolysis, protein, and fatty acid catabolism and insulin sensitivity (7). As a result, calorie restriction is thought to positively affect aging and the prevention/delay of metabolic diseases. Some of the effects of calorie restriction are shown in Figure 1.

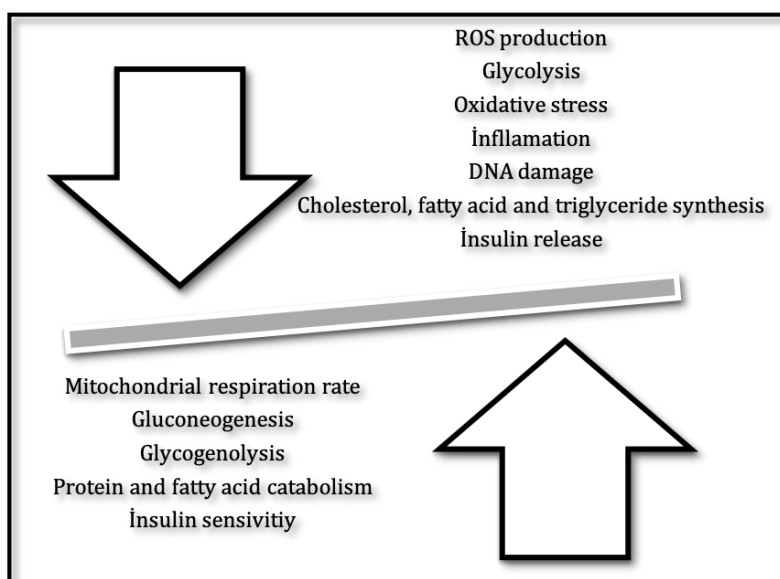


Figure 1. Metabolic changes that occur with calorie restriction

WHAT CAN WE EAT TO LIVE LONGER?

As has already been mentioned, there are similar attitudes to eating in the places where people live longer. Generally, their diets comprise mostly raw and plant foods, pure and high-mountain water, nuts, fermented foods, and no processed grains. Some of these diet attitudes are discussed below. In addition, these people do not smoke. These older adults also do physical activities like hiking and climbing because they grow their foods as vegetables and fruits picked from gardens, fields, trees, and mountains. They are also essential for family and community life. Their family and friends consider the experiences of older adults. These give a purpose of life to older adults and become a driving force for socializing (18,19,65).

The Blue Zones diet

As has already been stated, the places where people live the longest are called Blue zones. A Blue Zones are a geographical area where the inhabitants have similar lifestyles and a long life span. Not smoking, regular physical activity, socialization, having a purpose in life, spirituality, consumption of a diet rich in vegetables, fruits, whole grains are the factors that are related to long life. (18).

The dietary habits in blue zones comprise the following factors (66,67).

- **Plant-based diet:** 95% vegetable-based foods. Their diet includes foods such as fruit, vegetables, beans, bean curd, lentils, nuts, and seeds, which all make people stronger to fight diseases, and all these foods form the cornerstone of the diet.
- **Unprocessed (whole) foods:** whole foods are not processed in factories. They are made with ingredients recognizable as coming from the earth, such as rice, corn, soy, fruit, and vegetables, or prepared food such as tofu and manna bread.
- **Less meat consumption:** Inhabitants of blue zones eat meat approximately once a week, about the size of a matchbox. Their diet does not include processed meats such as hot dogs and bacon. Instead, they prefer free-range chicken and pork or lamb produced on a family farm.
- **High amount of fish consumption:** Fish is an essential component of the blue zones diet. It is considered that consuming a daily portion of fish is healthy. Wild-caught fish are good choices from the middle of the food chain, such as sardines, trout, snapper, cod, and anchovies. Predator fish, such as tuna, swordfish, and sharks should be avoided because of their potentially high levels of mercury.
- **Small amounts of milk and dairy products:** People in blue zones consume food made of sheep and goat milk (especially yogurt) several times a week.
- **Occasional eggs:** Inhabitants of blue zones consume eggs every day or at least three times a week. The eggs need to be collected from free-range poultry, which can graze naturally outdoors.
- **Seed and legume consumption:** Legumes are a good source of protein, and for centuries the inhabitants of the blue zones have consumed at least one cup a day. Black beans, pinto beans, garbanzo beans, lentils, fava beans, navy beans, and peas are consumed varieties of legumes.
- **Dried fruit and nuts as a snack:** Dried fruits and nuts are healthy fats that help people be psychologically happy. Almonds, hazelnuts, walnuts, peanuts, Brazil nuts, and peanuts are the most preferred nuts, and sunflower and pumpkin seeds are equally popular. People who live in blue zones consume a handful of various nuts regularly, and they generally avoid adding sugar or salt to dried nuts.
- **Bread consumption:** People in the blue zones eat small amounts of bread and prefer sourdough. Unlike other bread made from white flour, sourdough bread does not cause sudden increases in blood sugar.

- **Less sugar consumption:** Inhabitants of the blue zones prefer flavor with fruit and honey instead of sugar-sweetened food. It is known that added sugar increases inflammation and the risk of the body developing diseases (68).
- **Drinks:** Blue zone inhabitants drink coffee for breakfast, tea in the afternoon, wine at 5 pm, and water all day long. They avoid beverages with added sugar, such as soda and juices (19).

The Hunza diet

Hunza is in the western Karakoram mountains of northern Pakistan. In Hunza, people can be physically and mentally healthy in hundred years and above. It is believed that the secret of this life is associated with lifestyle and dietary habits. Their diet is rich in vegetables and fruits, raw foods, pure water, and unprocessed foods.

- **Hunza bread:** Unprocessed, whole-grain flour is mixed with water and then formed into a pancake. The grain selection for this bread includes wheat, barley, buckwheat, corn, millet, alfalfa, and rye.
- **Vegetable and fruit consumption:** Potatoes, tomatoes, cucumbers, carrots, onions, garlic, and pulses are preferred vegetables. The fruits are mulberries, apricots, apples, grapes, peaches, cherries, and some melons, which are rich in antioxidants.
- **Raw foods:** In Hunza, almost everything is eaten raw, uncooked, and just as nature intended.
- **Freshwater:** In Hunza, meltwaters flowing down from the snow-covered mountains are consumed instead of spring water. It is relatively uncontaminated, fresh, and rich in minerals. The people of Hunza also use this water for growing vegetables and fruit in their gardens. Due to the high quality of water, it contributes to everything eatable in Hunza.
- **Natural foods:** Grains play a vital role in their diet. The length of the growing

season is short in Hunza, which encourages the inhabitants to use grain wisely, saving a proportion of each year's harvest to sow in the following year. Poultry and, accordingly, eggs are scarce because there are more minor cereals to feed chickens or other birds (69).

The Abkhazia diet

Abkhazia is another area that people lived longer, and it is in Georgia. The typical diet of the people there consists primarily of eggs, cheese, butter, yogurt, milk, curds (*shor*), sour cream, bread, various vegetables, fruits, and herbs. In addition, they eat soup made of yogurt and greens (*dovgha*) along with various soups made with beans, peas, and grains. The people who have long life did not eat very much bread or products made with flour.

- **Animal fat consumption:** Abkhazians consume a medium amount of animal fat. They believe that if you eat animal fat, you have to balance it by eating fresh vegetables and herbs such as spinach, celery, dill, onions, spring onions, coriander, mint, basil, tarragon, and parsley.
- **Honey instead of sugar:** Sweets have been an essential part of the cuisine for a long time. When they prepare national sweets such as *pakhlava*, *shakarbura*, and *halva*, they generally prefer to use honey instead of sugar.
- **Yogurt consumption:** Since antiquity, it has been believed that regular consumption of yogurt is the secret to longevity as it promotes digestion and rejuvenates the digestive system. When Abkhazian eats meat, they serve it with yogurt sprinkled with mint to encourage its digestion. When they eat yogurt, they add some garlic to it. In Abkhazia, a popular drink (*ayran*) is made by diluting salted yogurt with water.
- **Garlic:** Modern scientists confirm that the regular consumption of garlic decreases cholesterol in the body and improves blood

circulation (70). They eat garlic with yogurt, which they call *sarimsagli gatig*.

- **Low bread consumption:** In the past, Abkhazians did not overuse bread and flour products.
- **Herbs:** Since antiquity, Abkhazians have been convinced that saffron and licorice prolong life, refresh the skin and face, and promote health for the liver, heart, and kidneys. In addition, these long-lived people traditionally consume large amounts of vegetables and fruit, especially apples.
- **Tea instead of coffee:** Regular tea consumption is another principal characteristic that people frequently practice (69).

The Vilcabamba diet

Vilcabamba is a small town located high in the Ecuadorian Andes. In Vilcabamba, many of the inhabitants are more than 100 years old, and that some of them are over 140 years old(69).

- **Colloidal minerals:** The results of laboratory analysis of the Vilcabamba water show that the unique balance of enriched colloidal minerals in the local drinking water is ideal for promoting optimum human health.
- **Vegetables and fruit:** They usually add mandarins to their salads. Mandarin orange is enriching in the flavor of the salads and has vitamin C, which enhances iron absorption for the body. In addition to health benefits, it grows abundantly in the valley. Avocados are another 'secret' component of the Vilcabamba diet.
- **Quinoa:** Quinoa is called the queen of grains; it is one of the foods with an almost perfect balance of all eight essential amino acids, so it is used as a protein.
- **Raw foods:** The diet of Vilcabamba is formed from 70-75% raw foods, emphasizing salads, vegetables, and locally grown fruit. According to these

dietary habits, people lean and are healthy instead of obese or sick(69).

- **Beans:** The black bean, called Spanish beans or Venezuelan beans, is the most consumed legume.
- **Yogurt:** Their use of natural, organic, unpasteurized yogurt from both goats' and cows' milk also provides beneficial probiotics (69).

The Mediterranean diet

The Mediterranean diet, similar to the blue zones diet, also helps people to live longer. Low adherence to the Mediterranean diet is associated with diabetes, cardiovascular disease, and other complications (71–73). It is also associated with mortality risk increases. Several meta-analyses show that the inverse relationship between Mediterranean Diet and mortality for all age groups (74,75). The traditional Mediterranean diet is characterized by a high intake of vegetable-based foods (vegetables, bread, other cereals, potatoes, beans, herbs, and nuts) and fresh fruit. Olives are the primary source of fat. Dairy products, fish, and poultry are consumed in medium to small amounts. Fish is especially essential for omega-3 fatty acids. Egg consumption is limited to four per week. Red meat is consumed occasionally and in small quantities, but no more than once a week. The Mediterranean diet has a low saturated fat content, corresponding to a maximum of 8-10% of the total calorie intake. Calorie intake from lipids is only 30% overall. Modest amounts of wine (1-2 glasses, for achieving moderate alcohol intake: 10–50 g/day for men and 5–25 g/day for women) are usually consumed with meals (56,76).

Various studies have shown that a diet rich in vegetables, fruit, and whole grains reduces the risk of death from chronic diseases and inflammation biomarkers (28,77,78). Therefore, it is thought that nutritional components associated with oxidative stress

and inflammation can affect telomere length (79). Telomeres are susceptible to oxidative stress due to their high guanine nucleotide content. Hydroxyl radicals can cause DNA damage in telomere length to occur through each replication and damaging DNA. Vegetables, fruits, and whole grains can be protecting DNA by antioxidant properties to the damage of free radicals. Soy and legumes, in addition to folic acid content also rich in antioxidant phytochemicals. These phytochemicals are thought to play an essential role in DNA methylation and integrity. For instance, it is widely known that the consumption of whole grains and herbs reduces inflammation (80,81).

Sugar and processed meat increase telomere shortening by increasing cell destruction through chronic inflammation (82–84). Insulin resistance is related to increased oxidative stress and inflammation and is thus thought to cause telomere shortening. Insulin resistance, inflammation, and oxidative stress can occur with increased high sugar intake, which increases glycemic load. As a result of these metabolic changes, telomere shortening can be observed. (85,86). Furthermore, processed meats can increase the formation of advanced glycation end products (AGEs), which act as inflammatory markers because of their high fat and protein content. AGEs can increase intracellular oxidation and cause telomere shortening (84).

According to Mediterranean Diet Foundation and Mediterranean Food Cultures, accompany by the Mediterranean diet, some social and cultural factors have a positive effect on health, and several recommendations are mentioned below.

Socialization: Pleasure is vital for taking the social and cultural values of food beyond the nutritional aspects. Activities such as cooking, sitting around the table, and sharing foods with family and friends provide social support and give a sense of community.

Baking and cooking together: Sharing baking and cooking can be an essential activity, and arrangements can be made for an appropriate time and place. Because cooking and baking together are relaxing and fun, it can be enjoyed with family, friends, and loved ones (56).

Seasonal biodiversity and traditional, local, and environmentally friendly food products make the Mediterranean diet compatible with a sustainable diet model for today and future generations. Furthermore, the consumption of seasonal, fresh, and minimally processed foods maximizes the content of healthy dietary substances (56). A comparison of the different diet types for living longer discussed in this paper is shown in Table II.

CONCLUSION

Blue zones, Abkhazia, Hunza, Vilcabamba, and Mediterranean areas have been known to the longer-lived people than other places. The most important reason is that those regions have different eating habits from other places; their diets predominantly comprise vegetables, fruit, and whole grains. They consume small meals with small portions. Various studies have shown that a low-calorie intake plays a vital role in delaying the aging process. The oldest inhabitants of Okinawa in Japan describe their eating behavior as *Hara Hachi*, an old Confucian term meaning 'eat until 80% full'. A thousand years ago, one of the big polymath Ibn Sina (known in the West as Avicenna), gave advice on eating habits that can make people healthier: "People who want to protect their health should pay much attention to food. They should not eat before feeling hungry. It is not good for them not to wait for their appetite. They should never eat until the stomach is full; they should get up

Table II. Different diet features of the places that people live longer

DIET ITEM	BLUE ZONES (18,19)	HUNZA (69)	ABKHAZIA (69)	VILCABAMBA (69)	MEDITERRANEAN (56,76)
Red Meat	Minimal	Minimal	Low (lamb)	Low	Red meat is consumed occasionally and in small quantities, but not more than once a week.
Fish	Consuming a daily portion is considered healthy. Sardines, trout, snapper, cod, and anchovies are good choices.	Minimal	Low	Low	Fish is consumed in medium-small amounts
Bread	Sourdough bread	Hunza bread	Abkhazia bread	-	Wholegrain bread
Vegetables and fruit	Dried fruits, a 95% plant-based diet, grains, and seeds.	High vegetables: tomatoes, cucumbers, onions, garlic, spinach, turnips, carrots, pumpkins, cabbage, and cauliflower. High fruit: mulberries, apricots, apples, grapes, peaches, cherries, and some melons	High vegetables: string beans, corn, cabbage, tomatoes, spinach, celery, dill, onions, spring onions, coriander, mint, basil, tarragon, and parsley. High fruit: apples, cherry plums, barberries, blackberries, pomegranates, green grapes, tomatoes	High vegetables: potatoes, mayoko, payoko; high fruit: oranges, blackberries, papayas, bananas, figs, avocados, Granadias	High intake of fresh vegetables and fruit.
Sugar	Low	Unrefined sugar	Honey instead of sugar	Unrefined sugar	Low
Common foods	Yoghurt	Yoghurt	Yoghurt and garlic	Quinoa	Olive oil
Drinks	Coffee for breakfast, tea in the afternoon, wine at 5pm, and water all day long	High: mountain melt water	Tea, Ayran	High: mountain waters (glacial melt)	Medium amounts of wine

from the table before the appetite is completely over". A millennium later, it is clear that nutrition and lifestyle are essential for managing the aging process well. Delaying the aging process and providing healthy aging are linked to optimal nutrition. It has been shown in this brief review that the people who live longer in different places in the world share a similar approach to what they eat. Although these attitudes to eating include lots of vegetables and fruit, raw, unprocessed, and fermented food, and pure freshwater, few studies have been carried out to explore their effects. More research is therefore needed to examine the link between nutrition and aging.

Conflict of Interest and Funding

The authors declare no conflict of interest.
The study was not funded.

Authors' Contribution

MA and HKBG determined the design of the review. HKBG wrote the first manuscript. MA did a critical review. MA and HKBG approved the final version of the document.

REFERENCES

1. World Health Organization (WHO). Global strategy and action plan on ageing and health. Who. 2017. 1–56 <http://apps.who.int/bookorders.%0Ahttp://www.who.int/ageing/WHO-GSAP-2017.pdf?ua=1>. Date of access: 23.08.2021
2. Navaratnarajah A, Jackson SHD. The physiology of ageing. *Medicine in Older Adults*. 2013; 41 (1): 1-6.
3. Sowa A, Tobiasz-Adamczyk B, Topór-Mądry R, et al. Predictors of healthy ageing: Public health policy targets. *BMC Health Serv Res* 2016;16.
4. Assmann KE, Ruhunehewa I, Adjibade M, et al. The mediating role of overweight and obesity in the prospective association between overall dietary quality and healthy aging. *Nutrients* 2018;10:1–15.
5. Leslie W, Hankey C. Aging, Nutritional Status and Health. *Healthcare* 2015;3:648–58.
6. Capurso C, Bellanti F, Buglio A Lo, et al. The mediterranean diet slows down the progression of aging and helps to prevent the onset of frailty: A narrative review. *Nutrients* 2020;12.
7. Karan M, Tufan F. Yaşlanma Mekanizmaları. *Ege Tıp Derg* 2010;49:11–7.
8. Pirlich M, Lochs H. Nutrition in the elderly. *Bailliere's Best Pract Res Clin Gastroenterol*. 2001;15:869–84.
9. Tierney AJ. Undernutrition and elderly hospital patients: A review. *J Adv Nurs* . 1996;23:228–36.
10. Wells JL, Dumbrell AC. Nutrition and aging: assessment and treatment of compromised nutritional status in frail elderly patients. *Clin Interv Aging*. 2006;1:67–79.
11. Norman K, Pichard C, Lochs H, et al. Prognostic impact of disease-related malnutrition. *Clin Nutr*. 2008;27:5–15.
12. Perry L. Assessing nutritional status. *Nursing times*. 1997. 51 p.
13. Koldaş ZL. What is aging and cardiovascular aging? *Türk Kardiyol Dem Arsivi-Archives Turkish Soc Cardiol*. 2017;1–4.
14. Liguori I, Russo G, Curcio F, et al. Oxidative stress, aging, and diseases. *Clin Interv Aging*. 2018;13:757–72.
15. United Nations Department of Economic and Social Affairs. World economic and social survey, development in an ageing world. *Choice Reviews Online*. 2007. <https://www.un.org/development/desa/ageing/publications/2008/08/world-economic-and-social-survey-2007-development-in-an-ageing-world/>. Date of access: 23.08.2021
16. Milman S, Barzilai N. *Dissecting the Mechanisms Underlying Unusually Successful Human Health Span and Life Span*. Cold Spring Harbor Laboratory Press. 2016;6(1):1-11.
17. World Health Organization (WHO). *World Report On Ageing And Health*. 2015. Available from: <https://www.who.int/ageing/WHO-GSAP-2017.pdf>. Date of access: 23.08.2021
18. Poulain M, Herm A, Pes G. The blue zones: Areas of exceptional longevity around the world. *Vienna Yearb Popul Res*. 2013;11:87–108.
19. Healthways BZP by. *Blue Zones - Food Guidelines*. 2014. https://www.bchd.org/docs/bzp/blue_zones_food_guideline_s.pdf. Date of access: 23.08.2021
20. Medvedev ZA. An attempt at a rational classification of theories of ageing. *Biol Rev Camb Philos Soc*. 1990;65:375–98.
21. Ekmekcioglu C. Nutrition and longevity–From mechanisms to uncertainties. *Crit Rev Food Sci Nutr*. 2019;0:1–20. <https://doi.org/10.1080/10408398.2019.1676698>
22. Höhn A, Weber D, Jung T, et al. Happily (n)ever after: Aging in the context of oxidative stress, proteostasis loss and cellular senescence. *Redox Biol*. 2017;11:482–501. <http://dx.doi.org/10.1016/j.redox.2016.12.001>
23. Harasym J, Oledzki R. Effect of fruit and vegetable antioxidants on total antioxidant capacity of blood plasma. *Nutrition*. 2014;30:511–7.
24. Yanar K, Simsek B, Çakatay U. Integration of Melatonin Related Redox Homeostasis, Aging, and Circadian Rhythm. *Rejuvenation Res*. 2019;22:409–19.
25. Dong Z, Sinha R, Richie JP. Disease prevention and delayed aging by dietary sulfur amino acid restriction: Translational implications. *Ann N Y Acad Sci*. 2018;1418:44–55.
26. Blackburn EH. Structure and function of telomeres. *Nature* 1991;350:569–72.
27. Davinelli S, Trichopoulou A, Corbi G, et al. The potential nutrigenoprotective role of Mediterranean diet and its function. *Ageing Research Reviews*, 2019;49:1-10.
28. Rafie N, Golpour Hamedani S, Barak F, et al. Dietary patterns, food groups and telomere length: A systematic review of current studies. *Eur J Clin Nutr*. 2017;71:151–8.
29. Todendi PF, Martinez JA, Reuter CP, et al. Biochemical profile, eating habits, and telomere length among Brazilian children and adolescents. *Nutrition*. 2020;71:1-6.
30. Freitas-Simoes TM, Ros E, Sala-Vila A. Nutrients, foods, dietary patterns and telomere length: Update of epidemiological studies and randomized trials. *Metabolism: Clinical and Experimental*. 2016;65(4):406-415.
31. Moskalev AA, Aliper AM, Smit-McBride Z, et al. Genetics and epigenetics of aging and longevity. *Cell Cycle*. 2014;13:1063–77.
32. Farhan M, Ullah M, Faisal M, et al. Differential Methylation and Acetylation as the Epigenetic Basis of Resveratrol's Anticancer Activity. *Medicines*. 2019;6:24.
33. Guarasci F, D'Aquila P, Mandalà M, et al. Aging and

- nutrition induce tissue-specific changes on global DNA methylation status in rats. *Mech Ageing Dev.* 2018;174:47–54.
<http://dx.doi.org/10.1016/j.mad.2018.02.001>
34. Hay N, Sonenberg N. Upstream and downstream of mTOR. *Genes Dev.* 2004;18:1926–45.
 35. Lushchak O, Strilbytska OM, Yurkevych I, et al. Implications of amino acid sensing and dietary protein to the aging process. *Exp Gerontol.* 2019;115:69–78. <https://doi.org/10.1016/j.exger.2018.11.021>
 36. Milman S, Atzmon G, Huffman DM, et al. Low insulin-like growth factor-1 level predicts survival in humans with exceptional longevity. *Aging Cell.* 2014;13:769–71.
 37. Wei M, Brandhorst S, Shelehchi M, et al. Fasting-mimicking diet and markers/risk factors for aging, diabetes, cancer, and cardiovascular disease. *Sci Transl Med.* 2017;9.
 38. Maggio M, De Vita FD, Lauretani F, et al. IGF-1, the cross road of the nutritional, inflammatory and hormonal pathways to frailty. *Nutrients.* 2013;5:4184–205.
 39. Hwangbo D-S, Lee H-Y, Abozaid LS, et al. Mechanisms of Lifespan Regulation by Calorie Restriction and Intermittent Fasting in Model Organisms. *Nutrients.* 2020;12:24.
 40. Stamatovic SM, Martinez-Revollar G, Hu A, et al. Decline in Sirtuin-1 expression and activity plays a critical role in blood-brain barrier permeability in aging. *Neurobiol Dis.* 2019;126:105–16. <https://doi.org/10.1016/j.nbd.2018.09.006>
 41. Li YR, Li S, Lin CC. Effect of resveratrol and pterostilbene on aging and longevity. *BioFactors.* 2018;44:69–82.
 42. Templeman NM, Murphy CT. Regulation of reproduction and longevity by nutrient-sensing pathways. *J Cell Biol.* 2018;217:93–106.
 43. Mizushima N, Klionsky DJ. Protein Turnover Via Autophagy: Implications for Metabolism. *Annu Rev Nutr.* 2007;27:19–40.
 44. Madeo F, Eisenberg T, Pietrocola F, et al. Spermidine in health and disease. *Science.* 2018;80:359.
 45. Fulop T, Witkowski JM, Olivieri F, et al. The integration of inflammaging in age-related diseases. *Semin Immunol* 2018;40:17–35.
 46. Tortosa-Caparrós E, Navas-Carrillo D, Marín F, et al. Anti-inflammatory effects of omega 3 and omega 6 polyunsaturated fatty acids in cardiovascular disease and metabolic syndrome. *Crit Rev Food Sci Nutr.* 2017;57:3421–9.
 47. Nikitenko LL, Fox SB, Kehoe S, et al. Adrenomedullin and tumour angiogenesis. *Br J Cancer.* 2006;94:1–7.
 48. Patel P, Mishra A, Sheikh AA, et al. Adrenomedullin: A novel peptide hormone: A review. 2017;6:2068–73.
 49. Kalman S. Adrenomedullin: Yeni Bir Renal Düzenleyici Peptid. *Türk Nefroloji ve Transplant Derg.* 2002;11:198–201.
 50. Fischer NM, Pallazola VA, Xun H, et al. The evolution of the heart-healthy diet for vascular health: A walk through time. *Vasc Med.* 2020;25(2):184-193
 51. Crous-Bou M, Fung TT, Prescott J, et al. Mediterranean diet and telomere length in Nurses' Health study: Population based cohort study. *BMJ.* 2014;349:1–11. <http://dx.doi.org/doi:10.1136/bmj.g6674>
 52. T.C. Sağlık Bakanlığı. Türkiye Beslenme Rehberi 2015 (TÜBER). 2016.
 53. Appel LJ, Sacks FM, Carey VJ, et al. Effects of protein, monounsaturated fat, and carbohydrate intake on blood pressure and serum lipids: Results of the OmniHeart randomized trial. *J Am Med Assoc.* 2005;294:2455–64.
 54. Estruch R, Ros E, Salas-Salvado J, et al. Primary prevention of cardiovascular disease with a mediterranean diet supplemented with extra-virgin olive oil or nuts. *N Engl J Med.* 2018;378:1–14.
 55. Orlich MJ, Singh PN, Sabaté J, et al. Vegetarian Dietary Patterns and Mortality in Adventist Health Study 2. *JAMA Internatinal Med.* 2013;173:1230–8.
 56. Bach-Faig A, Berry EM, Lairon D, et al. Mediterranean diet pyramid today. Science and cultural updates. *Public Health Nutr.* 2011;14:2274–84.
 57. Speakman JR, Mitchell SE, Mazidi M. Calories or protein? The effect of dietary restriction on lifespan in rodents is explained by calories alone. *Exp Gerontol.* 2016;86:28–38. <http://dx.doi.org/10.1016/j.exger.2016.03.011>
 58. Fontana L, Cummings NE, Arriola Apelo SI, et al. Decreased Consumption of Branched-Chain Amino Acids Improves Metabolic Health. *Cell Rep.* 2016;16:520–30. <http://dx.doi.org/10.1016/j.celrep.2016.05.092>
 59. Mirzaei H, Suarez JA, Longo VD. Protein and amino acid restriction, aging and disease: From yeast to humans. *Trends Endocrinol Metab.* 2014;25:558–66. <http://dx.doi.org/10.1016/j.tem.2014.07.002>
 60. Mirzaei H. The Conserved Role for Protein Restriction During Aging and Disease. 2016;22:134–9.
 61. Mitchell SJ, Madrigal-Matute J, Scheibye-Knudsen M, et al. Effects of Sex, Strain, and Energy Intake on Hallmarks of Aging in Mice. *Cell Metab.* 2016;23:1093–112.
 62. Flanagan EW, Most J, Mey JT, et al. Caloric restriction and aging in humans. *Annu Rev Nutr.* 2020;13:1–29.
 63. Simpson SJ, Le Couteur DG, Raubenheimer D, et al. Dietary protein, aging and nutritional geometry. *Ageing Res Rev.* 2017;39:78–86. <http://dx.doi.org/10.1016/j.arr.2017.03.001>
 64. Brandhorst S, Choi IY, Wei M, et al. A Periodic Diet that Mimics Fasting Promotes Multi-System Regeneration, Enhanced Cognitive Performance, and Healthspan. *Cell Metab.* 2015;22:86–99. <http://dx.doi.org/10.1016/j.cmet.2015.05.012>
 65. Mccarrison R. The Hunza Health Secrets. 1921-1927;1-5. <http://www.globaldialoguefoundation.org/files/41.pdf>. Date of Access: 23.08.2021.
 66. Legrand R, Nuemi G, Poulain M, et al. Description of lifestyle, including social life, diet and physical activity, of people =90 years living in Ikaria, a longevity blue zone. *Int J Environ Res Public Health.* 2021;18(12): 1-11.
 67. Pes GM, Poulain M, Errigo A, et al. Evolution of the dietary patterns across nutrition transition in the sardinian longevity blue zone and association with health indicators in the oldest old. *Nutrients.* 2021;13:1–13.
 68. Stanhope KL. Sugar consumption, metabolic disease and obesity: The state of the controversy. *Crit Rev Clin Lab Sci.* 2016;53:52–67.
 69. Ettington MK. Diets and Lifestyles of the World ' s Oldest Peoples. 2011;1–64. <http://mkettingtonbooks.com/plpdownloads/ebooks/diets-oldest-people.pdf>. Date of access:23.08.2021
 70. Ried K. Garlic lowers blood pressure in hypertensive individuals, regulates serum cholesterol, and stimulates immunity: An updated meta-analysis and review. *J Nutr.* 2016;146:389-396.
 71. Dinu M, Pagliai G, Casini A, et al. Mediterranean diet and multiple health outcomes: An umbrella review of meta-analyses of observational studies and randomised trials. *Eur J Clin Nutr.* 2018;72:30–43.
 72. Grosso G, Marventano S, Yang J, et al. A comprehensive meta-analysis on evidence of Mediterranean diet and cardiovascular disease: Are individual components equal? *Crit Rev Food Sci Nutr.* 2017;57:3218–32.
 73. Ballesteros JM, Struijk EA, Rodríguez-Artalejo F, et al. Mediterranean diet and risk of falling in community-dwelling older adults. *Clin Nutr.* 2020;39:276–81.
 74. Eleftheriou D, Benetou V, Trichopoulou A, et al. Mediterranean diet and its components in relation to all-cause mortality: Meta-analysis. *Br J Nutr.* 2018;120:1081–97.
 75. Bonaccio M, Di Castelnuovo A, Costanzo S, et al. Mediterranean diet and mortality in the elderly: A prospective cohort study and a meta-analysis. *Br J Nutr.* 2018;120:841–54.
 76. Willet WC, Sacks F, Trichopoulou A, et al. Mediterranean diet pyramid: a cultural model for healthy eating. 1995;61:1402-1406.
 77. Satija A, Bhupathiraju SN, Spiegelman D, et al. Healthful and Unhealthful Plant-Based Diets and the Risk of Coronary Heart Disease in U.S. Adults. *J Am Coll Cardiol.*

- 2017;70:411–22.
78. Tiainen AM, Männistö S, Blomstedt PA, et al. Leukocyte telomere length and its relation to food and nutrient intake in an elderly population. *Eur J Clin Nutr.* 2012;66:1290–1294.
 79. Liu JJ, Crous-Bou M, Giovannucci E, et al. Coffee Consumption Is Positively Associated with Longer Leukocyte Telomere Length in the Nurses' Health Study. *J Nutr.* 2016;146:1373–1378. <https://academic.oup.com/jn/article/146/7/1373/4616108>
 80. García-Calzón S, Zalba G, Ruiz-Canela M, et al. Dietary inflammatory index and telomere length in subjects with a high cardiovascular disease risk from the PREDIMED-NAVARRA study: Cross-sectional and longitudinal analyses over 5 y. *Am J Clin Nutr.* 2015;102:897–904.
 81. Lopez-Garcia E, Schulze MB, Fung TT, et al. Major dietary patterns are related to plasma concentrations of markers of inflammation and endothelial dysfunction. *Am J Clin Nutr.* 2004;80:1029–1035.
 82. Nettleton JA, Diez-roux A, Jenny NS, et al. Dietary patterns, food groups, and telomere length in the Multi-Ethnic Study of Atherosclerosis (MESA). *Am J Clin Nutr.* 2011;88:1405–1412.
 83. Leung CW, Laraia BA, Needham BL, et al. Soda and cell aging: Associations between sugar-sweetened beverage consumption and leukocyte telomere length in healthy adults from the national health and nutrition examination surveys. *Am J Public Health.* 2014;104:2425–2431.
 84. Fretts AM, Howard B V, Siscovick DS, et al. Processed Meat, but Not Unprocessed Red Meat, Is Inversely Associated with Leukocyte Telomere Length in the Strong Heart Family Study. *J Nutr.* 2016;146:2013–2018.
 85. Cai W, Gao Q Di, Zhu L, et al. Oxidative stress-inducing carbonyl compounds from common foods: Novel mediators of cellular dysfunction. *Mol Med.* 2002;8:337–346.
 86. Vlassara H, Cai W, Crandall J, et al. Inflammatory mediators are induced by dietary glycotoxins, a major risk factor for diabetic angiopathy. *Proc Natl Acad Sci.* 2002;99:15596–15601.