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Major evidence from the crosstalk between nutrology and lifestyle for healthy longevity: a systematic review

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Abstract

Introduction: Life expectancy worldwide has increased significantly. Centenarians represent a successful aging phenomenon. Genetic, environmental, and lifestyle factors can determine the life expectancy of humans. Certain healthy foods are associated with longer telomere lengths. **Objective:** It was to present the main evidence of the crosstalk between nutrition, lifestyle, and healthy longevity to promote health and improve quality of life in aging. **Methods:** The PRISMA Platform systematic review rules were followed. The research was carried out from May to July 2024 in the Web of Science, Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** 133 articles were found. A total of 33 articles were evaluated in full and 31 were included and developed in the present systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 27 studies with a high risk of bias and 23 studies that did not meet GRADE and AMSTAR-2. Most studies showed homogeneity in their results, with X^2=72.5%>50%. It was concluded that many metabolic or chronic diseases have been implicated in poor diet and lifestyle. Improving diet quality is associated with reduced all-cause mortality, considering that multivitamin and multimineral supplements can improve life expectancy, such as nutrients such as melatonin and coenzyme Q10 and micronutrients. The synergistic relationship of nutrients to influence physiological and cognitive function. Low concentrations of vitamin D have been linked to accelerated decline in cognition across ethnicities. N-acetylcysteine can help treat schizophrenia, bipolar disorder, and depression by decreasing oxidative stress and reducing glutamatergic dysfunction, and has broader preclinical effects on mitochondria, apoptosis, neurogenesis, and telomere lengthening. A healthy (low-sugar) plant-based diet with a reduced intake of energy-dense meat and processed meat enables healthy longevity. Several mechanisms are involved in the aging process, highlighting AMPK (AMP-activated protein kinase), SIRT1 (sirtuin), mTOR (mammalian target of rapamycin), and insulin/IGF-1 (insulin-like growth factor-1), autophagy impaired, changes in epigenetics, chronic low-grade inflammation, and cellular changes, senescence (inflammation), oxidative stress and telomere shortening.

Keywords: Nutrology. Lifestyle. Healthy longevity. Healthy aging.

Introduction

Life expectancy worldwide has increased significantly, accompanied by a sharp increase in chronic diseases and population aging. Centenarians represent a phenomenon of successful aging. A healthy lifestyle is associated with a lower risk of premature mortality and a longer life expectancy [1,2].

In this context, reduced physical activity and a sedentary lifestyle, unhealthy diet, overeating, and smoking are crucial determinants of the increase in obesity, type 2 diabetes mellitus (T2DM), hypertension, and alterations in the lipid profile, and are important risk factors for cardiovascular disease, dementia, and some forms of cancer [3,4].

The focus of nutrition research has shifted from studying the effects of individual nutrients and foods to studying dietary patterns, assuming that food/nutrient combinations may have synergistic and/or antagonistic actions beyond the individual components [1-4]. Several dietary patterns have been associated with health benefits. For example, the traditional dietary pattern and lifestyle followed by people in Mediterranean countries can help prevent chronic diseases and premature mortality [2]. The Mediterranean diet was designated among the healthiest recommended dietary patterns in the 2015–2020 Dietary Guidelines for Americans [5-7].

In addition, the Mediterranean diet has been associated with improved nutritional sufficiency in several observational and intervention studies aimed at assessing deficits in fiber, calcium, potassium, and magnesium, all dietary elements of public health relevance [8]. The traditional Mediterranean diet is not only a group of healthy foods, but also a cultural archetype that encompasses the way foods are selected, processed, and distributed, along with other lifestyle fundamentals. These characteristics led UNESCO, in 2010, to include the Mediterranean diet in the list of the intangible cultural heritage of humanity [6,9].

In this context, genetic, environmental, and lifestyle factors can determine the life expectancy of humans [2]. Nutrition is a key component that affects our health, and several studies show that nutrition also has the potential to increase life expectancy. In humans, certain healthy foods are associated with longer telomere lengths. Furthermore, a high intake of whole grains, vegetables, fruits, nuts, and also coffee is associated with a reduced risk of all-cause mortality, while a high intake of red meat especially processed meat is positively related to all-cause mortality [3,4].

Dietary supplementation with coenzyme Q10 (ubiquinone), melatonin, doses of vitamin C, vitamin D, minerals, short-chain fatty acids and omega-3 fatty acids, protein and carbohydrate content, Mediterranean diet and high-fiber diet may be beneficial in strengthening the immune response to fight infections and decrease inflammatory processes and worsening of comorbidities such as hypertension, diabetes, obesity, chronic lung disease, heart, liver and kidney disease, tumors, clinically apparent immunodeficiencies, immunodeficiencies such as early secretion capacity of type I interferon and pregnancy [9].

In this regard, the role of nutrition in mental health is becoming evident through clinical studies. Nutrition can be obtained from nutritional supplements, such as polyunsaturated fatty acids, vitamins, minerals, antioxidants, amino acids, and pre/probiotic supplements. A large number of meta-analyses have emerged examining nutritional supplements in the treatment of mental disorders. The strongest scientific evidence was found for PUFA (mainly eicosapentaenoic acid) as an adjuvant treatment for depression [10].

Given this, the present study aimed to present the main evidence of the crosstalk between nutrology, lifestyle, and healthy longevity for promoting health and improving quality of life in aging.

Methods

Study Design

This study followed the international systematic review model, following the PRISMA (preferred reporting items for systematic reviews and meta-analysis) rules. Available at: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1. Accessed on: 05/21/2024. The AMSTAR-2 (Assessing the methodological quality of systematic reviews) methodological quality standards were also followed. Available at: https://amstar.ca/. Accessed on: 05/21/2024.

Data Sources and Search Strategy

The literature search process was carried out from May to July 2024 and developed based on Web of Science, Scopus, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods to the present day. The following descriptors (DeCS /MeSH Terms) were used: Nutrology. Lifestyle. Healthy longevity. Healthy aging, and using the Boolean "and" between MeSH terms and "or" between historical findings.

Study Quality and Risk of Bias

The quality was classified as high, moderate, low,

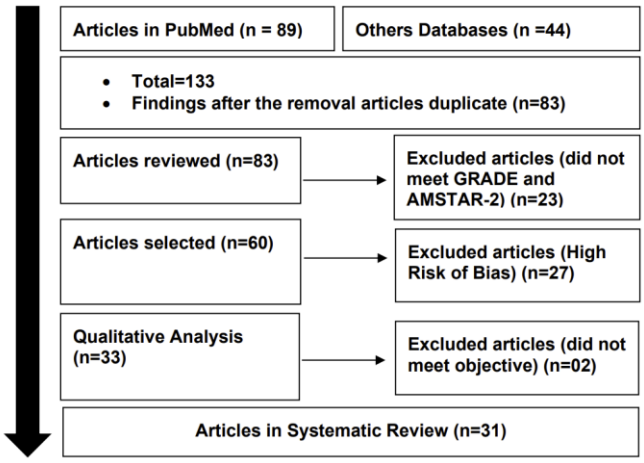
or very low regarding the risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analyses of randomized clinical trials, followed by randomized clinical trials. The low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument through the analysis of the Funnel Plot graph (Sample size versus Effect size), using Cohen's test (d).

Results and Discussion

Summary of Findings

A total of 133 articles were found that were subjected to eligibility analysis, and 31 final studies were selected to compose the results of this systematic review. The studies listed were of medium to high quality (Figure 1), considering the level of scientific evidence from studies such as meta-analysis, consensus, randomized clinical, prospective, and observational studies. Biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies presented homogeneity in their results, with X^2=72.5%>50%. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 27 studies with a high risk of bias and 23 studies that did not meet GRADE and AMSTAR-2.

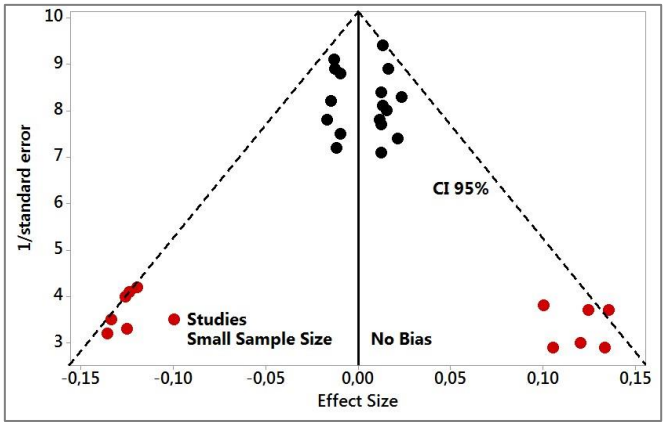
Figure 1. Selection of articles by exclusion based on GRADE and AMSTAR-2.



Source: Own authorship.

Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using Cohen's Test (d). Precision (sample size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph had a symmetrical behavior, not suggesting a significant risk of bias, both among studies with small sample sizes (lower precision) that are shown at the base of the graph (in red) and in studies with large sample sizes that are shown at the top (in black).

Figure 2. The symmetrical funnel plot does not suggest a risk of bias among the studies with small sample size that are shown at the bottom of the graph (in red). High confidence and high recommendation studies are shown above the graph (in black) (n=31 studies).



Source: Own authorship.

Major Clinical Results

In the healthy longevity scenario, maintaining a healthy weight throughout life is critical for healthy aging and longevity, reflecting the benefits of moderate caloric restriction throughout life. The specific types of food sources of fat, protein, and carbohydrates in the diet are most important in influencing chronic disease risk and mortality. Some traditional diets (e.g., Mediterranean, Nordic, and Okinawan) and contemporary dietary patterns, such as the Plant-Based Healthy Diet Index, the DASH (Dietary Approaches to Reduce Hypertension) diet, and the Alternative Healthy Eating Index, have been associated with lower mortality and healthy longevity. These patterns share many common components with a predominance of nutrient-rich plant foods, limitations in red and processed meat consumption, and a predominance of herbs and spices. Combining a healthy diet with other lifestyle factors could extend disease-free life expectancy by 8 to 10 years [11].

The authors Dai et al. (2024) [12] through a systematic review study analyzed lifestyles and health practices, focusing on diet and medication use for healthy longevity in community-dwelling adults aged 95 years and older. Thirty-four studies were included in the review. The age of centenarians/near-centenarians ranged from 95 to 118 years, with 75% (71–78%) female and 78% (68-88%) living in rural areas. They had an overall healthy lifestyle: current smoking (7%), alcohol consumption (23%), normal weight (52%),

overweight (14%), physical activity (23%), and sleep satisfaction (68%). The diet had on average 59.6% carbohydrates, 18.5% protein, and 29.3% fat; more than 60% consumed a diverse diet and <20% preferred salty foods, contributing to lower risks of mortality and functional decline. Approximately half used antihypertensives (49%) or other cardiovascular medications (48%). Common health problems included impaired basic activities of daily living (54%), hypertension (43%), and dementia (41%). Thus, the role of dietary practices and weight control in healthcare strategies to promote healthy aging is essential. Furthermore, rural lifestyles and sleep hygiene are potential factors that contribute to healthy longevity.

A study by authors Tessier et al. (2024) [13] identified a metabolomic signature of a healthy lifestyle and examined how it is related to the risk of total and cause-specific mortality and longevity. In four large cohorts with 13,056 individuals and a 28-year follow-up, five healthy lifestyle factors were assessed. The identified metabolomic signature of a healthy lifestyle reflected lipid metabolism pathways. Shorter and more saturated triacylglycerol and diacylglycerol metabolite pools were inversely associated with the healthy lifestyle score, while cholesterol ester and phosphatidylcholine plasmalogen pools were positively associated. Participants with a higher healthy lifestyle metabolomic signature had a 17% lower risk of all-cause mortality, 19% lower risk of cardiovascular disease mortality, and 17% lower risk of cancer mortality, and were 25% more likely to achieve longevity. The healthy lifestyle metabolomic signature explained 38% of the association between self-reported healthy lifestyle score and total mortality risk and 49% of the association with longevity. In this context, several mechanisms are involved in the aging process, such as dysregulated cellular, available energy, and growth pathways, including AMPK (AMP-activated protein kinase), SIRT1 (sirtuin), mTOR (mammalian target of rapamycin), and insulin/IGF-1 (insulin-like growth factor-1), impaired autophagy, modifications in epigenetics, chronic low-grade inflammation and cellular senescence (inflammation), oxidative stress, and telomere shortening [2,3].

Most of these pathways can be affected by special diets, foods, nutrients, or even medications, such as metformin [14]. The populations with the greatest longevity tended to be or were very physically active, non-obese, and of short stature, which suggests that they followed a calorie-restricted diet. In addition, they tended to have a high consumption of plant foods and a lower consumption of animal products. In addition to the traditional Okinawan diet, the Mediterranean diet has been associated with several health aspects, including protective effects on cardiovascular diseases, and neurodegenerative diseases, and reduced cancer mortality, enabling healthy aging and longer life expectancy [15]. Furthermore, greater adherence to the Mediterranean diet has been associated with longer telomeres [16,17]. Other components of the Mediterranean diet, such as the lower animal protein content and lower glycemic index, may modulate the insulin/IGF-1 or mTOR pathways, which are known to be involved in the process of healthy longevity. The Mediterranean diet also exerts anti-inflammatory activity and reduces markers of oxidative stress [6].

Several studies in recent decades have shown that certain interventions, such as caloric or methionine restriction, can extend lifespan. Several mechanisms of lifespan extension have been proposed, including suppression of mTOR, reduction of IGF-1, activation of FOXO and AMPK pathways, and/or induction of autophagy. Certain nutrients such as resveratrol can modulate epigenetic pathways and may affect outcomes associated with aging, such as reductions in inflammatory markers or low-density lipoprotein, which may reduce the risk of some diseases associated with aging. In addition, a high intake of whole grains, vegetables, fruits, and nuts is associated with a reduced risk of all-cause mortality [18].

Furthermore, meta-analyses show that a high intake of red meat especially processed meat not only increases the risk of major noncommunicable diseases but also the risk of all-cause mortality. Epidemiological studies suggest that diets high in protein, especially from animal sources, are associated with an increased risk of disease. However, protein is especially important for older adults to increase muscle mass and strength [19]. In the context of nutritional imbalance and its relationship with body and mind, nutrients of interest for cognitive health include polyunsaturated omega-3 fatty acids, polyphenols, vitamin D, and B vitamins [7]. A review by the Scientific Advisory Committee on Nutrition (SACN) (2018) [20] suggested that there is insufficient and inconclusive support for the idea that individual nutrients (vitamins C, E, and B vitamins, omega-3s, polyphenols, flavonoids, caffeine) could prevent cognitive decline. It is assumed that fish oils may be beneficial for brain health due to their omega-3 composition, but the evidence for fish oil and omega-3s does not indicate that they would be useful for preserving cognitive health [9]. However, oily fish such as herring, mackerel, salmon, trout, and fresh tuna contain omega-3s as well as vitamin D, which may also maintain brain health and mediate cognitive decline. Low vitamin D concentrations have been associated with accelerated cognitive decline across ethnicities [10].

Certain amino acids are emerging as promising adjunctive treatments for mind-body balance. Although

the evidence is still in its early stages, N-acetylcysteine in particular (at doses of 2000 mg/day or higher) has been suggested as potentially effective for reducing depressive symptoms and improving functional recovery in mixed psychiatric samples [21]. Furthermore, significant reductions in total symptoms of schizophrenia have been observed with N-acetylcysteine as an adjunctive treatment, although with substantial heterogeneity between studies, especially in study duration (indeed, N-acetylcysteine has a very late onset of action of approximately 6 months [22,23].

Besides, N-acetylcysteine acts as a precursor to glutathione, the major endogenous antioxidant, neutralizing cellular reactive oxygen and nitrogen [24]. Glutathione production in astrocytes is limited by cysteine. Oral glutathione and L-cysteine are broken down by first-pass metabolism and do not increase brain glutathione levels, unlike oral N-acetylcysteine, which is more readily absorbed and has been shown to increase brain glutathione in animal models. Furthermore, N-acetylcysteine has been shown to increase the release of dopamine in animal models. Furthermore, N-acetylcysteine may help in the treatment of schizophrenia, bipolar disorder, and depression by decreasing oxidative stress and reducing glutamatergic dysfunction, but has broader preclinical effects on mitochondria, apoptosis, neurogenesis, and telomere lengthening [25].

Although there are potential beneficial effects related to the use of nutritional supplements, this should not replace improving diet. Improving diet quality is associated with reduced all-cause mortality, whereas multivitamin and multimineral supplements can improve life expectancy [26-29].

In this context, building total well-being includes a holistic approach to the body, mind, and spirit components of life. Although the health benefits of reducing sedentary behavior and increasing physical activity are well documented, little is known about the influence on total well-being of an Internet-based physical activity tracker designed to help people achieve higher levels of physical activity. Therefore, a four-week intervention study based on a personal activity tracker was designed to reduce sedentary behavior and increase physical activity levels in the daily lives of sedentary adults and to determine whether these changes would also be associated with improved total well-being. Twenty-two men and 11 women (27 years ± 4.0) were randomly assigned to an intervention (n = 18) or control group (n = 15). The intervention group interacted with an online personal activity tracker (Gruve Solution™) designed to reduce sedentary time and increase physical activity during activities of daily living. The control group did not interact with the tracker, as they were asked to follow their normal daily physical activity and sedentary behavior routines. The Lifestyle Assessment of Well-Being Inventory was used to assess total well-being. Sedentary time, light, walking, moderate-intensity, and vigorousintensity physical activities were assessed for the intervention and control groups at baseline and week 4 by the 7-day Sedentary and Light-Intensity Physical Activity Record [30].

In recent years, the benefits of physical activity have drawn increasing attention to its physiological effects on the body, including well-being. The endocannabinoid system (ECS) has emerged as a focal point for determining the mechanisms of how exercise benefits the body and how it reduces or controls pain. The ECS, its ligands [endocannabinoids (eCB)], receptors (CB1 and CB2), enzymes for eCB synthesis and degradation, and the polyunsaturated fatty acids that serve as substrates, comprise a powerful biological organization of multiple controls that affect mood, inflammation, pain, and other neurological aspects of the central and peripheral nervous systems. Recently, researchers have reported increases in circulating eCB levels after exercise, with some eCBs exerting analgesic effects from exercise. Future research on the ECS should include mechanistic approaches to endocannabinoid signaling and explain the role of dietary polyunsaturated fatty acids in altering receptor signaling that affects pain. Furthermore, as other types of exercise, such as Tai Chi, have been reported to improve well-being, further investigation is needed to determine whether changes in eCB mediate the mind-body benefits of Tai Chi [31].

Limitations

More mechanistic studies and human trials are needed to better understand the molecular effects of diet on aging, and there is a pressing need to establish and maintain long-term cohorts that study diet and aging in culturally diverse populations.

Conclusion

It was concluded that many metabolic or chronic diseases have been implicated in poor diet and lifestyle. Improved diet quality is associated with reduced all-cause mortality, whereas multivitamin and multimineral supplements may improve life expectancy, such as nutrients such as melatonin and coenzyme Q10 and micronutrients. The synergistic relationship of nutrients to influence physiological and cognitive function. Low vitamin D concentrations have been associated with accelerated decline in cognition across ethnicities. N-acetylcysteine may help in the treatment of

schizophrenia, bipolar disorder, and depression by decreasing oxidative stress and reducing glutamatergic dysfunction, and has broader preclinical effects on mitochondria, apoptosis, neurogenesis, and telomere lengthening. A healthy (low sugar) plant-based diet with a reduced intake of energy-dense meat and processed meat supports healthy longevity. Several mechanisms are involved in the aging process, including AMPK (AMP-activated protein kinase), SIRT1 (sirtuin), mTOR (mammalian target of rapamycin), and insulin/IGF-1 (insulin-like growth factor-1), impaired autophagy, epigenetic modifications, chronic low-grade inflammation and cellular senescence (inflammation), oxidative stress and telomere shortening.

CRediT

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Conflict of Interest

The authors declare no conflict of interest.

Similarity Check

It was applied by Ithenticate@.

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